HORN ECONOMIC AND SOCIAL POLICY INSTITUTE (HESPI)

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Proceedings of Conference on Imperatives for Attaining the Sustainable Development Goals in the IGAD Region

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Table of Contents

Preface

On behalf of the Horn Economic and Social Policy Institute (HESPI), I am pleased to present this proceedings of the HESPI conference on IGAD economies (IGADEC 2016), which was organized by the Institute and its research partners in the region. -The 2016 Economic Conference was organized on a pertinent and timely issue to individual member countries and the IGAD region at large in pursing their development agenda within the global Sustainable Development Goals (SDGs). The conference focused on the imperatives for attaining the SDGs and brought together researchers, policymakers and development practitioners to debate evidence-based empirical findings of policy importance.

Although a number of IGAD member countries performed fairly well in their pursuit of the MDGs, and have shown sustained high economic growth for over a decade, most of the countries in the sub region remain among the least developed countires in the world. Moreover, several countries in IGAD are adversely impacted by instability and insecurity; widening inequality with large share of their population below the poverty line; growing youth unemployment; out migration and internal displacements; and poor economic and political governanace.

The 2016 conference on *"Imperatives for Attaining the SDGs"* addressed pertinent economic and social research policy issues aligned to the 17 SDG goals and their implications for the development of the IGAD region. The specific objectives of the conference were to promote knowledge generation and dissemination towards supporting the IGAD members to domesticate and realize the SDGs within the national and regional context.

The empirical research and the related policy debates of this conference particularly focused on inequality and human development; promoting quality Education, productive work and sustainable high Economic Growth; Agricultural pproductivity and growth , investsments and employment creation, as well as industrialization, innovation and infrastructure development As in previous years, rigorous and policy oriented studies aligned to the selected themes were presented and discussed among the policy makers and researchers. The conference also had policy panel discussion sessions on "local capacities and initiatives to combat climate change and implications to realizing sustainable development and the "institutional imperatives to create inclusive societies in the IGAD."

The 2016 proceedings distill and present selected research papers organized into 4 thematic sections on: Inequality, Agricultural Productivity, Investment andEmployment Creation; and Industrialization.The underlying message of the proceedings is applying appropriate policies and effective implementation to attain the SDGs within the IGAD context This can be achieved through dissemination fact-based research and distilling the policy implications, influencing policy formulation and governance processes. We believe the contents of these proceedings will serve as source of policy reference in critical areas and provide clear benefits in the national and regional efforts of pursing the global SDGs.

Finally, I wish to thank the sponsors and participants of the 2016 Economic Conference and particularly the authors who chose to present their research outputs on the selected themes. I also

very much appreciate the efforts expended by the staff of the Institute that organized the event and made it a succeess. It is hoped that this report of the conference proceedings will stimulate active and on-going debate and discussions within the IGAD sub region and beyond in the effective pursuit of the SDGs.

Ali Issa Abdi (PhD)
Managing Director, HESPI

Executive Summary

Upon the completion of the MDGs era in 2015, the UN has set 17 Sustainable Development Goals (SDGs) with 169 targets to be followed by member states in their development efforts until 2030. Those goals are believed to be the centerpiece of the post-2015 development agenda and considered as economic, social and environmental imperatives. In light of this, the Horn Economic and Social Policy Institute (HESPI) and its partners found it vitally important to create a platform for researchers, policymakers and development practitioners to debate on the "Imperatives for Attaining the Sustainable Development Goals" pertaining to the IGAD economies on its annual conference held from 24-25 October 2016 in Addis Ababa, Ethiopia.

Organizing such conference is particularly believed to be crucial and timely as several of the IGAD member states are being exposed to the threat of internal instability, severe climate change impacts and external economic shocks that all can be culpable factors on the way to move forward–toward the 2030 goals.

This Annual Proceedings, therefore, aims at documenting and disseminating the outcome of the conference through thirteen selected papers that are organized into four sections: Inequality in Human Development; Agricultural Productivity and Growth; Investment and Employment Creation; and Industrialization. An underlying message of the proceedings is that giving more concerted efforts to the issues raised in these core areas of research will be an important impetus in an effort to ensure sustainable development in the IGAD economies and beyond.

An overview of each paper compiled in each of the four sections is provided as follows:

The first section of the proceedings comprises three papers that deal with inequality in human development in three IGAD member countries: Ethiopia, Sudan and Somalia. The paper from Ethiopia looks into the inequality of opportunity among children in six regions of the country by comparing accessibility to basic social services such as primary education, safe drinking water, health access and nutrition. As measured by the Human Opportunity Indies the results indicate that there are high inequalities of opportunities in accessing basic social services in pastoral areas of Somali and Afar regional states comparing to Tigray, Amhara, Oromia and SNNP. Access to safe drinking water and access to health services are specially the lowest available opportunity as well as with the highest inequitably distributed among children in all areas including in Somali and Afar regional states. The second paper from Sudan also looks at households' expenditure on education; and makes analysis whether poor and rural households do spend less on education. The results show that income elasticity of education in urban sample model is greater than that of rural model. This signifies the lack of inter-generational educational mobility; and children from poor household are caught permanently in educational levels, where they are not able to "catch up" with their peers in high income families. The third paper from Somalia also conducts a comprehensive review and analysis of the country's education sector. The paper provides a broad overview of the sector and highlights the general state of affairs of current basic and higher education systems by mainly looking at the inclusiveness; accessibility and the challenges facing the sector. The paper also opens new discourse regarding future prospects, key yearly milestones, prioritized action plan, and creation of an improved educational framework and infrastructure. The paper points out that there

is a need for more access, inclusive and equitable high quality education for all through reconstituting the nations' public education infrastructure and system. Overall this section of the proceedeings concludes that there is more to do with those IGAD member countries to ensure inclusive and equitable quality education and fight inequality in all its forms so as to promote sustainable human development.

The second section that deals with Agricultural Productivity and Sustainability consists of five papers. The first paper looks at the source of agricultural output growth and the role of public expenditure on total factor productivity in Sudan, a country that lost about 75% of its productive oil fields and its main source of export income as the result of South Sudan's separation in 2011. The diminishing oil revenues brought agriculture back as the main source of growth, employment creation and poverty reduction. However due to government dependence on mono-cultural economy based on oil, growth of agricultural output decelerated to negative rates in recent years. Reversing this trend requires knowledge of what drives agricultural growth and productivity. The paper investigates sources of agricultural GDP growth in the time period 1984-2012. Growth Accounting decomposition revealed that for the 1984-2012 time periods, capital was the most important source of growth and accounted for around 54 percent of agriculture's GDP growth. Again, as the GDP growth of 5.4% was much lower than that of capital growth of 8.4%, there has been decreasing returns to capital in Sudan. Most importantly the study established that Total Factor prodcuitvity (TFP) growth was either negative or very low averaging just 1.4% and accounted for 26%. Further analysis revealed that 86% of the variation in agricultural TFP was explained by direct and indirect government expenditure. Not surprisingly the misplaced direct government expenditure in agriculture exerted a negative effect on agricultural productivity growth (an elasticity of -0.57). On the other hand public expenditure on other related non-agricultural factors produced a positive elasticity of 0.56. The main recommendation of this paper is that to achieve the alleged policy of achieving accelerated growth of agricultural output and diversification of the economy the government has to allocate much more resources into the sector taking into consideration the inter-linkages between the agriculture and the other sectors.

The second paper of this section explores the potential uptake determinants of Climate Smart Agricultural Practices to Supply Carbon Emissions Offsets in Drier-Agro Ecological Zones of Ethiopia. While the benefits of agro-environmental services using climate smart agricultural practices have been well documented in the literature, landowners' preferences and willingness to accept compensation to supply such benefits have been much less studied. To fill this research gap, this paper conducted a contingent valuation survey of smallholder farmers in north highlands of Ethiopia. The findings show that willingness to accept conservation tillage is negatively related to ownership of livestock, irrigation, distance to local market, extension service and membership to a farmer group, and positively related to age and education of the household head, awareness of climate change by the household, ownership of land and income, hired labor and off-farm income such as Productive Safety Net Program (PSNP). There also are indications that landowners in the region demand higher compensation, and the overall mean willingness to accept per year per "timid" of land is estimated at ETB 2,400 (117 USD) and ETB 3, 750 (183 USD) for minimum and zero tillage, respectively. Results are potentially important both for the understanding of landowner preferences and for the costs of voluntary climate change mitigation schemes currently

in use in many countries. The findings also suggest that the unique needs of mixed crop-livestock farming systems hinder further diffusion of conservation tillage. Future policy should consider addressing the needs of Ethiopian farmers, particularly crop producers heavily engaged in livestock activities.

The third paper explores whether there is any kind of link between remittances from Diasporas and Africa's agricultural technical efficiency. Panel data that covers 17 years was used to estimate the stochastic production frontier across 35 African countries. The result show that, contrary to most widely available literature, international remittances as percentage of GDP neither positively nor negatively affected technical efficiency of agricultural (cereal sub-sector) in Africa. All the determinants of technical inefficiency were however found to have the expected sign and three of them were significant: mobile phones per100 persons and real exchange rate (1% level of significance) and official development assistance (10%). The negative relationship between mobile infrastructures, official development assistance and real exchange rate has important policy implications in supporting the efforts to achieve fast economic growth and reduce poverty in the continent.

The fourth paper from Uganda examines how ICTs can be used in engaging youths in family farming for effective public agricultural extension services and rural development. It is well known fact that family farming has been contributing significantly to global food and nutrition security. Seventy percent (70%) of the world's food supply today comes from more than 500 million family farms over the world, which are supporting rural employment in many developing countries. This kind of farming is highly characterized by the youth and women. There is also estimation that by 2030, demand for food in rapidly growing urban areas will create a market for food products worth US $1 trillion. This market needs to be owned and operated by young African farmers. Subsequently, over the next thirteen years the world will mobilize efforts to end all forms of poverty and hunger through the UN 2030 Agenda, while ensuring that no one is left behind. Findings of the paper were: youths play a vital role as intermediary for ICT adoption by agricultural communities in capturing, documenting and disseminating and accessing local agricultural knowledge; identified challenges include: lack of involvement of the youths in agriculture related decision-making, poor access to agricultural knowledge and education, poor access to ICTs and limited access to financial services among others. Policy recommendations are: for the youths involvement in family farming, there is need to translate content in local languages, produce geographic specific content and ICT tools that are easy to adopt by the youths farmers; developing ICT training and capacity building programmes for youths farmers, strengthening rural tele-centres and rural ICT access points, developing and using ICT tools and applications adapted to rural conditions, using ICT to support extension delivery as well as strengthening the role of rural youth as agricultural information brokers via ICTs. The findings of this study would benefit: development partners, rural farmers, researchers and policy makers from the IGAD region and beyond in attaining agenda 2030.

The fifth paper looks at as to how commodity warehousing can serve as a tool for economic recovery in conflict-affected areas. The argument of this paper is that market structures such as warehouses have been considered fundamental for agricultural growth and economic recovery in post-conflict areas. However, experiences from Uganda indicate that these facilities are often not

used or operate below capacity. Yet the government and development partners increasingly show interest by investing in these facilities. This paper therefore critically examined the determinants of utilization of warehouse facilities and economic benefits in post-conflict areas. Results showed that only 27% of farmers used warehouses and stored less than 10% of what they produced. Usage of warehouses was only 13% of the average handling capacity. The results further indicate that access to price information, extension services, membership to business associations and credit positively and significantly affect warehouse utilization, whereas distance to warehouse and age of the respondents negatively affected warehouse utilization. There was a significant mean difference in prices received by warehouse users amounting to an average of 55% higher than non-users, in a span of one month after harvest. This implies that commodity warehousing has potential to increase rural household incomes, but should be adequately supported by strong farmer associations and embedded services (e.g. credit and extension) which offer added benefits.

The third section of the Proceedings presents papers related to firm level investment and innovation and their level of impact on job creation in local economies. The first paper particularly looks at the employment impacts of product innovations. Extending and applying a Dose Response Model under different intensities of innovation, the paper presents new evidence on the impact of product innovations on employment growth using the World Bank's Enterprise Survey (ES) merged with the newly available Innovation Follow-Up Surveys data covering the period 2010-2013 for five sub-Saharan African countries. The findings are generally consistent with the stylized facts in the empirical literature with product and joint product and process (JPP) innovations having compensation impacts on employment growth. It is however; found that these conclusions to be invalid beyond sub-interval of firms' intensity of innovation. In extensions to decent employment, product innovations appeared to be creating temporary jobs leading to questions about the sustainability of these new jobs. In terms of policy, the paper recommends extension of social security to all types of workers in line with national and regional innovation policies and the ILO-WHO Social Protection Floor Initiative.

The second paper from Sudan looks at the impact of Foreign Direct Investment (FDI) on domestic investment. This paper especially provides an empirical test for giving hope hypothesis. The postulated hypothesis states that, along with its potential contributions in augmenting domestic investment in recipient countries, the presence of FDI could also increase growth in domestic investment by giving hope to domestic firms to grow by raising their confidence in domestic business environment. To validate this hypothesis, the paper utilizes time series data covering the period from 1980 to 2013. The empirical analysis is performed using co-integration and Vector Error Correction Model (VECM) techniques. The findings indicate the existence of a complementary relationship between FDI and domestic investment. Moreover, as expected, the rest of the variables included in the model have displayed the anticipated signs. Based on these findings, policymakers might find it beneficial to encourage integration between domestic and foreign investments. This goal can be accomplished by taking up two policy actions. First, the interdependence between foreign and domestic investments can be preserved by stimulating MNCs that supplement domestic firms with raw materials, sophisticated technologies and furnish them with access to foreign markets. Second, this desirable complementary relationship can be also

reinforced by promoting the types of domestic investment that have a wide range of forward and backward linkages with FDI.

The last section presents three papers related to industrial development. The first paper analyzes conceptual issues surrounding the issue of industrialization in Africa taking Kenya as an example. This paper argues that Kenya like other countries in Sub-Saharan Africa has experienced impressive economic growth rates in the past decade. However, this growth has not been sustained and its effect on poverty reduction and job creation especially for the youth was minimal. Analysis of data shows that Kenya has wrongly characterized economic development and industrialization as a situation where agriculture must necessarily decline. This could create a wrong notion among policy makers that agriculture is not important for development. Also, industrial strategies that Kenya is using tend to be too broad and lack specificity thereby making their implementation difficult. The paper adds that as industrialization is not well conceptualized from the outset, the development strategy suffers from different problems and therefore fails to achieve the intended objectives. Hence, a fresh look at the approaches of industrialization can create a mechanism for coordinating development efforts of both National and County governments in Kenya.

The second paper explores the factors affecting supply issues at different functional nodes of wheat value chain. It also looks at roles of cooperatives and other institutions in supply issue. The result indicated that cooperative as an actor has failed to supply adequate pesticide and herbicide to the wheat producers. As a result, input retailers manifested their opportunistic behavior and exploited asymmetric information on input quality at small shops and spot markets, which in turn, declined wheat productivity. Wheat producer's marketed surplus significantly increased with land size, fertilizer, extension services, and distance from the main road, producer's wheat value chain function, whereas decreased with crop rotation. About 90% of wheat processing industries faced shortage of raw materials as the number one barrier for wheat products supply. In an effort to address this, concerned bodies should work on technology and extension service supply and coordination to address low raw materials and final products supply at each functional node of wheat value chain.

The last paper examines the performance of three state-owned airlines: Ethiopian Airlines, Ghana Airways and Malév Hungarian Airlines, which were formed between the late 1940s and the mid-1950s. While Ethiopian Airlines continues to operate successfully, the other two airlines have gone out of business. In an industry characterized by heavy competition and a high rate of failure, the success of the state- owned Ethiopian Airlines is intriguing. The evidence shows that Ethiopian Airlines outperforms the industry on some important benchmarks. Specifically, it outperforms both African and global industry indicators such as revenue per kilometer growth (RPK), available seat kilometer (ASK) growth, and passenger load factor (PLF) and operating profit margin (OPM). These findings suggest that being a state enterprise is not necessarily a characteristic that leads to failure. Corporate culture and governance appear to be important factors in the success of Ethiopian Airlines.

Introduction

1. About HESPI

The Horn Economic and Social Policy Institute (HESPI) is an independent, non-profit regional think tank and capacity building firm established in 2006 for the member countries of Intergovernmental Authority on Development (IGAD)[1] in particular and developing countries at large. HESPI provides economic and social policy analysis and research on issues of common interest to the sub-region. The Institute undertakes commissioned studies, policy analysis and research for the public and private sectors in areas of regional or country specific interest, and provides institutional and human resource capacity building. HESPI's mission is to assist with the formulation and implementation of sound economic and social policies, to promote high-quality research and policy analysis, and to provide advisory services to facilitate broad-based economic growth and poverty reduction. One of the strategies HESPI employees is through creation of policy forms of which the annual conference most instrumental.

2. Background to the HESPI Annual Conferences/Policy Forum in IGAD Economies

The IGAD region, which comprises of eight countries, namely Djibouti, Eritrea, Ethiopia, Kenya, Somalia, south Sudan, Sudan and Uganda, stretches over an area of 5.2 million Kms and is home to a population of over 221 million.

As though crisis is its unique identifier, the region faces wide varieties of challenges ranging from socio-political, economic and environmental challenges. It is home to the two of the world's fragile states - Somalia and South Sudan; the member states are not only among the most poor countries in the world but poverty is rising in some of these states; intra-community and inter-state crises and tensions characterise member states; and drought, environmental degradation, natural resource stress and scarcity, food insecurity due to crop failure and livestock epidemics are some of the environmental factors that adversely affect the region.

However, the IGAD sub-region has the required natural and human resources that could be developed and propel the sub-region to collective self-reliance where peace and security can prevail. Over the recent years, the sub-region is showing a good turn-around. For the last decade, the IGAD sub-region as a whole has recorded impressive economic performance. On average, the economies of the sub-region have been growing at annual rate of 5.9% since 2000.

Given promising insights of growth in some of the IGAD member states on the one hand and a range of problems and challenges that these members states face on the other hand, it is relevant and absolutely essential to have a platform where researchers, policy makers, development

[1] *Current IGAD members include: Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan, and Uganda*

practitioners discuss and scrutinize the challenges, and contribute to the development endeavours in the region.

As a regional institute, HESPI is well positioned to facilitate regional forums and platforms to discuss on economic, social and political developments in the IGAD region. Thus, HESPI along with its partners has initiated annual conference for the IGAD region called HESPI annual conference on IGAD economies. The conference is held once in a year offers a unique avenue for researchers, policymakers and development practitioners from Africa and elsewhere to debate on important economic, social and political developments in the IGAD region.

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The specific objectives of the annual conferences include:

- To offer a unique avenue for researchers, policymakers and development practitioners from the IGAD region and elsewhere to debate on important economic, social and political developments in the IGAD region

- To contribute to the economic, social and political development in the IGAD region through promotion and advancement of scientific research on economic, policy and social issues related to development of the IGAD economies.

- To promote scientific research and knowledge management as an important driver of policy dialogue, good policy planning and implementation in the IGAD region

The umbrella issues/topics for the conferences are annually selected based on analysis of emerging relevant socio-economic policy issues in the region usually suggested by the stakeholders and evaluated by the HESPI research team and the management.

Under each annual conference issue, 25-30 research papers are appraised and presented. The topic for:

- The 2014 conference was Economic, Social and Political Development in the IGAD region and its challenges

- The 2015 conference was on Inclusive Growth and Poverty Reduction in the IGAD region

- The 2016 conference is on *the "Imperatives for Attaining the UN Sustainable Development Goals*

- The 2017 Conference will be on Youth Unemployment and Creating Employment Opportunities in the IGAD region to be held in Sudan, Kartoum together with The MamounBeheiry Centre for Economic and Social Studies and Research in Africa (MBC)

Following the conferences, HESPI produces high quality proceedings that passes through multiple review phases and captures all the technical papers presented at the conferences under various headings and sub headings. The Conference Proceedings capture the edited versions of research papers presented with their technical details and policy recommendations.

The proceedings also include distilled substantive issues from the discussions at the conferences and also sections like introduction, opening remarks of key note speakers and finally conclusion of the conference.

3. Organization of the IGADEC 2016 Proceedings

The 2016 proceedings comprise thirteen edited papers. These papers were conveniently organized into the following four parts:

- Part I: Inequality in Human Development

- Part II: Agricultural Productivity and Growth

- Part III: Investment and Employment Creation

- Part IV: Industrialization

As mentioned earlier, while Part I comprises three papers from three IGAD member states (Ethiopia, Sudan and Somalia), Part II is a compilation of five papers from selected IGAD member states and other African countries. Part III also consists of two papers: one that deals with investment climate in Sudan and another that looks into product innovation and job creation in Sub-Saharan African countries. Likewise, Part IV presents three papers focusing on industrial strategy in some IGAD member states and other selected low income countries.

In what follows, the full contents of the papers in their respective sections are presented.

Part One: Inequality in Human Development

Inequality of Opportunities for Children in Ethiopia

Kedir J. IBRAHIM2, Belaineh LEGESSE, Jema HAJI and Mengistu KETEMA

ABSTRACT

The purpose of this study is to measure inequality of opportunities among children in Ethiopia. The study used secondary data from the 2015 Ethiopian Living Standard Measurement Survey (LSMS). In an effort to measure the inequality of oportuntiy, a total of 7207 sample children were considered from six regions: Tigray, Amhara, Oromiya, Southern Nation and Nationality of Peoples and Somali and Afar. Human opportunity indexes are quantified using various inequality methods by looking at the access to basic services like primary education, safe drinking water, health access and nutrition. The findings indicate that there is high inequality of opportunities in pastoral areas of Somali and Afar as compared to the other four major regions. Quantitatively, the human opportunity indies are found to be 61.5%, 23.6%, 20% and 61.8% for access to primary education services, safe drinking water, access to health and minimum nutrition, respectively. This indicates that, among the basic opportunity measures considered in the study, access to safe drinking water and access to health services were the lowest available opportunity as well as with the highest inequitably distributed among children in all areas including in Somali and Afar regions. Overall, the result revealed that children in Somali and Afar regions have low level of opportunity and also high inequality of opportunity as compared to other regions. These indicate that these regions allocate low resources to increase the average access rate of these opportunities. The study thus urges the concerned body to increase resources in the aforementioned sectors of the two underprivileged regions to promote equal opportunity for all children.

Keywords: Inequality of Opportunity, Human Opportunity Index, Dissimilarity Index, Pastoralist, Agro-Pastoralist

1. Introduction

Inequality is the central agenda in Sustainable Development Goals (SDGs) (FAO 2014a, 2014b; IFPRI 2014; Wild *et al.* 2015). The SDGs aspire in addressing inequality in all its form and giving equal opportunity for all humanity (Norton *et al*. 2014; Shepherd *et al*. 2014). Its success should be measured and judged on how it benefits the marginalized and excluded people live in different corner of the world (Arauco *et al.* 2014; Shepherd *et al*. 2014). In Ethiopia, the recent policy reforms have brought positive growth for the last 10 years. However, a positive economic growth does not by itself guarantee that every citizen benefited from it. Thus, growth must accompany with proper redistribution policy to benefit all societies including the young children that would carry the future economy.

Most of the time children from the rural areas of developing countries like Ethiopia are unable to access basic services. The government of Ethiopia claims in its report that inequalities were lower at both national and regional levels including pastoral areas. It asserts that inequality declines as

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measured by income at household level (MoFED 2013). However, such inequalities do not measure the kind of inequalities that are relevant from social, economic or moral perspectives (Lefranc *et al*. 2008). Inequality is much more than income in these areas, one form is intersecting with the other (Melamed 2014). Here, it is important to ask whether the recent growth created equal opportunity in access to basic services for the children in pastoralist and agro-pastoralist areas compared to other regions of Ethiopia. Unequal access to basic services such as education, health, nutrition, safe drinking water means that growth benefits do not flow equally across the different groups and regions (Jemmali &Amhara 2014). The existence of inequality in general is a warning signs that something is wrong in the economy (Hoyos & Narayan 2012).

Here we can argue that children in Afar and Somali pastoralists faced inequality in relation to accessing the basic services. In these areas, inequality can be both hidden within and perpetuated by different circumstances which are beyond the control of the children. It is difficult to understand the causes of inequality using the traditional approach only. There is a new development in inequality literature in employing equality of opportunity framework to analyze various inequalities of opportunities faced by individuals and its causes. There is no rigorous study on the dry land areas using this new approach. Through wider survey of literature, it is learnt that there is no a single study conducted on inequality of opportunity in the study areas. Hence, the purpose of this paper is to measure inequality of opportunities in the dry land of Ethiopia and identify factors that affect inequalities of opportunities in access to basic services such as education, health, nutrition, safe drinking water.

The paper is organized as follows: the second section presents the theoretical foundation, the third section provides the data and methods used for analysis followed by the presentation of results and discussion and finally provide conclusion and policy implication.

2. Theoretical Framework

The idea of inequality of opportunity is the view of contemporary societies and also consistent with modern theories of justice (Sen 2006). Currently the growing literature on economic inequality focuses on inequality of "opportunities" which have long been associated with very different views on social justice (Bourguignon *et al*. 2007). It gains attention after equality of opportunity theory developed by Roemer (1998). He defined equality of opportunity as a situation in which important outcomes are distributed independently of circumstances. Inequalities of opportunities according to him are caused by different factors. These are factors for which the individual can be held morally accountable, or by factors that lie beyond the individual's responsibility circumstance. In this perspective, inequality caused by differences in effort is acceptable. But inequality caused by circumstances is considered unjust and unacceptable (Roemer 2013; Son 2013). Importantly, it is explicitly recognized that effort is shaped by circumstances (Jones *et al.* 2014).

The concept of equality of opportunity is related to universal access to key goods and services such as clean water, basic education, health services, minimum nutrition, and citizenship rights which are crucial steps toward justice and fairness (Sen 2006; Barros *et al*. 2009; Nussbaum 2011; Vega *et al*. 2012). Expanding access to these goods and services has long been a central issue in the analysis of economic development. The chance people have to pursue the life of their choice

involves the opportunity to access key goods and services, which constitute human capital investments that expand each individual's abilities and options (Vega *et al*. 2012). Human and health capitals are important for one to progress in life (Boyden & Cooper 2009; Quisumbins 2009; Wong 2013).

However, most of the time children in developing countries have less access to the basic services that enable them to acquire these capitals in their life. In the household investment on nutrition, education and health are undertaken by the parent on their children. Most of the decisions taken while children are young are related to investment in human capital. Parents do care about the well-being of their children both now and in the future (Quisumbins 2009). However, many factors determine children's access to these services. Among these circumstances that widely used are parental education, household size, child characteristic and household economic status. These are beyond the control of the children that may determine inequalities of opportunity in their life. Generally speaking, the tremendous empirical literature has been showing inequalities in early childhood often have negative effect on the latter achievements and opportunities of the child in particular and the country in general.

The issue of child development remains hidden despite the wide acknowledgement that they deserve a special focus within the development debate (Roelen *et al.* 2012). Literature in different fields asserts early childhood opportunities are pre-conditions for the later life. The impact of inequality during childhood can have detrimental effects on their future life which are irreversible (UNICEF 2011; Woodhead *et al.* 2012). Since inequality of opportunity wastes talent, it is a loss of potential for national growth and development (Woodhead *et al.* 2012). Therefore, addressing this problem has versatile effect. It contributes to social improvement, growth and greater equality in income and wealth distribution (Hassine 2011). Moreover, understanding the situation of children at the beginning stage is good for proper intervention (Yaqub 2008; Velga *et al.* 2012).

3. Data and Methods

3.1 Data

The paper used secondary data from Living Standard Measurement Survey (LSMS) jointly collected by Central Statistics Agency (CSA) of Ethiopia and World Bank (2015). It used the second wave of survey that was fielded in 2014 and released in 2015. In the analysis of inequality of basic opportunities a total of 7207 individual children from Tigray, Amhara, Oromiya, SNNP, Somali and Afar were drawn; and comparison was made between children of the first four big regions and the latter two underserved regions.

3.2 Human Opportunity Index

Human opportunity index (HOI) has been widely used to estimate inequalities of opportunities. This method is developed by Barros *et al.* (2009) widely applied in recent empirical analysis of inequality of opportunity for children. The HOI focuses on goods and services that constitute investments by people with a view to improve a person's ability to expand his\her future production possibility frontier. These investments have a major impact on what a person can be or do. In a

broad sense, investing in these goods and services increases one's human capital (Vega *et al*. 2012). The HOI calculates how personal circumstances impact an individual's probability of accessing the services. The HOI measures the coverage rate and then adjusts it according to how equitably goods and services have been allocated among circumstance groups.

Following Barros *et al.* (2009) the formula for the HOI given as:

$$HOI = \overline{P}\,(1\text{-}D)$$

Where $\overline{P}$ is average coverage rate and D is dissimilarity index

It measures a country/region progress towards the opportunity for all children (Barros *et al.*, 2009). The HOI synthesizes two measures into a single indicator. First, the level or efficiency of basic opportunities in a society measured through the average coverage ($\overline{P}$) rate for a given opportunity and second, how equitably those opportunities distributed were measured through the index of dissimilarity (D) (Vega *et al*. 2012; Hoyos and Narayan 2012; Goli *et al*. 2014; Jones *et al.* 2014). The measurement of HOI is based on two important estimates i.e. average access rate of the opportunity under consideration and inequality of the opportunity measured by the dissimilarity index. To obtain the measure of HOI, first both these components should be estimated from the data. The LSMS survey has the required information at the individual level (i.e for the children) on both opportunity and circumstance variables. Usually estimation of HOI follows certain procedure first the relationship between access to a given opportunity and circumstances should be estimated. Second the estimated parameters were used to construct the index.

For the binary outcomes such as having access to basic services, the probability of access is estimated either by parametric models such as logit or probit but also non-parametrically. Most of the time, the non-parametric method limits the number of circumstance variables used. This is because it requires large data set to have enough samples in each group based on circumstance (Hassine 2011; Isfahani *et al.* 2014). Parametric methods are regression-based and can easily incorporate more circumstances into the analysis (ibid). Here, the parametric approaches were considered to estimate the HOI index.

The regression model must be estimated to determine the empirical relationship between each circumstance and access to basic services. This can be done by estimating the logit model parametrically. Then predict the probability of access to basic services for each individual with a given set of circumstances as well as the overall coverage rate was obtained. To predict the probability of access to a given opportunity, let us define an outcome variable y_i which takes a value of 1 if the i^{th} child has access to an opportunity (education, health, safe drinking water and nutrition) and takes a value of 0 if the i^{th} child lacks access to the opportunity under consideration. The conditional probability of access is given by $E(y_i|C) = p_i$, Where p_i is the probability that the i^{th} child has access to an opportunity conditional on circumstances.

Therefore, we estimate p_i by means of a logit model using a set of k circumstance variables c_{i1}, c_{i2}. . . c_{ik}.

$$Ln\left(\frac{P(y=1\mid c_1,....c_k)}{1-P(y=1)\mid c_1,..c_k}\right)=\sum_{j=1}^{k} f_k(C_k)=C_k\beta_k$$

Where $C_k=(c_1,\ldots,c_k)$ denotes a vector of circumstance variables which includes family background, demographic characteristics and community characteristics.

Estimates of the parameters, β_k obtained from the above logit regression are denoted by $\hat{\beta}_k$ and used to obtain the predicted probability of access to opportunity for each child. The regression output be interpreted in the usual way to understand the determinants of access to opportunity under consideration.

Moreover, the estimate of the predicted probability of access to a given opportunity explained by the circumstance variables was obtained as:

$$\hat{P}_i=\frac{\exp\left(\hat{\beta}_0+\sum_{j=1}^{k} C_{ki}\hat{\beta}_k\right)}{1+\exp(\hat{\beta}_k+\sum_{j=1}^{k} C_{ki}\hat{\beta}_k)}$$

Using the predicted probability, the average coverage rate of the opportunity in the population and the D-index of opportunity are computed as follows.

$$\overline{P}=\sum_{i=1}^{n}\alpha_i\hat{p}_i$$

and

$$\hat{D}=\frac{1}{2\overline{p}}\sum_{i=1}^{n}\alpha_i\left|\hat{P}_i-\overline{P}\right|$$

Where n is the number of sample individuals, α_i is the population weight attached to the i^{th} sample individual, and $\overline{P}$ is the proportion of the population with access to a given opportunity. $\overline{P}$ called level or coverage. D measures the degree of inequality of opportunity that is explained by the individual's circumstances. As such, (1-D) may be interpreted as equity of opportunity. D takes values between 0 and 1. D = 0 implies that every child in a society enjoys the same opportunities, while D = 1 implies perfect inequality in the society. Then the estimate for HOI is calculated, using the formula HOI= $\overline{P}$ (1-D) for each opportunity.

4. Result and Discussion

4.1 Children Anthropometric Measurements

Anthropometric measurements were used as indicator of nutritional status at population level. It was constructed from the LSMS data. The new WHO (2006) reference categories were used. Children anthropometric indicators were showed in table 1 for major regions including the Somali and Afar. Overall, in this measure the children under five in Ethiopia showed poor result despite the good progress recently. The result showed that 42 percent of the children are stunted, 10 percent

was wasted and 21 percent are underweight in 2014. The figures were far below GTP target. The target level was given 30 and 3 percents for Stunting and wasting respectively. However, underweight result showed dropped to the GTP target level of 21 percent. This is a remarkable achievement at national level despite variations at regional level. Stunting and wasting were increased by 1.8 and 1.1 percents respectively from there level 40 percent and 9 percent in 2011. The proportion of underweight dropped from 25 percent level in 2011 (Headey 2014) to the GTP target level.

However, at regional level there are grater variations in all these indicators. Stunted ranges between 50 percent higher in Amhara to 32 percent in Oromiya. Wasting was more serious in both Somali and Afar and stood at 23 and 17 percent respectively. Similarly, children underweight is also high in these regions, 35 percent of children under five in Somali region have less weight as compared to the healthy reference categories with the same age and sex. Similarly, this figure was found to be 24 percent for Afar. This region is also among the highest proportion where underweighted child are found next to Somali and Tigray region. The result confirms that still significant proportions of children face nutritional problems in the nation in general and the study areas in particular. Wasting and underweight were found to be more serious in the study areas as compared to the other major regions considered here. Stunting was found to be less by comparisons.

All the major three anthropometric parameters showed the country/regions were grouped under high prevalence of malnutrition categories. The degree of malnutrition was also high at both national and regional levels. Using the WHO[3] (1995) criteria, stunting was very high in all regions including Somali and Afar. Wasting was serious in all regions too except Somali and Afar where the problem was at critical stage. Similarly, underweight was also high in all regions except Somali and Tigray where it is severe in that order. So populations with a high fraction of people stunted or underweight was evidence of nutritional deprivation. These have greater implication for the country's long term economic growth.

Table 1: Child Anthropometric Indicators in Ethiopia, by Region

Regions	Stunted	Degree	Wasted	Degree	Underweight	Degree
Tigray	48.43	Very High	11.32	Serious	30.19	Very High
Amhara	50.68	Very High	9.18	Serious	18.37	High
Oromiya	32.02	Very High	8.99	Serious	16.57	High
SSNP	44.08	Very High	6.41	Serious	18.45	High
Somali	38.42	Very High	22.97	Critical	35.14	Very High
Afar	37.16	Very High	16.88	Critical	24.68	High
National	41.83	Very High	10.14	Serious	21.11	High
GTP1	↓		↓		↓	
	30		3		21	

Source: *Author calculation using LSMS (2015)*
Note: All measures shows percent below -2 S.D

[3] *Percentage of children aged less than 60 months and below -2 Z-scores for H/A & W/A >=30 percent is considered as very high, 20-29 percent considered as High and <10 percent is low. While for W/H >=15 percent very high, 10-14 High and <5 percent considered as low.*

It is also important to see the relationship between these measures. The relationship was as expected see the figures 1-3 in the appendix. Wasting and Stunting are not correlated, whereas there is positive correlation between underweight and wasting and between underweight and stunting. These relationships also confirmed from the data used in this paper.

4.2 Inequalities of Opportunity

The inequality of opportunity was proxied by access to primary education, access to safe drinking water, access to health services and access to minimum nutritional. The estimation was done using the coverage rate, dissimilarity index and HOI. The HOI is expressed on the scale of 1 to 100, with the higher figure reflect good level of equality and lower value reflect poor/inequitable accesses.

4.2.1 Access Primary Education Services

Education now a day is considered as one of basic service and that every citizen has the right to access it. Access to primary education was measured by whether children between 7–15 years of age currently attend school or not. The access to primary education services across the main regions in rural areas and the study areas were presented in Table 2. The result showed the average opportunity, human opportunity index and inequality index. The average probability of accessing primary education varies among different regional states.

The highest score was obtained for Tigray with (85 percent). It is indicating that majority of the children have accessed primary education in this region. These figures were 76 % in Amhara and Oromiya (73%). In rural areas of Somali and Afar regions the average probability of accessing primary education was only 64 percents in both regions. Even though, the government claimed increases in the coverage of education services in both urban and rural areas of the country, but the access of this service was far below its universal coverage rate.

In additional to the average probability access, it is also important to examine the inequality and human opportunity index in accessing primary education. These were measured by D-index and HOI respectively. The D-index showed how the existing access to primary education services was distributed among the children in different regions. This measure varies among the regions. It ranges from 2.5 percent in rural areas of Tigray to 5.6% in rural areas of Oromiya. This indicates that only 2.5 percent of existing available access in primary education must be reallocated to bring equality of this service among the children in Tigray. In Oromiya 5.6 percent has to be reallocated to ensure equality among the children in the region. In Somali and Afar regions 4 percent of the available educational opportunity needs to reallocate.

The human opportunity indexes which combine both the average probability of accessing primary education and how this service is equitable distributed also give a better picture. Using this index, the distributions of primary education services were highly variable across the rural areas (see Table 2). The human opportunity index was high in rural Tigray. It indicates that 84 percent of primary education services were available and equitably allocated among the children in this region. In Amhara region 73 percent of the available educational opportunity also equitably distributed. However, only 61.5 percent of primary educational services were available and equitably allocated

among the children live in Somali and Afar regions. The results for all major regions were found to be far below assuring universal access in primary education services. This was indicated by human opportunity index fall below 90 percentage points for all regions.

Table 2: Result for Primary Education Access

Region	Average Opportunity	D-Index	Human Opportunity Index
Tigray	85.7	2.5	83.5
Amhara	76.4	4.3	73.1
Oromiya	73.3	5.6	70.0
SNNP	72.6	2.7	70.6
Somali &Afar	64.1	4.0	61.5
National	74.5	3.5	71.9

Source: Author calculation using LSMS (2015)

4.2.2 Access to Safe Drinking Water

Unlike the primary education opportunity, result for accessing safe drinking water was tougher for the citizen. The average probability of accessing (see Table 3) safe drinking water is low for all regions. It is 61 percent in rural areas of Oromiya. It indicates 61 percent of children in this region live in the house which has access to safe drinking water. Similarly, 59, 55 and 54 percents of children live in the house which has access to safe drinking water in Tigray, SNNP and Amhara, respectively. In comparison only 30 percent of children live in the house which has access to safe drinking water in rural areas of Somali and Afar regions. Overall, only 54 percent of children live in the house which has access to safe drinking water in rural areas of Ethiopia. These figures indicated that the provision of safe drinking water was at low level in all regions and it was the worst in pastoral and agro-pastoral areas of the country. The D-index showed the highest 21 percent in Somali and Afar regions. It indicated that 21 percent of the available safe drinking water must be reallocated to ensure the equality of safe drinking water. This showed there was high inequality of safe drinking water distribution in the pastoral and agro-pastoral areas. On the other hand, this figure was 7.4 percent in SNNP, 6.4 percent in Amhara and 6 percent in Tigray regions.

The human opportunity index also showed grater variation among these regions. The human opportunity index was found to be highest in Oromiya regions. It indicates 58 percent of access to safe drinking water was available and equitably distributed among children in the region. The 56 percent of this opportunity were available in Tigray region and also equitably distributed among the children. However, for the Somali and Afar regions the human opportunity index showed at a lowest level. It means 23 percent of total opportunity needed to ensure the universal access to safe drinking water was available. This is also inequitably distributed among children lives in these regions. At national level only 50 percent of safe drinking water opportunity was available to ensure universal access. The result for all the country in general and regions in particular were far below assuring the universal access in safe drinking water for the citizens.

Table 3: Result for Safe Drinking Water Access

Region	Average Opportunity	D-Index	Human Opportunity Index
Tigray	59.1	5.6	55.7
Amhara	54.1	6.4	50.6
Oromiya	60.6	3.6	58.4
SNNP	54.9	7.4	50.8
Somali &Afar	29.8	20.8	23.6
National	53.5	7.0	50.0

Source: *Author calculation using LSMS (2015)*

4.2.3 Access to Health Services

The other important basic service considered was access to health services. Similar to the safe drinking water, the result for access to health services was at lower level. The average probability of accessing health services showed 55 percent in Tigray. It was 28 percent in Oromiya and 25 percent in SNNP and 24 percent in Amhara (see Table 4). The average probability of accessing health service was only 23 percent in Somali and Afar regions. At national level the average probability in access to health services was 54 percent. In general the average probability of accessing health service showed at a low level. The inequality of accessing health services are also varies among these regions. The highest inequality was observed in the Somali and Afar with the D-Index of 13 percent. It was also 10 percent in Oromiya and 7 percent in Tigray and Amhara regions. The human opportunity index was highest in Tigray region. It indicates that 52 percent of total opportunity needed to ensure universal access to health services was available and equitably distributed among children. However, this index was low in all other major regions. The human opportunity index was 25, 24 and 22 percents for Oromiya, SNNP and Amhara regions respectively. It was 20 percent for Somali and Afar regions. The above results indicated that access to health services was at low level in all regions. This may be a result of a combination of factors like first; the rural community may have less access in geography to this services. Second, the majority of the communities (both rural and urban) have poor culture in health services utilization unless they are sick. Even in the time of sickness majority of rural community may prefer to use traditional health services over the modern health services in some part of the rural communities.

Table 4: Result for Health Access

Region	Average Opportunity	D-Index	Human Opportunity Index
Tigray	55.2	6.6	51.5
Amhara	23.5	6.5	22.0
Oromiya	27.8	10.1	25.0
SNNP	25.4	5.3	24.1
Somali & Afar	22.9	12.9	20.0
National	28.4	5.4	26.8

Source: Author calculation using LSMS (2015)

The other important opportunity considered was access to minimum nutrition. It was proxied by anthropometric measures. This was only done for the children less than 5 years old. There are various measures of anthropometric measurements like wasting, stunting and underweight. These measures were constructed from weight, height and age of children's data from LSMS. All measures have their own advantage wasting mostly used to measure the short run nutritional status of children. Stunting indicate the past history of nutritional status of the household in general and individual children in particular.

4.2.4 Access to Minimum Nutrition

Underweight combine the two measures both wasting and stunting. As far as nutritional status is concerned underweight is the baste measure which considered in this study too. Access to nutrition was measured by underweight if a child underweight he/she considered not has access to the minimum nutrition required for physical and mental development. However, if a child not underweight he/she considered as has access to the minimum nutritional required. Using this measure result for access to minimum nutrition was showed in Table 5.

The average probability of accessing the minimum nutrition was varying among children under 5 years old. The rate was highest in Oromiya indicating that 79 percent of children who live in this region have access to minimum nutrition. The figures were 77 and 74 percents in Amhara and SNNP regions, respectively. The lowest coverage rate was observed in Tigeriy followed by Somali and Afar with the second smallest coverage rage. The average probability of accessing basic minimum nutrition was 65 and 68 percents respectively in these regions. The highest inequality was observed in the Somali and Afar with the D-index of 8 percent followed by 7.4 percent in Tigeriy and 5 percent in Amhara and 3.2 percent in SNNP regions. The human opportunity index was highest in Oromiya region with 76 percent. It was 73 and 71 percents in Amhara and SNNP regions, respectively. However, in Somali and Afar regions 61 percent of total opportunity needed to ensure the universal access to minimum nutrition was available and equitably distributed among rural children in these regions. At national level 72 percent of total opportunity needed to ensure the universal access to minimum nutrition was available and equitably distributed among rural children in Ethiopia.

The human opportunity index in average access to minimum nutrition was higher than corresponding figures for average access of other opportunities in Somali and Afar regions. By comparison access to minimum nutrition and primary education service were available in these regions. The inequality measure also indicates higher for all opportunity in Somali and Afar. Among the basic opportunity considered access to safe drinking water and access to health services were the lowest available opportunity. They are also the highest inequitably distributed opportunities in Somali and Afar regions.

Table 5: Result for Underweight

Region	Average Opportunity	D-Index	Human Opportunity Index
Tigray	64.7	7.4	59.8
Amhara	77.3	5.2	73.2
Oromiya	79.2	3.7	76.2
SNNP	74.3	3.2	71.8
Somali and Afar	67.6	8.4	61.8
National	75.0	3.8	72.1

Source: *Author calculation using LSMS (2015)*

In all the cases the human opportunity index was less than the average probability of access (coverage rate) attributed to positive values of the dissimilarity index. This indicate that the fraction of existing opportunity which has to be reallocated to ensure equal distribution. The result discussed so far using average access rate, dissimilarity index and human opportunity index shows three interesting patterns for all regions in general and the study areas in particular. First, regions with high average access rates for any given opportunity also have high rates of human opportunity index and also with low level of inequality index. This can be easily understood if access to minimum nutrition and access to primary education services are considered except the latter one for Oromiya. The second, regions with high human opportunity index also showed high dissimilarity index for a particular opportunity. This pattern is evident in Oromiya especially with the access to primary education services. The third, regions with the lower human opportunity index also have very high inequality for the same opportunity. This pattern is very evident in Somali and Afar regions using all opportunity considered here. This has greater implication of the resources allocation of the country in general and Somali and Afar regions in particular. It indicated the regions allocate low resources to increase the average access rate of these opportunities. Moreover, the existing services also distributed inequitably in these regions.

4.3 Inequality Contribution

This part showed the specific D-index by decomposing the inequality of opportunities according to the contributions of individual circumstance variables. The specific D-index was measured for specific circumstance variables considered here (like household economic status, sex of the child, mother's education; father's education and household size were presented hereunder).

The Shapley decomposition technique developed by Shorrocks (2013) was used. For access to primary education services, the most important circumstance variable that influences child access to primary education was both parental and mother education level (see Table 1 in appendix). The contribution of parental education ranges from 29 percent in SNNP to 64 percent in Oromiya. Similarly, if the only circumstance variable considered is mother education level 19 percent and 35 percent of available educational opportunities needed to be reallocated to avoid the inequality of access in primary education. In Somali and Afar the D-index for the parent and mother education level were 63 percent and 22 percent, respectively. The contribution of parent's education level to the inequality of access in primary education found to be high in all regions. The educated parent sends their kids to school as compared to the less educated parents.

The household size was found to be the second most important inequality contributors with 24.1 percent in SNNP to the highest 44.1 percent in Tigray. The household with large size may less invest in education of the child as compared to the household with small size. However, this variable is not significant in the other regions. The child sex only found significant inequality contributor in Tigray with 34 percent. This implies there is systematic gender discrimination in Tigray in access to primary education services. But this variable not significant contributor in the other model estimated for the other regions including Somali and Afar regional states. The other surprising result was the household economic status has little contributes to inequality of access to primary education in all regions. Thus, among the narrow circumstance variable considered here difference in parent education level and mother education level explained most inequality that exist in primary education. There was a positive coefficient between these variables. There is positive correlation between parent education and children education level. This has an implication for intergenerational social mobility. Parental educational disadvantage transmitted to their children as educational disadvantage and vise versa. However, as far as this result is concerned it is inconclusive. In addition to education level further research is needed by accounting all possible intergenerational social mobility indicators and their relationship.

In the case of access to safe drinking water (see Table 2 in appendix) parental education is still a dominant factor to inequality contributors. The contribution ranges from 24 percent in SNNP to 80 percent in Somali and Afar regions. Mother education level also a very important factor that determines the access to safe drinking water to the children in three out of six cases considered. Educated parents make a better decision on privation of safe drinking water to their kids as compared to uneducated parents. They may have better information on the consequence of unsafe water to human health and use boiled water at home despite its sources of origins. The second most important circumstance variable inequality contributor is household economic status. The contribution of this variable is 52.1 percent in SNNP region. This was around 8 percent to the inequality of access to safe drinking water in Somali and Afar regional states. Better off household may have a capacity to provide safe drinking water to household members including children, while, poor household was unable to do this. The sex of the child was contributed very little in all regions to the inequality. The household economic status has also little contributes to inequality of access to safe drinking water in Tigray, Amhara and Oromiya too.

Result for inequality contributors to access in health services presented in (Table 3) see in the appendix. All circumstance variables were found to be influential with the variation in access to health services among children. However, the dominants are mother education level, household size and father education level in the order of importance. The contribution of mother education level to the inequality access in health services ranges from 13 percent in SNNP to 62 percent in Amhara. If the only circumstance variable considered is mother education level 17 percent of the available opportunity needed to be reallocated to eliminate the inequality among children in access to health services in Somali and Afar regional states.

Similarly, for father education level 40.2 and 49 percent of the available opportunity needed to be reallocated. This can eliminate the inequality among children in access to health services in Tigray and Oromiya, respectively. The educated parent may have better information about the importance of health services for their family than uneducated parents. The second important inequality

contributor was household size. It contributes 35 percent in Tigray and 73 percent in SNNP. It was the dominant inequality contributors with 52 percent in Somali and Afar regions. This is followed by mother education level and household economic status with their respective values of 17.1 and 16.2 percents. The household with large household size may less care for their children health and showed poor health record as compared to household with small size. The household economic status also found to be significant contributor to the inequality of health services. It was 16.2 percent in Somali and Afar regions. The poor has less access to health services as compared to the better-off household. However, this variable has insignificant inequality contributors in all other regions. Similarly, the child sex was found only significant inequality contributor in Tigray with 18.7 percent. But this variable was also not significant inequality contributor in other regions.

In relation to access in minimum nutritional status, parental education level, household economic status and sex of the child were the main contributor to inequality. The parental education level was dominant from 61 percent in Amhara to 81 percent in Oromiya and 68 percent in SNNP regions (see Table 4 in appendix). But, it was less or little inequality contribution in the other regions. The educated parent has better knowledge in provision and use of food and including nutritious food for their kids as compared to the less educated parents. The household economic status is the second most important contributors to the inequality of access to minimum nutrition. This ranges from 1.6 percent in the Somali and Afar regional States to the highest 11 percent in Tigray. This figure was also 2.3 percent in SNNP region. The poor has less access to minimum nutrition as compared to the better off household. The child sex only found significant inequality contributor in Tigray with 21.4 percent. This implies there is systematic gender discrimination in Tigray in access to minimum nutrition. But this variable was also not significant inequality contributor in other regions.

In general, among the circumstance variables considered parent and mother education levels are the dominant inequality contribution in all regions. The household economic status and household size are also significant inequality contributors. However, in most case sex of the child has not plays significant roles in the inequality estimation this was a surprising result especially for the study areas.

5. Concluding Remarks

Addressing inequality in all its form by 2030 seen as a long journey that most developing and developed country have to walk. Inequality measured differently but mainly two types broadly as inequality of outcome and inequality of opportunity. In developing countries like Ethiopia in general and the study areas in particular, the latter type of inequality matters more. For the country to achieve the intended SDGs knowing the types and the causes of inequality specifically for the children is crucial. In this study the inequality of basic opportunity namely access to primary education services utilization, access to safe drinking water, access to health service utilization and access to minimum nutrition are considered. These opportunities are internationally recognized one and also by the Ethiopian government as well. These are the important one in building the future human capital of every nation. Accessing these opportunity depends on a number of factors however if the inequality of these opportunities arise due to circumstance which are beyond the control of the child it is injustice and should be corrected and addressed.

The average access rates, human opportunity index and dissimilarity index the indexes used to measure the opportunity. Access to health service and safe drinking water were the lowest accessible opportunities indicated by their coverage rate. They are also the most inequitably distributed opportunities among children who live in Somali and Afar regions. The results backed by the human opportunity index that also show the lowest for both opportunities. Among the short list of circumstance included in these study parent education and mother education, followed by household economic status and household size are the major inequality contributors in most of the regions including Somali and Afar states. Therefore, the following policy implications were drown from the result: The government has to increase the access in these basic opportunities for the children to meet the universal coverage rats. Part of the inequalities observed in the basic opportunity can be addressed partly by increasing the coverage rates especially for access to safe drinking water and health service. Government has to carefully reallocate the financial resources to increase the access of these basic opportunities. Improving the household economic status and education level of parents also reduces the inequality among children that arise because of these circumstances too.

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Annexes

Table 1A: Result for Primary Education Access Inequality Contributors

Region	Sex	Household Size	Parent Education	Mather Education	Household Economic Status
Tigray	34.2*	44.1*	5.0	7.2	7.1
Amhara	22.1	1.3	52.1*	18.9*	4.5
Oromiya	0.2	0.8	64.4*	34.5*	0.2
SNNP	11.3	24.1*	27.8*	34.3*	2.2
Somali &Afar	5.6	2.2	63.8*	22.2*	1.3
National	0.05	8.85*	56.2*	34.4*	0.19

Source: Author calculation using LSMS (2015)

Table 2A: Result for Access to Water Inequality Contributors

Region	Sex	Household Size	Parent Education	Mather Education	Household Economic Status
Tigray	0.2	19.3*	6.1	73.1*	1.3
Amhara	17.8	6.0	48.7*	26.8*	0.4
Oromiya	0.02	59.7*	27.9*	10.2	1.7
SNNP	0.1	4.1*	23.6*	20.4*	52.1*
Somali &Afar	0.1	4.4	80.4*	8.3	7.5*
National	0.4	3.8*	60.0*	34.6*	1.0

Source: Author calculation using LSMS (2015)

Table 3A: Result for Access to Health Utilization Inequality Contributors

Region	Sex of the Child	Household Size	Parent Education	Mather Education	Household Economic Status
Tigray	18.7*	34.7*	40.2*	5.3	1.3
Amhara	2.0	2.4	13.8	61.6*	20.4
Oromiya	0.09	0.76	49.0*	50*	0.2
SNNP	0.0	73.3*	5.7	12.6	5.9
Somali &Afar	0.9	52.4*	11.3	17.1*	16.2*
National	0.09	32.7*	41.8*	20.1*	4.7

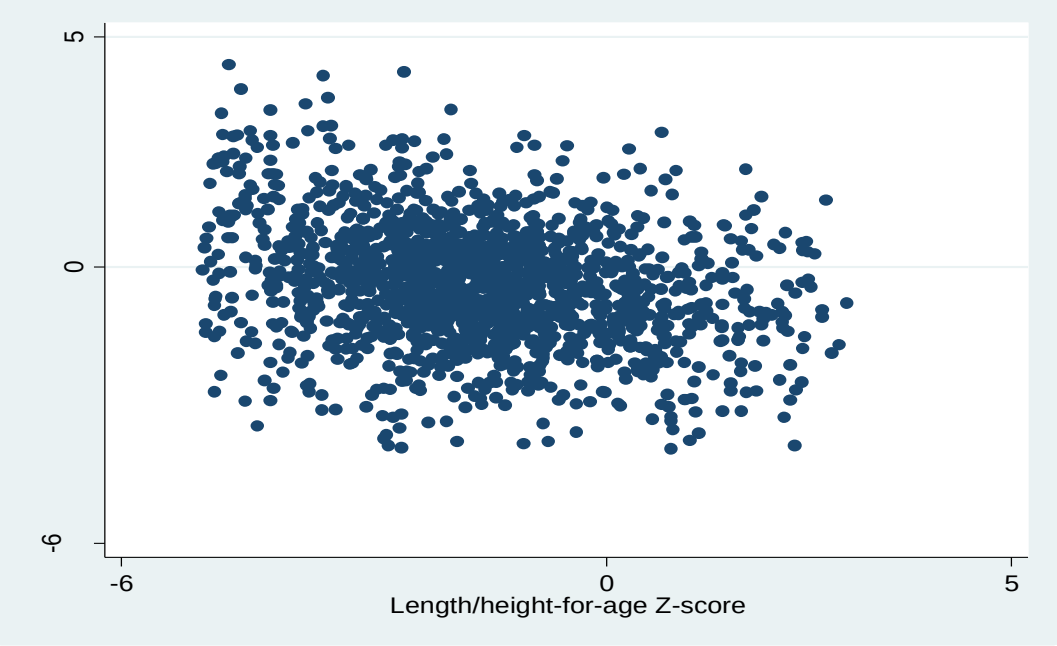
Source: Author calculation using LSMS (2015)

Table 4A: Inequality Contributors for access in Minimum Nutrition

Region	Sex	Household Size	Parent Education	Mather Education	Household Economic Status
Tigray	0.2	3.1	9.5	7.7	10.8*
Amhara	21.4*	1.0	60.6*	0.7	0.02
Oromiya	1.2	0.2	81.2*	17.7	-
SNNP	0.11	15.2	67.7*	16.1	2.3*
Somali &Afar	0.8	11.0	1.0	11.0	1.6*
National	2.3	0.08	69.7*	19.1*	8.9*

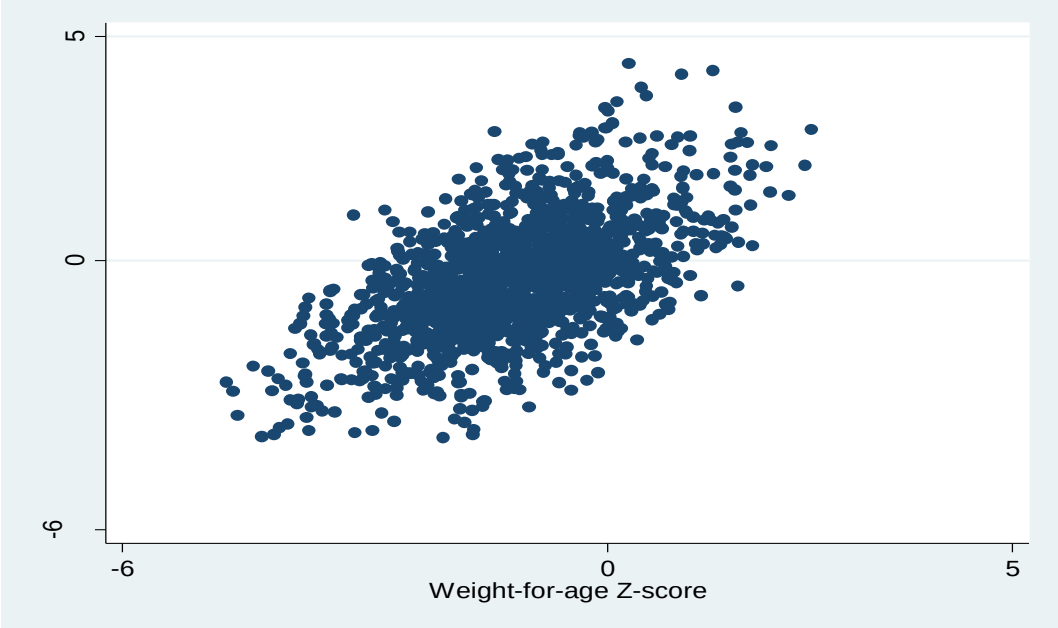
Source: Author calculation using LSMS (2015)

Figure 1A: Anthropometric Relationship



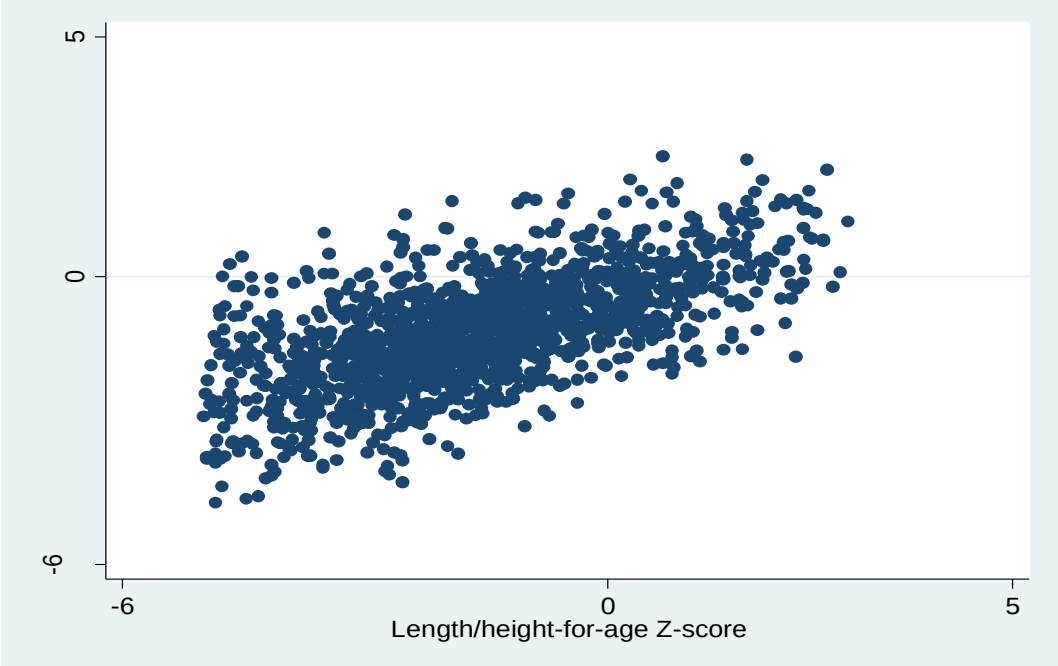
Sources: Own computation using data LSMS (2015)

Figure 2: Anthropometric Relationship



Sources: own computation using LSMS, 2015 data

Figure 3: Anthropometric Relationship



Sources: own computation using LSMS, 2015 data

Understanding Household Education Expenditure in Sudan: Do Poor and Rural Households Spend Less on Education?

Ebaidalla M. EBAIDALLA[4]

ABSTRACT

This paper examines the factors that influence households' expenditure on education in Sudan, with particular emphasis on the impact of household income. The study used the National Baseline Household Survey data (2009) for national, urban and rural levels. The results of Tobit model indicate that household's income, head education, head age, household size, number of school-age children and residing in urban areas are the most significant factors that affecting education expenditure. Expectedly, the results show that income elasticity of education in urban sample model is greater than that of rural model, implying that household resides in urban areas are likely to spend more on education. In addition, the effect of household income is found to be positive and significant in the highest income quintile. Overall, the results revealed that household with higher income, whose head is educated and resides in urban areas tends to spend more on education compared to poor and rural households. These results signify the lack of inter-generational educational and income mobility in Sudan. In other words, children from poor household are caught permanently in low income and educational levels, and do not able to "catch up" with their peers in high income families. Finally, the paper ends with some policy recommendations that aim at achieving equality of opportunity in education in Sudan.

Keywords: *Household expenditure, Education, Tobit model, inequality of opportunity, Sudan*

JEL Classification: I21, I22, I24, C24

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1. Introduction

Education has been considered as a key factor for supporting economic growth and development and alleviating poverty in developing countries. According to human capital theory, education allows individuals to gain better skills and knowledge needed to access jobs, hence enhances productivity and economic growth; which in turn help in eradicating extreme poverty and hunger (Bryant 1990; Becker 2009; Mincer 1970; Schultz 1961). Therefore, the issue of education expenditure by both government and households has gained a sizable attention from researchers and international development organizations.

In Sudan, the education system has been affected by many economic transformations that the country undergone in the last three decades. Specifically, the adoption of liberalization and free market policies in early 1990s have resulted in reducing public spending on education. Since then, the size of private investment in education has expanded remarkably. Accordingly, households' expenditure on education has gone up although basic education such as, primary and secondary education, is still delivered through public sector. Moreover, the reduction of government expenditure on education has contributed greatly in lessening the quality of public education; hence a large segment of population is pushed into private education. This leads to a significant increase in household education expenditure, particularly in urban areas and among high income households.

Against this backdrop, many questions can be raised in accordance with the aims of this study, including: What are the key determinants of the households' education expenditure in Sudan? Does the poor and rural household spend less than urban and rich household? To what extent could the factors that affecting education expenditure varies across rural and urban areas as well as among different categories of income groups?

Regarding the importance and policy relevance, the empirical investigation to be undertaken by this study is useful for several reasons. First, investigating household education expenditure is crucial to provide evidence, which can be used to formulate relevant policies targeting planning and reforming education system in Sudan. Second, understanding the factors that affecting educational spending in Sudan may help policymakers and key stakeholders (i.e. national and international NGOs) to design effective strategies that ensure better access to education so as to create more jobs and reduce poverty. Finally, by identifying the factors affecting education expenditure among different areas (i.e. urban and rural) and income quintiles, the study would place strong foundation in designing effective education programs for disadvantaged groups of population.

This paper is organized into six sections as follows. The next section outlines some stylized facts about education system and its finance in Sudan. Section three discusses the theoretical and empirical literature on the determinants of household educational spending. While section four outlines data and research methodology, section five presents the empirical results and discussions. Section six ends with a conclusion and possible ways forward.

2. Education in Sudan: An Overview

Gained its independence in January 1956 from British colonial, Sudan inherited education system which was designed to provide civil servants and professionals to serve the colonial administration. The distribution of education facilities such as, teachers and enrollment was biased in favor of the needs of the British administration and Western curriculum. Thus, the education services were clustered in urban cities, although about 70% of population resides in rural areas. However, at that time the education was fully sponsored by government and the public expenditure on education was about 20% (Nour 2012). Most of education during the colonial era was focused on the basic education (i.e. primary, intermediate and secondary), while tertiary education was limited to University of Khartoum. In addition, a few number of students of wealthier parents received secondary and university education abroad.

After the independence, the education system in Sudan has received considerable attention from national governments. The national education policies concentrated on the target of achieving universal and compulsory education with aim of equitable distribution of facilities among urban and rural areas. Therefore, the education system has experienced a significant change in terms of years of schooling and distribution of schools. For instance, the Nimeiri regime (1969) considered the education system as inadequate for the needs of social and economic development, hence reorganized the education system in the 1970s (Elmagboul 2014). The basic education system was changed from 4-4-4 to 6-3-3 (6 primary years compulsory, 3 year for intermediate and 3 for secondary). The technical and vocational education also has gained more attention during Nimeiri government. Moreover, during the era of 1970s the tertiary education has expanded by establishment two new universities in addition to oldest one University of Khartoum.

During 1980s, Sudan has undergone a remarkable expansion in basic education, despite the economic and political instability. That is, in this decade hundred primary and secondary schools have been opened. The technical and vocational education also has been increased remarkably. All these efforts led to increase the rate of enrolment significantly from in 1980.

In early 1990s, the education system in Sudan has witnessed a great transformation. First, the education system in Sudan was further reorganized into 8 years of primary education followed by 3 years secondary schooling. In addition, Arabic language was adopted as instruction language in all universities. Moreover, the tertiary education has expanded and more than thirty universities have been established. The number of private schools has grown rapidly following economic policies lifting government subsidies to service sectors, including education.

Regarding financing education in Sudan, the British colonial inherited the country a tax-based education system, in which the state provides free education service for all population. Thus, the successive national governments adopted free education and this continued until the adoption of free market policies in early 1990s decade. However, after the implementation of Structural Adjustment Program (SAP), the government began its sudden withdrawal from education services provision. The austerity measures adopted in 1992 has resulted in great reduction in public spending on education. To fill the gap in financing education resulting from these policies, the government

provided licenses to private schools. In line with this system, parents are also requested to pay some fees for public schools in order to utilize education.

To understand the contribution of government in education, Table 1 below presents the public spending on education in Sudan and a sample of Sub-Saharan African countries. The table shows that public spending in Sudan is accounted for a small proportion from the country's GDP compared to other countries in the sample.

The Table shows that Sudan has the smallest public education spending ratio to its GDP, compared to other SSA countries in our sample. Specifically, the government expenditure on education (% of GDP) remained rotating around 1% during 1990-1999. During 2000-2009, it increased positively to the rate of 1.8% indicating the expansion in education expenditure, which may be due to oil revenue at such period. Moreover, during the last period (2010-2014) the spending on average progressed to 2.1%. However, in all periods the public spending on education in Sudan lags far behind the levels of public expenditure in SSA countries.

Table 1: Public Education Expenditure (% of GDP) in Sudan and a sample of SSA countries

Country	1990-1999	2000-2009	2010-2014
Angola	2.6	2.7	3.5
Botswana	6.3	9.7	9.6
Cameroon	3.1	3.0	3.1
Cote d'Ivoire	4.8	4.1	4.7
Ethiopia	2.6	4.6	4.5
Ghana	4.1	6.0	6.9
Kenya	6.0	6.3	5.5
South Africa	5.8	5.0	6.0
Sudan	**1.0**	**1.8**	**2.1**
Uganda	2.5	3.6	2.5

Source: World Bank, World Bank Indicator (2016)

Regarding the contribution of government education spending to the total public spending, Table 2 below presents data on public spending on education as a percentage of total government expenditures for Sudan and a sample of SSA. Table 2 indicates that Sudan has the second lowest percentage of public education spending (% of total government spending) after Angola. For instance, during the period (1990-1999), Kenya holds the highest rate of public spending on education, which is about to threefold those of Sudan. The low rate of public educational spending as percentage of GDP and total government expenditure implies low public investment in education in Sudan. This also indicates that public education spending fall below the standardized international adequacy criterion which was earlier adopted in the 1960s and related to the supply side and implies the allocation of either 8% of GDP on education or 20% of total government or public spending on education (Nour 2013). The reduction in government spending on education has resulted in a significant deterioration in efficiency indicators like education attainment and enrollment.

Table 2: Public Education Expenditure (% of Total Government Expenditure) in Sudan and a sample of SSA countries

Public Education expenditure (% of Total Government Spending)			
Country	**1990-1999**	**2000-2009**	**2010-2014**
Angola	6.1	6.9	8.7
Botswana	20.0	24.3	21.0
Cameroon	11.6	18.7	15.7
Cote d'Ivoire	19.0	21.9	20.7
Ethiopia	14.0	20.6	26.7
Ghana	15.0	22.3	27.9
Kenya	24.0	25.0	20.6
South Africa	20.0	19.4	19.2
Sudan	9.1	8.9	11.0
Uganda	10.0	14.8	11.5

Source: **World Bank, World Bank Indicator (2016)**

Regarding the demand for education, Table 3 presents the gross enrolment ratio for the three educational levels, primary, secondary and tertiary, respectively[5]. The table shows that the enrolment ratio for primary education in Sudan was close to some African countries that belonging to poor income group like Angola. However, the primary enrolment ratio falls below some of SSA counties like Kenya and Ghana. Regarding the secondary enrolment ratio, Sudan also has a lower rate compared to some SSA countries like Botswana, Ghana and Kenya. The low enrolment ratio in primary and secondary education in Sudan may be attributed to poverty and economic instability. During the period under consideration, the tertiary enrolment ratio in Sudan has the second highest ratio during all periods after South Africa. This high tertiary enrolment ratio may be due to expansion in tertiary education over the last three decades.

Table 3: Gross Enrolment Ratio by Educational Level in Sudan and a Sample of SSA Countries (%)

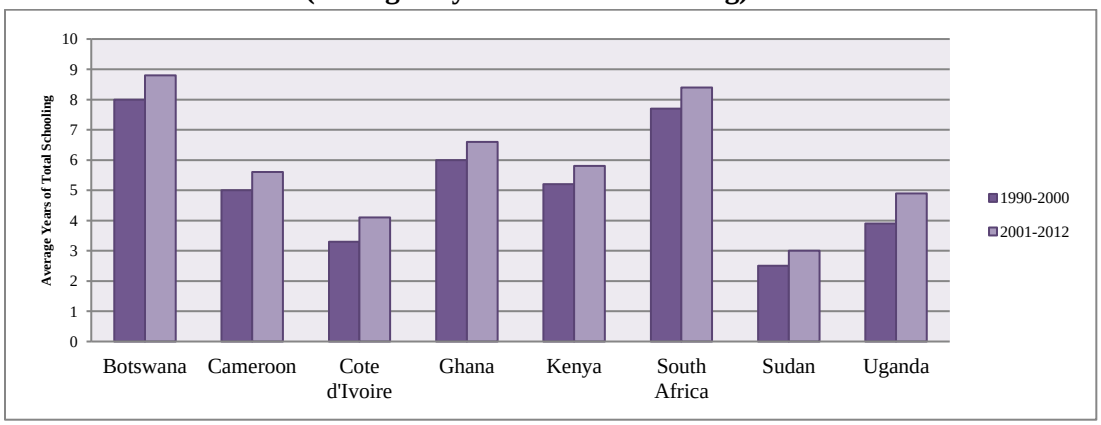
	Primary level			**Secondary Level**			**Tertiary Level**		
	1990-1999	**2000-2009**	**2010-2014**	**1990-1999**	**2000-2009**	**2010-2014**	**1990-1999**	**2000-2009**	**2010-2014**
Angola	18.4	115.4	85.7	11.6	18.9	28.8	0.6	2.3	8.4
Botswana	15.2	17.0	16.9	55.0	77.5	83.3	5.3	10.6	21.4
Cameroon	10.5	16.6	29.1	25.9	30.0	51.6	3.6	6.1	11.5
Cote d'Ivoire	1.7	2.9	5.3	24.3	25.6	40.1	4.6	9.1	8.5
Ethiopia	1.4	2.3	14.2	11.5	24.2	35.7	0.8	2.6	7.4
Ghana	83.7	75.0	113.7	37.5	47.3	60.9	1.2	6.9	13.5
Kenya	36.9	48.1	67.4	38.5	48.1	67.6		3.1	
South Africa	26.1	42.1	75.8	79.6	88.9	92.9	13.1	16.3	19.3
Sudan	16.2	23.6	34.3	33.2	36.2	39.3	6.3	11.0	15.4
Uganda	9.1	11.4	12.4	10.4	21.0	80.8	1.5	3.5	4.2

Source: World Bank, World Bank Indicator (2016)

[5] *Gross primary or secondary school enrolment ratio - The number of children enrolled in a level (primary or secondary), regardless of age, divided by the population of the age group that officially corresponds to the same level (World Bank, 2016).*

Regarding the educational attainment, Figure 1 below shows the average years of total schooling in Sudan and a sample of SSA countries[6]. As indicted from the Figure, Sudan has the lowest rate of educational attainment among other SSA countries in comparison. The low level of educational attainment confirms the relatively low level of school enrollment. This also supports the high rate of illiteracy in Sudan, which is about 26% in 2013 (World Bank 2013). However, there are many factors that may responsible for low educational attainment, including high cost of education and poverty as well as unemployment. In general, the low rate of education attainment and enrollment indicates low commitment to the standardized international adequacy and equity criterions in the demand side as measured by the lack of adequacy in enrolment rate in primary, secondary and tertiary education and literacy rate of population (Nour 2013).

Figure 1: Education Attainment of population aged 15 and older in Sudan and a sample of SSA countries (average of years of total schooling)



Source: World Bank, World Bank Indicator (2016)

3. Literature Review

Given the importance of education in economic growth and development, the determinants of household's educational expenditure have gained a considerable attention from both researchers and policy makers in last decades. However, most of the exiting literature has focused on the macroeconomic perspective and government expenditure on education. On the other hand, the issue of household' expenditure on education has gained a few attention particularly in developing countries. In this section we briefly review some empirical studies on this issue.

The empirical literature indicates that household education expenditure is influenced by many variables, including household' characteristics, parent' education level and household income, among them. However, the main consensus among most of empirical studies is that household' income is the most significant factor affecting education expenditures (e.g. Hashimoto & Heath 1995; Tilak 2002).

6 Educational attainment refers to the highest level of schooling that a person has reached. Here we use average years of total schooling as calculated by Baroo and Lee (2010).

Huston (1995) analyzed the impact of income and household characteristics on education expenditure in US. Using a sample from the 1990-1991' Consumer Expenditure Survey, he found that head age, education level, income, region, race, and family size are the most significant factors affecting household education expenditure.

Kanellopoulos and Psacharopoulos (1997) investigated the factors that affect private expenditure on education in Greece, using household Expenditure Survey of 1988. They found that household size and number of children under six years of age have negative effect on private spending on education, while household head's years of education and income have a positive impact on education expenditure. In the same vein, Psacharopoulos and Papakonstantinou (2005) examined the household expenditure on university education in Greece, using a sample of 3000 university freshmen. They argued that private education is highly inelastic, indicating its importance in Grecian household budget. They also found that private out of pocket spending to prepare for the entrance exams and study at college exceeds that of public spending. In addition, they found that poorer families spend a higher share of their income on education of their children. Moreover, using data from household surveys for 1990 and 1992, Psacharopoulos et al. (1997) examine the extent of private expenditure on education in Bolivia and calculate an income elasticity of 0.23. They conclude that education expenditure is not a luxury good for Bolivian families.

Tilak (2002) studied the household education expenditure in rural India using the national survey on Human Development in rural India (HDI) (1994). The paper also examines the household expenditure on education by different groups of population. He found that there is nothing like free education in India and household expenditure on education represents a considerable portion of household budget. In addition, households from lower socio-economic background and low income groups spend considerable amounts on acquiring education, including specifically elementary education, which is expected to be provided free to all by the State. His results also indicate that household income, educational level of the head of household and the household size are among the most significant factors affecting education expenditure. Interestingly, he found that education is income inelastic in India by compiling time series of household expenditure estimates over the period 1960-61 and 1984–85.

Glewwe and Jacoby (2004) examined the relation between household resources and demand for education in Vietnam using household panel survey data covering the period 1993-1998. They found positive relationship between household income and demand for education, even after controlling for locality-specific factors such as change in education returns, supply and quality of schools, and opportunity costs of schooling.

Tansel and Bircan (2006) studied the demand for private tutoring in Turkey, using household expenditure survey (1994). Adopting Tobit model, the authors showd that private tutoring is neither a luxury nor a necessity item in the household's budget. They also found that parents' educational level, especially of mothers have positive and significant effect on private tutoring expenditures, which means inequity in the intergenerational distribution of education. Moreover, the results indicate that private tutoring expenditures increase at a decreasing rate with the age of the household head, hence implying lifecycle considerations. Their results also indicate that urban

families spend more than rural household residents. Finally, household private tutoring expenditures are found to be declined with the number of children in the household.

Qian et al. (2011) examined parents' expenditure on their children education, using household survey data from 32 selected cities across China in 2003. Their results show that household income has significant effects on both domestic and overseas educational expenditures. The results also indicate that households whose mothers have secondary school or college education and fathers who are working in professional occupations are likely to spend more on education. Moreover, this study found that household belonging to the highest income group, having a college-educated father, having a mother who is a cadre or middle professional and living in coastal areas has a higher probability to spend on children' education abroad.

Othman et al (2012) examined the determinants of household' expenditure on education in Malaysia. Using household survey data, they found that household characteristics such as parents' income, educational level of parents, mother's work status, job category of head of household and parents' awareness of globalization in respect of their children's education are the most significant factors affecting education expenditure. Specifically, their results show that the elasticity of income is very high (approximately 1%) indicating the importance of household income in education expenditure.

Huy (2012) investigated the factors that affecting household expenditure on children's education in Vietnam. Using the Vietnamese Household Living Standards Survey (VHLSS 2006) and adopting tobit model, he found that household income has a positive and significant effect on household education expenditure. That is, increase in the income of the household is always associated with an increase in educational expenditure. His result also revealed that households whose heads have a higher level of education or with professional jobs are more likely to spend more on education. Moreover, households with more primary-school-age or secondary school-age children are likely to spend more on education compared to households with pre-school-age or college-age children. Vu Quang shows that families with more resources and better human capital are those who are able to spend more income on their children's education.

Andreou (2012) investigated the determinants of household education expenditure in Cyprus, using expenditure surveys of 1996/7, 2002/3 and 2008/9. He found that the level of education expenditure increases with income across years. In addition, his results pointed out that household' income, number of children in household, region of residence and head's age and education level are the most important factors affecting the level of household expenditure on education.

Recently, Acar et al (2016) using Turkish household budget surveys from 2003, 2007 and 2012, investigated the determinants of household education expenditures adopting an Engel curve framework. In particular, they estimate Tobit regressions of real educational expenditures by income groups to examine if and to what extent the determinants of educational expenditures differ by income groups. Their results indicate that the estimated expenditure elasticity is low for the top- and the bottom-income quartiles while it is high for the middle-income quartiles. The results also show that for all income groups the expenditure elasticity of education increases over time, indicating that Turkish household allocates greater share of their budgets to education expenditures.

The above discussion has made clear that there is a dearth of empirical studies on household educational expenditure in Africa in general and Sudan in particular. Therefore, this study would contribute to the existing literature by examining the factors that affecting household health expenditure across national, urban and rural areas. Moreover, unlike the previous studies, this paper emphasizes the role of income and regional disparities in household educational expenditure.

4. Methodology and Data

4.1 Data and Variables

The data used in this study is sourced from the national baseline households survey (NBHS) conducted by the Central Bureau of Statistics in 2009. The survey contains data on all household' expenditures (e.g. food, education, health, utility, etc.) as well as demographic and socio-economic characteristics of households and individuals. The survey comprises 48825 individuals of 7913 households and covering 15 states. However, information on education expenditure for each individual in household is not exist, thus, we use household as a unit of the analysis. The data include expenditure of the household in past 12 months (year). Following previous studies (e.g. Qian & Smyth 2010; Huy 2012) we focus on households with dependent children of age is not older than 22, as most of households' members are graduated from university by that age. Accordingly, there were 7,257 valid households who hold such criteria[7]. Therefore, we ensure that there is no sample selection problem, because most of the households with children have positive education expenditure.

Based on the literature review discussed in the previous section, the dependent variable in our analysis is household education expenditure on education. The dependent variable is explained by a vector of explanatory variables, which include household income and socio-economic characteristics. The socio-economic characteristics include a set of variables that are hypothesized to influence household education expenditure such as, household size, education level of head of household, gender, age of the head of household, marital status and dummy variables indicating region of residence, and occupation. Regional and seasonal factors are also considered. The definition and descriptive statistics of the variables used in the analysis is presented in table 5.

4.2 Estimation Technique

To analyze the factors that affecting household education expenditure, this paper uses tobit model, which is appropriate technique to estimate household expenditure with zero observations (Tobin, 1958). That is, because not all the households spend on education services, numerous zero observations will exist in the data and we are facing with the so-called censored sample problem (Barslund 2007; Czarnitzki & Stadtmann 2002; Dardis et al. 1994). The tobit model was originally developed by Tobin in 1958 to accommodate censoring in the dependent variable. This model also

[7] *The study does not discriminate between private and public education expenditure because there is no information on the type of schooling and/or education expenditure in the NBHS' data.*

overcomes the bias associated with assuming a linear functional form in the presence of such censoring. The Tobit model considers that all zeros are attributable to standard corner solutions. Negative values of the dependent variable are assumed to be exist but are considered to be unobservable and bunched at zero. Based on the Tobin's model, it is assumed that a latent variable that measures the consumer's propensity to spend money on education (y_h) is related to the vector of explanatory variables (X_h) and undetectable influences, as specified on the following:

$$y_h^* = \beta X_h + \varepsilon_h \qquad (3)$$

It is assumed that a household h spends (y_h^*) on education if the latent variable (y_h^*) is positive. In contrast to the observed expenditure of household h (y_h), the value of the unobservable value (y_h^*) can be negative. Negative values of the latent variable imply that household will not spend any money on education:

$$y_h = \begin{cases} y_h^* & if\ y_h^* > 0 \\ 0 & if\ y_h^* \leq 0 \end{cases}$$

The conventional estimators for these types of models are based on maximum likelihood estimation (MLE). The MLE produces consistent estimates of the parameters of the tobit model, under appropriate assumptions such as, homoscedasticity and normality of the error terms. The likelihood function consists of two parts: the product of the probabilities that households do not spend any money on education [$Pr\ (y_h = 0\ )$] and the product of the probabilities that households spend y_h^* on education [$Pr\ (y_h = y_h^*\ )$]:

$$L(\beta, \sigma_e) = \prod_{censored} Pr\ (y_h = 0) \prod_{uncensored} Pr\ (y_h = y_h^*\ ) \qquad (4)$$

Assuming standard normal distributed errors (ε_h), the likelihood function of censored model can be rewritten using a probability density function (ϕ) and cumulative distribution function (Φ) of the standard normal distribution as (Tobin, 1958):

$$L(\beta, \sigma_e) = \prod_{censored} \Phi\left(\frac{0 - X_h\beta}{\sigma_e}\right) \prod_{uncensored} \frac{1}{\sigma_e}\phi\left(\frac{X_h - X_h\beta}{\sigma_e}\right) \qquad (5)$$

Equation (5) will be estimated via the maximum likelihood (ML). The estimation is run for different samples, namely full, urban and rural households' samples, as well as for different households' income groups.

5. Empirical Results and Discussion

This section presents the empirical results and discussions. First, we present some descriptive statistics about the variables that used in the analysis and then report the econometric results.

5.1 Descriptive Statistics

Before analyzing the factors that influencing household educational expenditure in Sudan it is useful to present some descriptive statistics, thus Table 4 below describes the definition and mean as well as the standard deviation of variables employed in the analysis. As can be read from the table, the reported statistics indicate that the mean of total household income is SDG 6846 per annum. This is somewhat consistent with the national statistics as reported by NBHS (2009). However, the higher standard deviation of the total income point to the prevalence of income inequality in Sudan. The mean of health expenditure is about SDG 472 per month, representing about 17% out of non-food expenditure. This suggests that a considerable portion of Sudanese households' income is spent on education. The standard deviation of household education expenditure is also high, indicating a great disparity among households in terms of education expenditure.

The table indicates that the average of gender variable is very high (about 90%), indicating the dominance of male in heading households. Regarding the mean and standard deviation of education variables, the table show that most of head of households and spouses have low level of educational attainment, confirming the wide spread of illiteracy in Sudan.

Moreover, as can be read from the table, the mean of number of heads engaging in agriculture and industry is very small, while the mean for service activity is very high. This implies that a considerable portion of household's income is generated from service activities, confirming the dominance of service sector in Sudan economy. Moreover, as can be fairly read from the table, the average of household size is about six, which is consistent with the NBHS, 2009. Interestingly, the mean of dummy variable (married) is high implying that most of the households' heads are married and with couples. Finally, the mean of electricity is found to be relatively small, demonstrating the weakness of infrastructure in Sudan, particularly in the rural areas.

Table 4: Summary Statistics of Variables used in the Analysis

Variable	Definition	Mean	Std. Dev.
Education Expenditure	Household expenditure on education	472.501	4644.570
Income	Household total disposable income in SDG	6846.134	24416.660
Household's Head Characteristics			
Age	Age of head of household in years	45.811	14.810
Gender of head	Gender of the head of household (1 = male; 0 = female)	0.896	0.305
Education level of Household head			
Primary	Primary school, dummy	0.192	0.394
Secondary	Secondary school, dummy	0.078	0.268
University	University, dummy	0.042	0.201
Education level of Spouse			
Spouse Primary	Primary school, dummy	0.191	0.393
Spouse Secondary	Secondary school, dummy	0.070	0.255
Spouse University	University, dummy	0.032	0.176
Number of children in household			
Pre-school	The number of children aged 1 to 6 living in the household.	0.967	1.046
Primary school	The number of children aged 6 to 14 living in the household	1.500	1.512
Secondary school	The number of children aged 15 to 17 living in the household	0.404	0.628
University level	The number of children aged 18 to 22 living in the household	0.971	1.099
Profession of Household's Head			
Agriculture	A dummy variable where 1 =household's head being engage in agricultural activities, 0 otherwise.	0.072	0.258

Industry	A dummy variable where 1 =household's head being engage in industrial activities, 0 otherwise.	0.003	0.053
Service	A dummy variable where 1 =household's head being engage in industrial activities, 0 otherwise.	0.925	0.262
Household Type of Dwelling			
House	A dummy variable where 1 = being a resident in house, 0 otherwise.	0.995	0 .068
Apartment	A dummy variable where 1 = being a resident in apartment, 0 otherwise.	0.006	0.108
villa	A dummy variable where 1 = being a resident in villa, 0 otherwise.	0.005	0.126
Household Characteristics			
Household size	Number of household' members	6.173	2.806
Room	Number of rooms	3.265	1.869
Married head	A Dummy variable, (1= married; 0= unmarried)	0.895	0.306
Electricity	A Dummy variable, (1= electrified; 0= un-electrified)	0.391	0.488

5.2 Econometrics Results

First, the results of tobit estimation of equation (3) for the full, urban and rural sample are presented in Table 1 in Appendices. As can be observed from the table, most of the variables carry their expected signs and in line with the theory. The result reveals that the coefficient of household' total income is positive and significant in all estimated models. However, the results show some differences in income coefficients across models, indicating variations in terms of income impact on education between regions. For instance, the elasticity of income is higher in urban sample compared to rural sample. This result indicates that households residing in urban areas spend about 6% more on children education than those living in rural areas. This result suggests that urban households devote a considerable portion of their budget to children education. This can be explained by the fact that the extremely poor quality of education in Sudan, led most of urban households to switch their children to private institutions, which supply better educational services than the public ones. For a national level, an increase in household income by a 1%, elevates its education spending by 8.4%. This strong association between households' income and education expenditure indicates the absence of free provision of education in Sudan. Alternatively stated, due to the withdrawal of government from financing education, the households are pressed to cover education spending relying on their own resources. Furthermore, quality deterioration of public school pushes a considerable part of population to private institutions.

Regarding the household' head characteristics, the results show that age of head has positive and significant impact of education expenditure. This result confirms many previous empirical studies (e.g. Othman 2012 and Andreos 2012). Also, the coefficients of education level of head and spouse are found to be positive and significant in full, urban and rural sample models. This means that a household whose head received university degree or diploma is likely to spend the more on their children's education. This result indicates that educated heads and mothers are likely to spend more in education. This finding is in line with the previous studies of Acar (2016) and Huy (2012).

The number of secondary school and university age children has positive and significant impact on education expenditure. This implies that household with children in high education institutions tend to spend more on education compared to those with more children in low education levels. In

addition, household head who engage in the service activities tend to spend more in education compared to those participating in agricultural activities. This is because most of service activities are located in urban areas, where household has higher opportunity to spend more on education compared to rural household who engages in agricultural sector.

Moreover, the results show that the coefficients of household size, number of room and access to electricity have positive and significant impact on household education expenditure in Sudan. This can be justified by that fact that larger household with urbanized facilities tends to spend more in education. This finding is also confirms the positive and significant coefficient of urban dummy variable, which indicates that household residing in urban areas tends to spend more in education than those live in rural area.

In terms of geography, households residing in the Northern, eastern, central and Kurdofan regions are likely to spend less on their children's education than households residing in the capital city (Khartoum). This confirms the fact that households in Khartoum devote a large investment for their children's education. Expectedly, the coefficient of Darfur region is found to be negative but not significant. This finding can be justified by the fact that people of Darfur suffer from civil war and a large portion of Darfur population live in IDP camps and spend nothing in education, as most of education services provided by government and non-governmental organizations.

Overall, households with higher income and residing in urban areas tend to spend more on education of their children. This finding confirms our hypothesis that rural and poor household spend less in education in Sudan. In addition, households whose head and mother have higher education level are likely to invest more on education.

Regarding the factors that affecting education expenditure by income quintile, Table 2 in Appendices reports the marginal effects for the tobit estimates. As can be read from the table, the coefficient of household income in the bottom four income quintiles are insignificant. On the other hand, the effect of household income in the highest (fifth) income quintile is found to be positive and statistically significant. This indicates that households belonging to high income quintile are likely to spend more on children education. This result confirms the previous results of full, urban and rural models. This also implies that children education is an important investment for rich population. However, the result suggests that an increase in income of household that belonging to low income quintiles does not raise the education expenditure, as poor households devote a greater part of their budget to food and health expenses.

Similar to the results obtained from the full, urban and rural samples, the education level of household head is found to be very significant in influencing household expenditure, particularly for the highest income group. This finding supports the previous analysis that household with higher income and educated head tends to spend more on education than poor and less educated heads. In addition, the number of secondary and university-age children increases household education expenditure in both fourth and fifth quintile. In addition, households whose head is working in service sector and belonging to third and fourth income quintile spend more on education compared to other income quintiles. Moreover, the results shows that households reside

in other regions than Khartoum spend less. Finally, the coefficient of Darfur is not significant, confirming the pervious analysis.

6. Conclusion and Policy Implications

This paper examines the factors that influence household educational expenditure, with emphasize on the role of household income. The study used the NBHS data (2009) for national, urban and rural levels and employed a tobit model. For further understanding of income impact on children education, the analysis is executed for different income groups.

The results of tobit estimation reveal that households' income, head's educational level, head's age, household size, number of school-age children and residing in urban areas are the most significant factors affecting education expenditure in full, urban and rural sample of the surveyed households. Interestingly, the empirical results show some variations between the effects of household income on education expenditure across urban and rural areas. Specifically, the income elasticity of education in urban sample model is greater than that of rural model, implying that household resides in urban areas tends to spend more on education than rural households. In addition, the effect of household income is found to be positive and significant in the highest income quintile, implying that rich household tends to spend more than poor household.

Overall, our results indicate that household with higher income, residing in urban areas tends to spend more on education in Sudan. In addition, household whose head and mother have higher education level are likely to spend more on education than the others. These results signify the weakness of inter-generational educational and income mobility in Sudan. This also suggests that children from poor household are caught permanently in low income and low education levels; and do not able to "catch up" with their peers of high income families. Accordingly, education policies in Sudan need to take into account the equality of opportunity in education to ensure that children from low education families have as much access to education as their richer counterparts; thus leading to higher intergenerational mobility in Sudan. Accordingly, liberalization of education that adopted in 1992 should be revised with cautions so as to achieve income and educational equality.

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Annexes

Table 1A: Tobit Estimation Results for Household Education Expenditure in Sudan (Full, Urban and Rural Sample)

Variable	Full Sample	Urban	Rural
Income	0.084***	0.130***	0.067***
	(0.000)	(0.001)	(0.003)
Household's Head Characteristics			
Age	0.007***	0.006**	0.008***
	(0.000)	(0.043)	(0.000)
Gender of head	-0.106	-0.138	-0.071
	(0.177)	(0.332)	(0.445)
Married	-0.056	-0.090	-0.046
	(0.471)	(0.516)	(0.625)
Education level of Household head			
Primary	0.153***	0.156*	0.151**
	(0.002)	(0.062)	(0.011)
Secondary	0.337***	0.390***	0.238**
	(0.000)	(0.000)	(0.016)
University	0.654***	0.526***	0.864***
	(0.000)	(0.000)	(0.000)
Education level of the Spouse			
Spouse Primary	0.136***	0.045	0.202***
	(0.006)	(0.578)	(0.001)
Spouse Secondary	0.371***	0.311***	0.360***
	(0.000)	(0.004)	(0.002)
Spouse University	0.439***	0.374***	0.408**
	(0.000)	(0.009)	(0.038)
Number of children in household			
Pre-school	-0.155***	-0.153***	-0.149***
	(0.000)	(0.001)	(0.000)

Primary school	-0.006	-0.063*	0.034
	(0.790)	(0.075)	(0.190)
Secondary school	0.151***	0.118**	0.177***
	(0.000)	(0.027)	(0.000)
University level	0.181***	0.159***	0.196***
	(0.000)	(0.000)	(0.000)
Profession of household's head (agriculture as reference)			
Service	0.338***	0.375	0.350***
	(0.001)	(0.498)	(0.000)
Industry	-0.186	-0.412	0.107
	(0.745)	(0.636)	(0.889)
Household type of dwelling (house as reference)			
Apartment	0.375**	0.479**	-0.157
	(0.024)	(0.015)	(0.682)
villa	-0.152	-0.335	-0.078
	(0.233)	(0.249)	(567)
Other Household characteristics			
Household size	0.079***	0.093***	0.065***
	(0.000)	(0.001)	(0.002)
Room	0.037***	0.062***	0.021
	(0.001)	(0.002)	(0.128)
Electricity	0.353***	0.425***	0.306***
	(0.000)	(0.000)	(0.000)
Urban	0.273***		
	(0.000)		
Region (Khartoum as reference)			
Northern	-0.555***	-0.720***	-0.260
	(0.000)	(0.000)	(0.109)
Eastern	-0.444***	-0.524***	-0.183
	(0.000)	(0.000)	(0.274)
Central	-0.660***	-0.481***	-0.538***
	(0.000)	(0.000)	(0.001)
Kordufan	-0.534***	-0.625***	-0.319*
	(0.000)	(0.000)	(0.053)
Darfur	-0.081	-0.103	0.110
	(308)	(0.347)	(0.497)
Constant	0.962***	0.997***	0.827***
	(0.000)	(0.000)	(0.000)
Observations	7257	2230	5027
Pseudo R2	0.113	0.093	0.092
LR chi2	1589.20 (0.000)	491.25 (0.000)	767.91 (0.000)
Log likelihood	-6198.213	-2378.344	-3784.186

Note: p-values in parentheses

***p<0.001,**p<0.01,*p<0.05

Table 2A: Tobit Estimation Results for Household Education Expenditure by Income quintile

Variable	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
Income	0.030 (0.431)	-0.050 (0.224)	-0.026 (0.551)	0.007 (0.875)	0.152*** (0.001)
Household's head characteristics					
Age	0.004 (0.185)	0.005 (0.130)	0.007* (0.052)	0.004 (0.193)	0.008** (0.021)
Gender of head	0.209 (0.161)	-0.088 (0.569)	-0.230 (0.187)	-0.174 (0.322)	-0.064 (0.721)
Married	-0.140 (0.352)	-0.105 (0.502)	-0.382** (0.027)	0.070 (0.681)	0.006 (0.970)
Education level of household head (illiterate as reference)					
Primary	0.025 (0.846)	0.084 (0.420)	0.241** (0.015)	-0.046 (0.633)	0.343*** (0.001)
Secondary	-0.181 (0.476)	0.070 (0.705)	0.370** (0.013)	0.059 (0.679)	0.545*** (0.000)
University	1.107 (0.207)	1.381*** (0.005)	0.313 (0.277)	0.094 (0.623)	0.696*** (0.000)
Education level of the Spouse (illiterate as reference)					
Spouse Primary	0.244* (0.060)	0.026 (0.815)	-0.055 (0.579)	0.115 (0.235)	0.206** (0.043)
Spouse Secondary	0.904*** (0.009)	-0.101 (0.631)	0.202 (0.245)	0.330** (0.041)	0.378*** (0.003)
Spouse University	1.519*** (0.004)	0.821** (0.015)	-0.089 (0.812)	0.509** (0.017)	0.285* (0.094)
Number of children in household					
Pre-school	-0.157** (0.015)	-0.211*** (0.001)	-0.181*** (0.002)	-0.126** (0.015)	-0.153*** (0.003)
Primary school	0.109** (0.043)	-0.164*** (0.003)	0.002 (0.966)	0.007 (0.874)	-0.010 (0.799)
Secondary school	0.224*** (0.005)	0.037 (0.619)	0.158** (0.018)	0.228*** (0.000)	0.098 (0.115)
University level	0.136** (0.026)	0.006 (0.917)	0.144*** (0.008)	0.209*** (0.000)	0.209*** (0.000)
Profession of household's head (agriculture as reference)					
Service	0.201 (0.123)	0.250 (0.149)	0.455** (0.041)	0.808*** (0.006)	0.241 (0.485)
Industry	-0.991 (0.255)	-0.241 (0.801)	0.116 (0.915)	1.137 (0.320)	

Household Type of Dwelling (house as reference)					
Apartment	-0.416 (0.179)	-0.228 (0.503)			0.624*** (0.006)
Villa		-0.348 (0.283)	-0.149 (0.316)	-0.027 (0.921)	
Other Household Characteristics					
Household size	0.004 (0.925)	0.212*** (0.000)	0.107*** (0.009)	0.037 (0.279)	0.033 (0.266)
Room	0.062* (0.061)	0.005 (0.871)	-0.003 (0.916)	0.015 (0.531)	0.006 (0.774)
Electricity	0.092 (0.585)	0.228*** (0.002)	0.212** (0.018)	0.258*** (0.005)	0.542*** (0.000)
Region (Khartoum and reference)					
Northern	-1.096*** (0.005)	-0.809*** (0.000)	-0.459** (0.010)	-0.564*** (0.000)	-0.768*** (0.000)
Eastern	-0.971*** (0.009)	-0.645*** (0.001)	-0.349* (0.050)	-0.387** (0.021)	-0.614*** (0.000)
Central	-1.246*** (0.001)	-0.947*** (0.000)	-0.689*** (0.000)	-0.692*** (0.000)	-0.660*** (0.000)
Kordufan	-0.818** (0.028)	-0.625*** (0.001)	-0.521*** (0.005)	-0.599*** (0.001)	-0.714*** (0.000)
Darfur	-0.573 (0.113)	-0.299 (0.113)	0.074 (0.681)	-0.095 (0.562)	-0.090 (0.540)
Constant	1.577*** (0.001)	1.844*** (0.000)	2.080*** (0.000)	1.565*** (0.000)	1.173*** (0.001)
Observations	1419	1507	1671	1211	1440
Pseudo R2	0.110	0.087	0.079	0.066	0.103
LR chi2	155.61 (0.000)	182.7 (0.000)	214.17 (0.000)	205.94 (0.000)	402.61 (0.000)
Log likelihood	-625.912	-952.165	-1244.937	-1442.129	-1740.427

Note: p-values in parentheses

***p<0.001,**p<0.01,*p<0.05

Somalia's Education System: towards Accessibility, Inclusiveness and Quality Education

Zainab Hassan[8]

ABSTRACT

The purpose of this paper is to conduct a comprehensive review and analysis of Somalia's current education sector. It utilizes a secondary research methodology encompassing a combination of techniques to generate useful and insightful information and data. These included a review of documents either from government archives, or data collected from independent research articles from online sources. Relevant information and data was analyzed incorporating qualitative and quantitative research methods. This paper demonstrates how the nation's educational institutions have evolved through many stages beginning from the colonial era and post-colonial periods to the subsequent 25 years after state collapse, and its transformation from all public and free education to mostly a private commodity. Consequently, the educational system requires broad review, assessment and readjustment. It attempts to provide a broad overview of the sector and highlights the general state of affairs of current basic and higher education systems all across the nation. It touches on inclusiveness and accessibility of education, and the challenges facing the sector. This paper also helps open new discourse regarding future prospects, key yearly milestones, prioritized action plan, and creation of an improved educational framework and infrastructure. It concludes that reconstituting the nations' public education infrastructure and system is vital to the development of the nation, and there is sufficient room for both public and private education systems that can seamlessly function and coexist together. There is a real need for more access, inclusive and equitable high quality education for all. Key policy recommendations include: establishing comprehensive education policy framework to close existing gaps in governance, quality, relevancy and accessibility; developing educational policy with appropriate rules, regulations and management structure; enacting necessary legislation to improve inclusivity, access, equity and quality of education; constituting quality assurance and accreditation processes for existing and future private and public institutions; harmonizing and standardizing primary, secondary and higher education curriculums as part of a larger exercise in quality assurance; and developing minimum standards for teaching and learning resources and facilities such as textbooks libraries, Information technology (IT) centers, and laboratories.

Keywords: *Education Census Data; Education Sector; Education System; Somalia*

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1. Introduction

Education is a key instrument for shaping societies to achieve their optimum potential in the course of forming a great human capital. Nations develop productive citizens by providing lifetime learning opportunities which gives individuals vital skills to lead a productive life which leads to collective success. Education empowers people to play important roles in influencing the train of life and its diverse aspects. The rate of development for nations is often a reflection of their basic educational foundation which sets the stage for national success or failure (Street 2014; Swanson & Holton, 2001). Nelson Mandela's famous remark sums up the value of education to humanity as follows:

"Education is the most powerful weapon which you can use to change the world."

Somalia's education system has seen many setbacks. The nomadic heritage has always been the greatest obstacle to the creation of a modern system of education. The legacy of colonial powers is another. The British in Northern Somalia had an entirely different system of education than its fellow European colonizer, Italy in Southern Somalia. There were two different sets of curriculums in two different languages of instruction (HIPS 2013).

Following Somalia's independence, efforts were made to remedy some of the basic problems holding back the advancement of education. The military government that ruled the country from 1969–1991 instituted a compulsory education policy and adopted a centralized curriculum. A Latin-based Somali language script was instituted. The Somali language was legislated as the preeminent language of instruction for up to high school level of education. The result was a massive school enrollment, and national literacy rates rose up sharply within a short period. Public school education including university remained free of charge until the collapse of the central government in 1991 (Mohamud 2013a).

The civil war and the ensuing chaos and insecurity caused the complete collapse of public sector services including education. This has created a dangerous and irreversible gap in public education sector. Consequently, some private schools were established by daring entrepreneurs. Other schools were built and run by faith-based denominations often espousing religious and/or political agenda. Most of these institutions are rudimentary and are haphazardly organized. Many others have been very expensive for average families to afford them. Somalia's education system falls under four categories: Government, Non-Governmental Organizations (NGOs), Community-run, and Private schools, namely Umbrella Organizations (Umbrellas).

2. Overview of Education

Historically, the quest for Somalia's literacy and educational development were generally defined by four major landmarks. First, the teaching of the Qur'an set root widely across the nation long before the colonial occupation of Somalia (Cassanelli & Farah 2007). Second, the introduction of a universal formal education system was established after independence, and it has been a priority for Somali governments. Shortly after independence, many popular nationalist songs were created

and composed depicting the perception of what education could do for the individual and for society. One of those songs is by the late Somali poet, Abdullahi Qarshe, with verses like *"Aqoon la'aani waa iftiin la'aane* – Lack of knowledge is lack of enlightenment" (Abdi 1998). However, formal education expanded during the first ten years of the military regime of 1969-1990 with the compulsory education law of 1970.

Third, the Somali language was written in 1972, and the military regime declared the expansion of public education. Fourth, the national Somali language literacy campaign of 1974-1975 with the catchy recruiting slogan of "Bar ama Baro – Teach if you know, Learn if you don't" focusing on the art writing and reading the new Somali language script (Mohamud 2013b). The literacy campaign galvanized the participation of citizens, utilizing school teachers, students, administrators, and other public servants to staff the project. This seven month literacy campaign started in urban areas and transitioned to rural, agriaran, and nomadic areas. Many literacy centers were established throughout the county and were operated by middle and high school students supervised by their teachers. Adult education programs were implemented across the nation using the new script; thus, this period marks the highest peak of Somali literacy at 65% success rate (Mohamud 2013b).

These Government sponsored initiatives and publicly supported campaigns significantly improved access to basic education for both male and female students countrywide at a higher pace. As a result, enrollment rates increased in the first two and half decades after the Somali independence in 1960 (Mohamud 2013a).

As Table 1 indicates, formal education enrollment in Somalia started to decline in the 1980s, and continued to decline during the first decade and half of the state failure, and picked up again. Maintaining military needs absorbed most of the dictatorship government expenditure, and as a result, the availability of funds to the education sector was very limited. Factually, "Only 1.5% to 2% of the national budget was set aside for the education sector in the late 1980s." (Bennaars, Seif & Mwangi 1996).

Table 1. Enrollment Figures 1960-1980

Level	1960	1965	1970	1975	1980
Elementary	16,300	23,300	26,000	197,700	131,000
Intermediate	2,800	5,600	14,800	21,800	140,00
Secondary	800	1,900	5,200	7,000	24,400

Source: (UNDP, 1981)

2.1 Basic Education

The Somali education sector is among the few sectors of the Somali economy that continues to serve the public after the Somali civil war. This was largely made possible by a number of courageous former university faculty members, school teachers, and business owners who took it upon themselves to take up the task. Parents also played greater roles in helping to restore and maintain a semblance of a functioning education system during the absence of a national government.

Since the collapse of the central government and educational institutions, most of the primary and secondary schools have been run by private entities that formed Education Umbrellas, especially in Federal Member States of Jubaland, South West, and Galmudug (FMS) as well as Banadir Administration. Currently, most of primary, secondary, and post-secondary education institutions are owned and operated by education umbrellas. Approximately, 80% of schools and 96% of higher education institutions in the above mentioned States are owned by Umbrellas, followed by NGOs, self-organized community groups including the diaspora, and government (Ministry of Education 2013).

Out of 270 primary schools in Banadir region, 79% is administered by umbrellas, followed by 12% NGOs, 8% Community, and 1% Government (FGS Ministry of Education 2013). However, it is important to note that 77% of known primary and secondary schools in Banadir reported their statistics (MoE 2013). The government reopened the first public schools in 2013, and currently provides about 1% of the basic education services.

The total number of school age children in primary schools in Somalia is estimated to be 3.7 million. Of those, nearly 1.4 million children attend primary education (Dalel & Sabul 2016). Student enrollment is relatively higher in regions with more peace and stable security environment. Thus, Gross Enrollment Rates (GER) in primary education is at 56% in the North-East Somalia (Puntland State) compared to 37% in other FMS and regions in south and central area (Ministry of Planning 2015). In addition, the GER for the North-West (Somaliland) is at 45% (Somaliland Ministry of Education 2014). Thus, areas with functioning public administrations with relative peace and stability tend to produce more service delivery and student enrollment rates are higher. However, overall nationwide enrollment growth rates are still very low.

Table 2. Education System Basic Indicators for Banadir and Puntland

Indicators	Banadir	Puntland
Gross Enrollment Rate	36.3%	55.6%
Gross Enrollment Secondary	9.5%	12.6%
Qualified Primary School Teachers	18.3%	62.1%
Qualified Secondary School Teachers	20%	22%
Primary School Teacher/Pupil Ratio	19.9%	33%
Total Enrollment/Primary, ABE, NFE, Secondary, TVET, & HE	102,957	180,115

Source: Dalel & Sabul 2016

Due to high level of dropout, secondary enrollment rate is much lower than primary. Enrollment numbers go down as students move up in the ladder of grade levels. This is even more pronounced for female students.

2.2 Post-Secondary Education

Before the state collapse in1991, the Somali National University (SNU) was the only higher education institution in the whole country. SNU was composed of 13 faculties with 15, 672 registered students and around 700 academics, administrative and service staff (Jimale, 2014). SNU

offered two and four year programs leading to the bachelor's degree. A graduate school that was to offer post-graduate courses was established right before the collapse of the Government.

In 2014, the Shabelle campus of the SNU was reopened with 6 faculties and 375 student cohort. This current school year of 2016-2017, SNU added a new faculty of Engineering and enrolled 700 new students. Its current total student enrollment is 1,408. Realizing the absence of the role of government to invest in education, the Somali private sector rushed to fill the gap and created privately owned higher education institutions. This trend has been in effect during the last two decades or so. These Higher Education Institutions (HEIs) are mostly owned and operated by private entities. These institutions come in varying sizes and levels of development, language of instruction, capacity, quality and educational output. Many of these universities are upstarts while others are well established. A few of them have well-equipped libraries and science laboratories, and many of them claim accreditation from local, regional or international educational associations.

Orientation Day for New Students
Photo:Courtesy of Somali National University

Data is often inconsistent regarding the number of HEIs in the country. Different estimates suggest somewhere between 63 and 81 HEIs with the majority in south and central Federal Member States (FMS). As of 2014, Universities in these States alone are about 52, with the highest concentration in the Banadir region and their numbers growing every year, followed by Somaliland and Puntland. Enrollments of HEIs range between 73 and 6,476 students nationally. Furthermore, approximately 40,000 students are estimated to be currently enrolled in all HEIs (Hassan & Riechi 2015a). Post-graduate programs are currently offered by 6 universities in the south and central FMS and regions. The total number of students that graduate annually is estimated to be about 3,000 including post graduates.

Growth patterns across all FMS, regional administrations and Somaliland have been remarkable in the last two decades considering only one university existed in the country before the collapse of the state in 1991. Two factors could be responsible for this finding. First, this pattern could possibly be related to the significant growth of the higher education sector in the last two decades experienced by sub-Saharan Africa (HIPS 2013; Varghese 2007). Second, the weak central government in Somalia and the lack of capacity of regional states has consequently caused the privatization of social services including education (Bradbury 2007; HIPS 2013). As a result, the rapid growth in the private sector of the higher education may have changed the prospect of higher education from a public good to a tradable product. Therefore, it might have encouraged more private actors into the higher education market.

Higher education plays a crucial role in national development and its investment is a key to supporting job creation, innovations and economic growth. Currently, net enrollment at HEIs is much higher than SNU before the civil war. However, quality and equitable access to these private institutions poses the greatest challenge in the overall education system. These include lack of capacity to keep up with increasing demand for expansion, acquisition of vital skill sets and modernization.

Table 3: Private HEI Enrollment Sample by Gender 2013/2014

Name of Institution	Male	Female	Total
Banadir University	1967	676	2,643
SIMAD University	3,092	932	4,024
Mogadishu University	4,412	2,064	6,476
Horseed International University	1,402	616	2,018
Indian Ocean University	336	135	473
Hamar University	47	371	418
Jazeera University	960	794	1,754
Kismayo University	668	79	747
Galkayo University	537	138	675
Jamhuriya Univ. of Science & Technology	910	202	1,112
Horizon International Univ., Mogadishu	539	448	987
University of Southern Somalia, Baidoa	186	64	250
GRAND TOTAL	**10,646**	**3,883**	**21,577**

Source: HASSAN 2014

2. Inclusiveness and Accessibility

Somalia continues to face the uphill battle of reviving its public education institutions including institutes for higher learning. Somalia today is at the bottom of international literacy, education and human development indices, resulting from more than two decades of civil unrest, lacking cohesive national education authority to mandate, and regulate public and private education. Therefore, the Somali government has a long way to go on providing inclusive, accessible, equitable quality education system. Inclusiveness and accessibility could be judged on how much access does the population has to public education regardless of their geographic area, gender and socio-economic status.

First, education facilities are mainly concentrated in urban areas which limit the accessibility of education to rural and nomadic populations. According to the Somali Population Estimation Survey 2014, approximately 23% of the population lives in rural areas while 26% are nomadic/pastoral nomads. These communities have very limited opportunities to enroll their children in schools.

Second, though gender is cross-cutting issues in the Somali Peace and State-building goals (PSG) of the Federal Government of Somalia (FGS), and it is integral part of the Somalia National Development Plan's education chapter, gender gap is another issue that impacts inclusiveness and accessibility. Many education studies reveal gender disparities has been existent in allover the education sector in the classroom, and it is even more pronounced in the faculties and

administration positions in public and private primary and secondary schools as well as higher education institutions.

In primary education, the Enrollment Rates in Puntland is at 56% of which 32% are girls while enrollment in the South and Central zone is 37% in which 39% are boys and 33% girls. In Somaliland, the 2011 National Development Plan indicates there were 36% females enrolled in primary school.

Table 4: Primary School Average Pupils in Banadir Region by Grade & Gender 2012/13

Grade	Total	Male	Female
P1	11,932	6,420	5,512
P2	8,890	4,789	4,101
P3	8,158	4,457	3,701
P4	7,549	4,230	3,319
P5	5,634	3,104	2,530
P6	6,038	3,520	2,518
P7	5,059	3,039	2,020
P8	5,668	3,295	2,373
Total	58,928	32,854	26,074

Source: Federal Government of Somalia, Ministry of Education, 2015

Comparing 2012/13 school year's average primary school enrollment in Banadir region by gender, male average pupils exceeds female pupils in all the classes. Assuming that enrollment rates are approximately the same and comparing 1st grade enrollment to 8th graders, the data demonstrates that approximately 43% of boys and 53% of girls drop out of school. Many factors contribute to high drop-out rates for girls, especially in more vulnerable groups such as nomadic communities and IDPs, including youth pregnancy, early/forced marriages, families unable to afford school fees and other expenses related to education, need for household chores, and income generating activities such as agriculture, cattle rearing or domestic work.

The gender gap limits access and inclusivity in education, and inhibits progress for females to compete in the professional workplace and overall economy. Though the FGS is in the process of adopting a policy for enhancing higher education equity to overcome gender related challenges in the sector, its milestone is at 30% which is significantly low.

Third, the private education system is mainly responsible for unequal access to education resulting in wide disparities between upper/middle income and low income communities. Since about 80% of schools and 96% of higher education institutions are privately owned and require school fee payment, most Somali families are unable to pay $10 per month for each child in primary and secondary schools.

In the higher education sector, SNU being the only publicly-funded institution, only few students from low-income families can be admitted. Subsequently, it is those learners who can afford to pay fees that are admitted in the many private HEIs. Based on faculty of study and the perceived prestige of universities, tuition fees vary as there are no standard admission procedures. For instance, Medicine is the most expensive costing close to $2,000 per year, followed by Engineering which costs about $1,000 per year while Computer Science costs about $500 per year, and Education is

offered for free due to the need for teachers and low demand for students (Hassan & Riechi 2015b). The current scenario, therefore, leaves huge challenges of equity and access in the higher education sub-sector.

People living in rural areas, nomads and pastoral nomad communities as well as 9% of the Internally Displaced Populations (IDPs) are highly unlikely to pay school fees for their children. Thus, the private education system excludes the poorest families who cannot afford to pay the levies and educational materials for their children. Subsequently, it is those learners who can afford to pay fees that are admitted in the many private institutions. The current scenario, therefore, leaves huge challenges of inclusivity, equity and access in all levels of the education sector.

3. Education Sector Challenges

Prior to the civil war, most education infrastructure was mainly concentrated in the capital city, and few urban areas. The civil war created a significant gap for the education sector. The current Federal Government of Somalia (FGS) is constitutionally mandated with a four-year term in 2012, but has little capacity in improving as well as establishing a comprehensive regulatory framework and oversight.

A number of key crosscutting issues affect education sector in Somalia including institutional issues that affect quality, access and equity. Among those challenges are: Limited learning infrastructure (overcrowded classrooms, sanitation, furniture, shortage of instructional material). Currently, over 50% of government owned existing schools and buildings are damaged or unsafe for use. Of the other half, most of these schools and building are occupied by private schools, universities and administrations which also limits public educational facilities and administrations that could be used to tuition free education.

Lack of qualified teachers, lecturers and administrators and limited educational resources are among the other challenges in the provision of education. These weak education institutions, especially poor quality primary, secondary and post-secondary education are ill prepared for employment. In Addition, the privately run education systems lack centralized curriculum and utilize different foreign curricula and syllabuses, and levy tuition which limits the access to primary, secondary and tertiary education. In addition, it lacks assessment and standardized systems of teaching and learning.

Another major widespread challenge for the education sector is inadequate financial funding from external donor and national and local government. The Federal Government of Somalia allocated 4.2% of its budget to education in 2014 for the first time in almost quarter of a century.

Jubaland, South West, Galmudug states, Banadir Regional Administration, and Hiiraan and Middle Shabelle regions (current Hirshabelle State) in the south and central part of Somalia experienced reduction of funds in the last three years. Donors allocation is estimated to be $25.8 million for south and central regions in 2016 down from $31.1 million in 2015. Likewise, public expenditure on education has been reduced to 3% from 4.2% covering the same zone (Dalel & Sabul 2016). However, in Somaliland the share of budget allocated to the Ministry of Education increased from

7.9% in 2011 to 12% in 2013. Likewise, Puntland's Ministry of Education expenditure remained stable at 3.9% up to 2013, and was recently increased to 8.1% by the cabinet. Financial resources have serious repercussions on the development of education sector.

Lack of regulatory framework caused by weak government institutions, exacerbated by poor capacity and shortage of qualified teachers, academics and teaching staff led to rampant low quality education. In addition, a lack of professional training and development for teachers, inadequate teaching materials, lack of education ethics and lack of research and publications also derailed the sector (Jackson & Aynte 2013).

Limited institutional capacity and systems at the federal and state Ministries of Education including policies, procedures and the necessary legal framework has contributed to the sprouting of private universities in the recent years. Currently, there are no legal and regulatory frameworks for higher education sub-sector in place. However, it was notable that SNU is currently operating under the legal framework of previous governments before the Somali civil war started. These include the 1962 Presidential Declaration, and 1969 Legislative and Administrative Acts (Jimale 2014). There is need to update these legal frameworks so as to strengthen this national higher education institution.

Finally, insecurity due to Al-Shabaab threats and the war against them has forced some schools and universities, especially in south and central regions to abandon their facilities. For instance, most of the existing private universities in Banadir utilize rented properties in areas considered more secure that are not designed as university campuses to meet the needs and demands of their students. As a result, the affected institutions incurred extra expenses and delayed implementation of planned educational programs and activities.

4. Prospects of the Education System

Significant strides have been made toward strengthening governance and management as well as improving access to inclusive education services. Some of the key achievements include:

- Centralized form four secondary school examinations administered for 3,500 students in 2015 and coverage increased to 20,000 students in 2016. Examinations have been successfully administered in Galmudug, Jubaland, Middle Shabelle, Hiiraan, and South-west administration for the first time in over two decades.
- Progress towards national primary examinations in south and central regions has been made in 2016.
- Completion of National Curriculum framework.
- Framework of engagement between Federal and state level moves under development.
- 10 new model schools funded by the European Union under construction.

- Education pledging conference being organized in Kuwait.
- Regulatory framework (Basic and Higher Education Bill) draft completed and waiting to be presented at the cabinet of ministers and consultation forum preparations initiated.
- The sector is involved in drafting the National Development Plan's education chapter.
- Education Management Information System (EMIS) statistics yearbook for Banadir region developed for the first time, and in process of covering all south and central regions.
- Adopted since 2012, sector-wide donor supported programs of the education sector have been integrated in alignment with existing plans.

4.1 Education System Milestones for 2016

- New 150, 000 children enrolled (30% girls), towards this, 30 new schools and 200 new classrooms will be constructed.
- Inclusion of teacher salaries in the WB's RCRF project.
- 7,500 teachers to be trained.
- Standardized national curriculum and examinations.
- Establish & support 8 TVET centers
- Key legislation on basic and higher education passed.
- Capacity building of MoECHE.
- Share of government expenditure in the education sector increased from 4.2% to 10%.

4.2 Key Priorities and Recommendations

- Establishing comprehensive education policy framework to close existing gaps in governance, quality, relevancy and accessibility;
- Develop educational policy with appropriate rules, regulations and management structure;
- Enact necessary legislation to improve inclusivity, access, equity and quality of education;
- Constitute quality assurance and accreditation processes for existing and future private and public institutions;

- Harmonize and standardize primary, secondary and higher education curriculums as part of a larger exercise in quality assurance;
- Develop minimum standards for teaching and learning resources and facilities such as textbooks libraries, Information Technology (IT) centers, laboratories etc.
- Rehabilitate and construct where necessary of the buildings of the former public schools and Somali National University;
- Prepare academic and administrative human resources management policy and introduce continuous professional development for educators;
- Expand equitable access to quality education and training;
- Increase enrollment rates, especially female students in all education levels;
- Mitigate student dropout, especially for females;
- Create employment opportunities for youth to reduce unemployment rates.
- Provide scholarships for low income pupils;
- Increase teacher salary to attract more student candidates;
- Increase progressively the public spending over the next 3 years (NDP timeframe);
- Develop Policy framework for sustainable, competitive and autonomous national education system and involve all state level education sector (National Education Act, Public Private Partnership, policies etc.);
- Invest in and develop national capacity for research and innovation

5. Concluding Remarks

The Somali Population Estimation Survey reveals that the Somali population inside the country is 12.3 million. More than 70% of these are under the age of 30 years.

Youth unemployment stands at about 61%. These numbers clearly demonstrate the need for education and marketable skills which demand more schools, colleges, universities, and Technical Vocational Education and Training (TVET) centers in order to meet Somalia's social and economic needs for highly educated and skilled population.

Somalia as a nation needs to re-emphasize the importance of education in the overall national well-being through legislations enacted by the Federal Parliament, and adopted by Federal Member States and Regional Adminstration. In addition, the role of the Somali as the national language for instruction and public service should be reemphasized to boost national literacy rates that fell from

65% at the end of the literacy campaign in 1974-1975 to currently 28%-34% for females and males respectively.

Challenges facing the Somali education system in post-civil war Somalia are too many and too overwhelming as a result of the vacuum created by the absence of sound public education and the proliferation of unregulated and loosely organized educational programs. Even though the quantity and variety of education services available has mushroomed, the quality of education and relevancy to the lives of the people and society as a whole did not vastly improve Somalia's overall standing. Current Education programs seem to suffer from lack of qualified faculty, substandard curriculum and inadequate educational resources and infrastructure to support quality education programs. There has been significant growth in education, especially in the private sector throughout Somalia. Although there are many positive aspects to this rapid growth given the initial conditions and recent history of the country, it raises serious concerns about the inclusiveness, accessibility, relevance, and quality of education provided. This concern warrants an urgent intervention given the magnitude of challenges facing both basic education and higher education institutions, coupled with the limited involvement and oversight of governing authorities.

Limited financial resources is requiring immediate action and commitments from all stakeholders, and rising enrollments in private HEIs where majority of students pursue studies in computer-related, business administration and social sciences is quite a challenge for the education sector. This raises great concerns over the placement of these high numbers of graduates, and relevance of courses being offered to the needs of the economy and overall national development.

Although most universities offer free education for teachers, enrollment is one of the lowest compared to other fields because teachers are paid poorly. It is impossible to improve the quality of education and increase enrollment without trained teachers, administrators and university lecturers.

There is sufficient room for both public and private education institution to operate in harmony and coexist in compliance with overall standards such as established policies, regulations, and oversight. However, improving accessibility and the quality of education, and adopting a policy for enhancing education equity to overcome gender gap in the sector is crucial.

Meeting the needs of the society through expanding education to vulnerable populations including people with disabilities, people living in poverty, such as rural populations, nomads and IDPs, will enhance the educated class of the society, and is essential for lifelong learning and the development of the country. Lastly, globalization calls for a world class education system, so Somali children and young adults would be able to compete with their peers around the world.

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Part Two: Agricultural Productivity and Growth

Sources of Agricultural Output Growth and Impact of Public Expenditure on Agricultural Total Factor Productivity

Fadia K. HASSAN[9] and Abdel M. IBRAHIM[10]

ABSTRACT

As a result of the secession of south Sudan in 2011, Sudan lost around 75% of its productive oil fields and its main source of export income. The diminishing oil revenues brought agriculture back as the main source of growth, employment creation and poverty reduction. However due to government dependence on mono-cultural economy based on oil, growth of agricultural output decelerated to negative rates in recent years. Reversing this trend requires knowledge of what drives agricultural growth and productivity. This paper is an attempt to investigate sources of agricultural GDP growth in the time period 1984-2012. Also, because of the dominant role of total factor productivity on economic growth recognized in the literature the paper explores the extent to which government expenditure in agriculture contributed to agricultural productivity growth. The Growth Accounting Method is used to identify the sources of growth, and the OLS regression is used to assess the impact of government expenditure. Preliminary statistical analysis found that the share of public spending in agriculture was exceedingly low (0.2%) which contrasted dramatically with the sector's importance in the economy. The Growth accounting decomposition revealed that between 1984 and 2012, capital was the most important source of growth and accounted for around 54 percent of agriculture's GDP growth. Also, the GDP growth of 5.4 percent was much lower than that of capital growth of 8.4 percent implying decreasing returns to capital. Most importantly the study established that TFP growth was either negative or very low averaging just 1.4 percent and accounted for 26 percent. The regression results revealed that 86% of the variation in agricultural TFP was explained by direct and indirect government expenditure. Not surprisingly the misplaced direct government expenditure in agriculture exerted a negative effect on agricultural productivity growth (an elasticity of -0.57). On the other hand public expenditure on other related non-agricultural factors produced a positive elasticity of 0.56. The main recommendation of this paper is that to achieve the alleged policy of achieving accelerated growth of agricultural output and diversification of the economy the government has to allocate much more resources into the sector taking into consideration the inter-linkages between the agriculture and the other sectors.

Keywords: *Agricultural expenditure, Non-agricultural expenditure, Agricultural TFP, Capital Accumulation, TFP Growth.*

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1. Introduction

In the advent of oil, the structure of the Sudan economy has shifted over time, from predominantly reliant on agriculture for growth and exports, to reliance on the oil sector. However, as a result of the secession of south Sudan in 2011, Sudan has lost around 75 percent of its productive oil fields and its main source of export income. The value of oil exports dropped from about 10 billion US$ in 2010, the year before secession, to about 4 billon US$ by the end of 2013. The diminishing oil revenues brought agriculture back to the growth agenda. As noted in the "Interim Poverty Reduction Strategy Report", after two decades of neglect, agriculture, including livestock, forestry and fisheries is back in on Sudan's growth agenda. The fourth pillar in the strategy pin-pointed agriculture is to be one of the main sources of growth, employment creation and poverty reduction.

In the previous decades, Sudan followed different agricultural development strategies. The dominant paradigms, common to most Africa ranged from: Food-Self-Sufficiency; Food-First; Structural Adjustment 1 (SAP1: demand management); Structural Adjustment 2 (SAP2: equity with growth); and Sustainable Development However as (Delgado 1995: 4) noted "the basic design and mode of implementation of all these paradigms came from outside Africa. It is hard to think of other significant regions of the world in modern times where outside influences on basic development strategy issues have been so pervasive". May be this is why there is little evidence of an agreed vision incorporated into strategic thinking of the best way to deal with the challenges that face the agricultural sector in Sudan. Because: The sector that employs most people in the economy has the highest incidence of poverty, 61.9 percent against 37.4 percent in the non-agricultural sector (Central Bureau of Statistics 2009). It is also the sector that employs most people without education. Almost two in three workers in this sector have no education. Workers in the agricultural sector have low productivity and earn low wages, compared to workers in services who have low productivity and earn high wages (World Bank 2015). The productivity of Sudanese agricultural and pastoral production is typically less than 35 percent of productivity achieved in on-farm trials (Ministry of Foreign Trade 2009).

Reversing the decelerating trend in agriculture is no doubt an immediate development challenge for Sudan. Evidence from empirical growth literature on developed countries' experience at the early stages of their development illustrated the dominant role of TFP (technological progress or intangible capital) on economic growth relative to that of physical capital accumulation. Contributions of TFP to income per capita and real labor productivity were found to be 90 percent and 80 percent on average respectively (Kusnets 1971:cited in Hayami & Godo 2005) and contributions of investment in intangible capital (TFP), such as education and research, made contributions to economic growth two to three times larger than accumulations of tangible capital. Such results urged a shift in development paradigm where it was advocated that poor economies with low saving capacities instead of merely trying to increase their stock of tangible capital to accelerate their rates of growth, could borrow foreign technology and invest in intangible capital such as education, research and development (Hayami et al, 2005). The literature stressed that technical change was a superior strategy compared to either extensive farming or intensive agriculture as it unlike the other two options, increased production at reduced unit-cost/prices in real terms. Moreover it has been advocated that in view of the lack of structural transformation of

the Sudan economy and its dual nature up till now, one of the main drivers of growth of the economy has to be the rate of growth of the agricultural sector (Ali 2006).

TFP being a measure of the net growth of output per unit of total inputs its level is determined by how efficiently and intensely the inputs are utilized in production. Therefore the analysis of the sources and determinants of productivity has been studied intensively during the last decades. The consensus reached by research in this area is the importance of government expenditure as a determinant of agricultural total factor productivity growth especially government investments in agricultural research, education, extension, and infrastructure like rural roads, regulated markets, credit supply to agricultural household, etc.

This paper explores the sources of agricultural output growth and the impact of government expenditure in agriculture and non-agriculture on its productivity in Sudan for the period 1984-2015. The 'Growth Accounting' approach is used to identify the sources of growth, while econometric techniques are used to assess the impact of agricultural and agricultural related non-agricultural public spending on agriculture's total factor productivity growth. The results established that capital accumulation has been the main driver of real agricultural GDP growth and accounted for 47 percent of the total growth. Furthermore, direct public expenditure in agricultural had a detrimental effect on agricultural factor productivity growth. On the other hand indirect public spending in agricultural-related tangible and intangible capital exerted a positive effect on factor productivity growth.

This paper is about the role public spending can play to reverse the adverse trends in agricultural growth and productivity. It explores the sources of agricultural output growth and the impact of government expenditure in agriculture and non-agriculture on its productivity in Sudan for the period 1984-2015. The 'Growth Accounting' approach is used to identify the sources of growth, while econometric techniques are used to assess the impact of agricultural and agricultural related non-agricultural public spending on agriculture's total factor productivity growth. The results established that capital accumulation has been the main driver of real agricultural GDP growth and accounted for 47 percent of the total growth. Furthermore, direct public expenditure in agricultural had a detrimental effect on agricultural factor productivity growth. On the other hand indirect public spending in agricultural-related tangible and intangible capital such as roads, electricity, health and education exerted a positive effect on factor productivity growth.

The rest of this paper is organized as follows: Section 2 reviews the literature on government expenditure and productivity. Section 3 looks briefly at the patterns and trends of aggregate public spending, development spending and spending in agriculture. The conceptual framework and model are outlined in Section 4. Section 5 presents and discusses the empirical results and section 6 concludes.

2. Trends and Composition of Public Agricultural and Non- Agricultural Expenditure

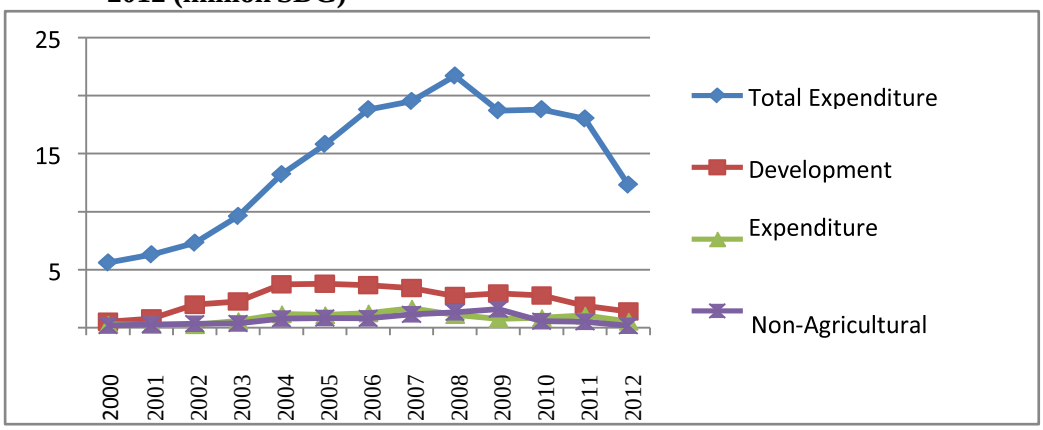
This section examines the trends of public expenditure in agriculture and the structure of this

expenditure in Sudan. The lack of economic data with good quality is a well-known problem in developing countries and it is particularly true for public expenditure data. In our case disaggregated consistent time series data on government spending in agriculture and relevant non-agriculture categories is available only for the 2000-2012 period. Therefore the detailed analysis of the trends and composition of government spending in agriculture and some of non-agriculture categories will be limited to this period.

2.1 Evolution and Composition of Government Spending in Agriculture

A typical phenomenon common among oil exporter third world countries is the surge in government expenditure accompanying natural resource booms. Thus the observed rapid increase in expenditure up to 2008 started to decline. A further examination of figure (1) shows that the striking drop in real Government expenditure and its components started in 2011, the year that marked South Sudan's secession and drop in oil revenue. Between 2011 and 2012 total expenditure dropped by around 32%, development expenditure by about 26% and agricultural expenditure by 50%. Although the drop in source like oil is expected to negatively impact the whole economy, yet we see from the figure that even during the golden era of oil exports expenditure in development in general, and agriculture and agriculture related components was very low.

Figure (1): Evolution of Real Government Expenditure and its Broad Component, 2000-2012 (million SDG)



Source: Ministry of Finance and National Economy of Sudan
Note: The year 2000 marks Sudan's large scale exporting of oil.

The Government financial statistics show that the share of public resources allocated to the agricultural sector in the government total budget experienced large fluctuations and ranged between 3.2 to 8.8 percent during 2000-2012 (table A.3). It averaged about 3.9 percent during the years 2000 to 2002, and then the 2003-2007 period saw improvements in the budget allocation towards the agricultural sector that averaged 7.4 percent before it dropped again to 4.8 percent on average during 2008- 2012. For the whole decade the share has been less than the 10 percent requirement under the Moboto Declaration[11]. Thus despite its important contribution in the economy clearly there is low budget support to agriculture in Sudan compared to that of many

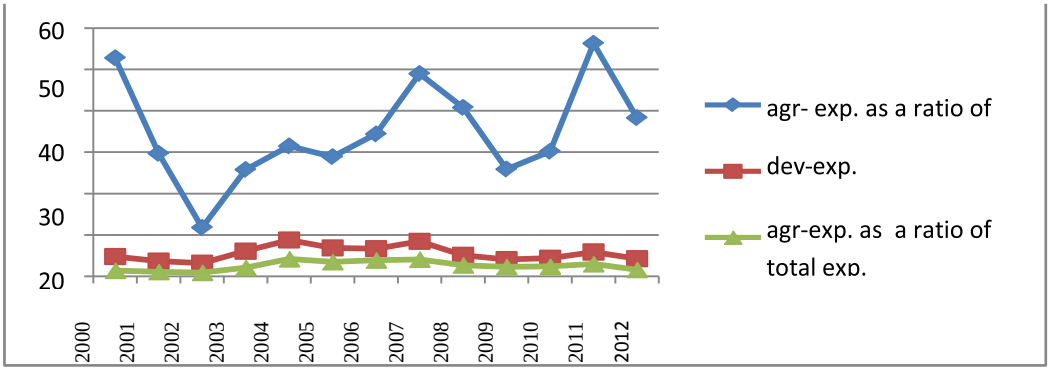
[11] For more about the Moboto Declaration see (Fan, Johnson, Saurkar & Makombe 2009).

other African countries and much lower than budgetary allocations in Asian countries which was as high as 15 percent during the green revolution era.

An alternative measure which assesses the adequacy of budget allocation to the agriculture sector is the ratio of agricultural expenditure to agricultural GDP. The measure also saw large variations across the period. Between 2000 and 2003, the ratio stagnated around 1 to 1.3 percent, then more than doubled to average 2.8 percent during 2004-2008, and it peaked 4.7 percent in 2009 before dipping to as low as 0.5 percent in 2012. With an average of 2.1 percent, Sudan lags far behind averages for other developing regions. For example in Africa the ratio of agricultural expenditure to agricultural GDP was between 5 to 7 percent while for Asia it ranged between 8 to 10 percent.

Examining the structure of spending on agriculture shows that it constitutes two main categories, current expenditure and development expenditure. One can see from Figure (2) that the bulk of expenditure in agriculture went to the development category. Development expenditure accounted for an average 85.9 percent of total agricultural expenditure during 2000-2012, and the rest 14.1 percent went to current expenditure. This distribution can be explained by the government's investment in the construction of new dams and the rehabilitation of old ones since the late nineties. However, although expenditure on irrigation infrastructure is an important prerequisite for agricultural growth, concentrating expenditures on improving part of the production chain to the neglect of others will not achieve the desired outcome of promoting agricultural production. Unless expenditures in the different components that constitute agricultural production are allocated simultaneously, the performance of agriculture will remain poor. Thus to state just one example, when regular agricultural surveys that help to facilitate diagnostic analysis of the agriculture sector's performance and assist in the design of informative policy making and effective government interventions, the sector has not seen one for almost two decades now. As noted by Govereh (2009:41), "Investment expenditure needs sequencing and joint implementation. If roads are built first and R&D later, the rate of return for each investment will change if the sequence changes. ……, the time order of agricultural investment is important and decisions have to be made on what investment will be implemented first".

Figure (2): Real Agricultural Expenditure as a Ratio of Real Agricultural GDP, Real Total Expenditure, and Real Development Expenditure



Source: Ministry of Finance and National Economy of Sudan

A more indicative measure that can be used to better see the position of the agricultural sector in the government's budget allocation is the ratio of agricultural expenditure's share in total

expenditure to the agricultural GDP share in total GDP. A ratio of unity indicates that the government allocated its budget consistent with the contribution of agriculture to the country's economy (Mogues & Morris 2008), and a ratio smaller than unity shows that the agricultural sector did not receive the public funds consistent with its role in the economy. As table (1) indicates this ratio at most reached 0.34 in 2008 and averaged just 0.19 during 2000-2012. What this reveals is that public resources allocated to the agricultural sector were on average about two-tenth of its contribution to the economy. No doubt that the agricultural sector has not been able to play its role in the growth and transformation of the economy.

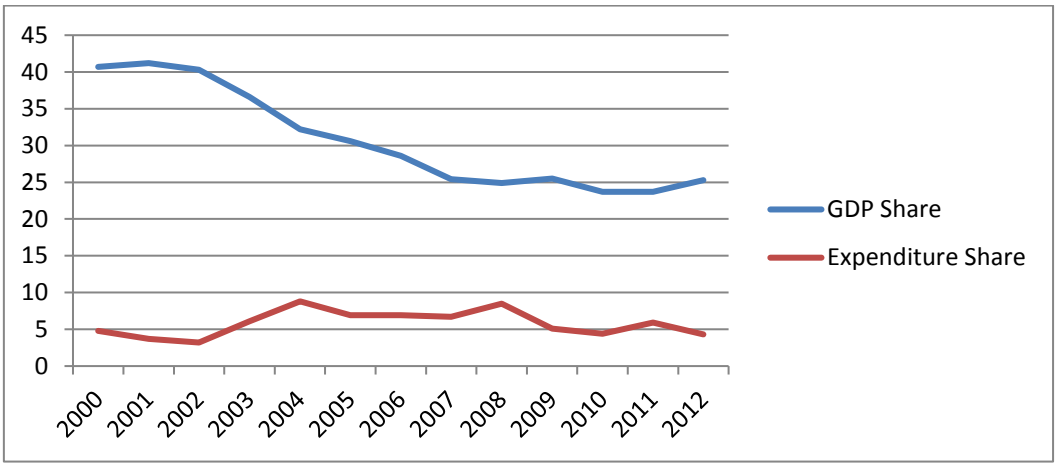
Table (1): Ratio of Agricultural GDP to Total GDP and Ratio of Agricultural Expenditure to Total Expenditure

year	AgrGDP (m SDG)	GDP (m SDG)	AgrGDP/GDP (a)	TExp (m SDG)	AgrExp (m SDG)	Agr- Exp/TExp (b)	(b) / (a)
2000	12,821.5	31,516.3	40.7	3521.6	170.0	4.8	0.12
2001	14,066.4	34,104.4	41.2	4185.4	155.0	3.7	0.09
2002	15,691.7	38,978.3	40.3	5181.7	165.6	3.2	0.08
2003	16,863.6	46,053.9	36.6	7361.0	446.8	6.1	0.17
2004	17,825.9	55,340.9	32.2	11037.3	976.7	8.8	0.27
2005	19,771.9	64,616.4	30.6	14333.5	986.8	6.9	0.23
2006	21,872.9	76,349.5	28.6	18239.1	1216.4	6.9	0.24
2007	23,297.4	91,644.8	25.4	20444.4	1746.5	6.7	0.26
2008	27,932.1	112,177.1	24.9	25985.6	1329.0	8.5	0.34
2009	30,867.8	121,166.2	25.5	24941.1	1013.0	5.1	0.20
2010	35,408.9	149,414.6	23.7	28324.0	1258.6	4.4	0.19
2011	40,455.8	170,806.7	23.7	31911.7	1877.8	5.9	0.25
2012	23,072.9	209,978.0	25.3	29609.0	1279.7	4.3	0.17
Average			**30.7**			**5.6**	**0.19**

Source: Ministry of Finance and National Economy of Sudan

Figure (3) shows the evolution of the share of agriculture spending in total spending and the share of agricultural in GDP. It further illustrates that the two magnitudes followed different trends. For most of the years when the share of agriculture in GDP dropped that of agricultural expenditure in total spending either stagnated or dropped. Since the 2000-2011 time period marks the oil dependency era for Sudan, the figure clearly shows that oil revenue did not facilitate growth and diversification of the agricultural sector causing the economy to transform from agriculture to the services sector. It is clear that during this time period the agricultural sector suffered from the consequence of the 'Dutch Disease' as resources were siphoned away to the oil sector as well as to more lucrative enterprises such as investment in resturants and imports of luxury food items.

Figure (3):hare of Agriculture in Total Expenditure and Share of Agriculture in GDP, 2000-2012



Source: Ministry of Finance and National Economy of Sudan

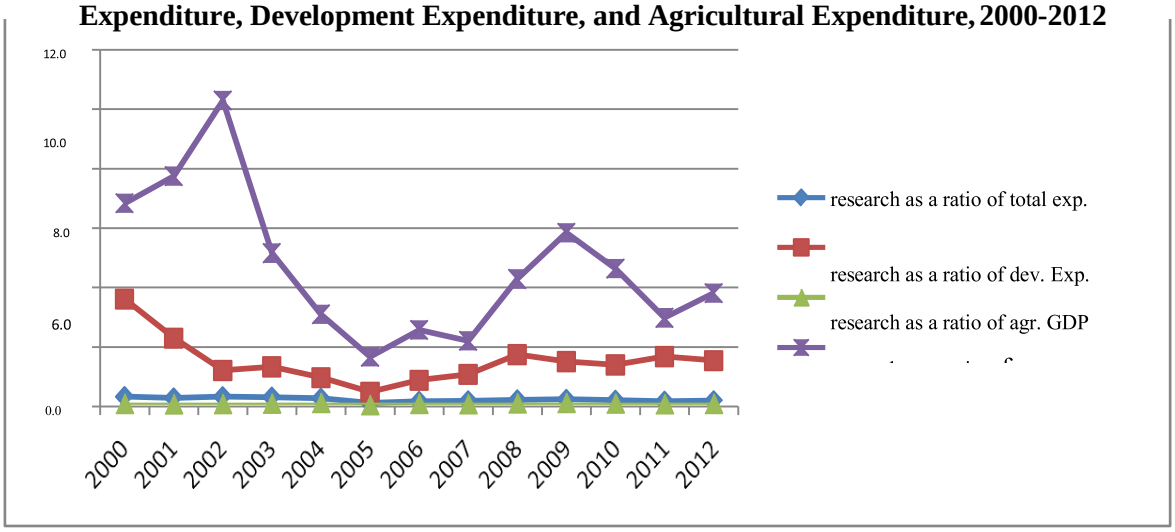
2.2 Intensity and Composition of Government Spending in Research

We now turn our attention to discussing the composition of public expenditure on agricultural research. The importance of expenditure on research for agriculture GDP growth, especially for developing countries, have been emphasized in the relevant literature (see for example Bachewe 2012; Saikia 2009; Kumar, Mittal & Hossain 2008, Avila & Evenson 2004; Coelli & Prasada 2003; Desai & Namboodiri 1997; Evenson, Pray & Rosegrant 1999; Rosegrant & Evenson 1995 among others). Examining Figure (3) we observe great variability and a declining trend in the ratio of expenditure in research to total expenditure in agriculture. It dropped from an average of around 8.3 percent during 2000- 03 to less than half this amount, to an average of about 3 percent in 2011-2012.

Further disaggregation of total expenditure in research (Figure (3)) reveals that the lion's share of expenditure in research goes to wages and salaries which increased from 53.8 percent in 2000 to 95.5 percent in 2012. This means that spending on the other two components of expenditure in research, namely purchases of goods and services and development, decreased from 46.2 percent to 0.5 percent during the same period.

Another good indicator of the attention given by the government to research as importance prerequisite for agricultural development is expenditure in research as a ratio to agricultural GDP. This share stagnated around 0.1 percent in each year during 2000-2012 compared with 0.72 percent for SSA and 0.53 percent for developing countries in 2002. A revealing example of the extent of negligence of agricultural research in Sudan is that the intensity of expenditure in research stands at about a quarter of that of Mozambique's intensity of 0.4 percent cited as one of the lowest agricultural research expenditures in African countries (Zavale et al. 2011).

Figure (4): Agricultural Research as a Ratio of Agricultural GDP, Government Expenditure, Development Expenditure, and Agricultural Expenditure, 2000-2012



Source: Ministry of Finance and National Economy of Sudan

2.3 Intensity and Composition of Government Spending in Non-Agriculture

Regarding the non-agricultural government's expenditure, as noted by Alpuerto et. Al. (2009: 11-12) as an example in this respect "… growth in TFP…., is often linked to public goods or services that generate positive externality in the growth process to benefit private agents such as farmers. The public goods or services that generate such positive externality to agricultural growth include public investment in education and health to improve human capital or infrastructure investment and road network development to reduce transportation and other market-related costs". Table (2) shows the share of these items in aggregate expenditure. The table shows that between 2000 and 2012 the share of non-agricultural expenditure in government's budget averaged 4.5 percent with large variability where the share ranged between 1.3 percent in 2012 to 8.4 percent in 2009. On the other hand a little bit more than a quarter of total development expenditure has been allocated to non-agricultural expenditure where it reached about 28 percent on average during the same period.

Turning now to the share of the components of non-agricultural expenditure in total expenditure we see that expenditure allocations to roads and bridges, energy, health, and education averaged 1.5 percent, 2.7 percent, 0.15 percent, and 0.16 percent respectively. We specifically highlight the very low public budget allocations to the health and education sectors which did not exceed 0.4 percent of total outlays at most in both cases. Here we note that one of the main problematic features of agricultural production in Sudan is low productivity, across all crops, compared to potential. It has been proved elsewhere that investments made by a government to increase farmers' literacy improved production efficiency and enhanced agriculture's TFP (Bachewe 2012). No doubt that public expenditure directed towards helping the farmer to improve his output and to devote his energies and his knowhow more effectively will enhance agricultural production. A healthy and more educated farmer will be able to make better use of extension packages, advisory services, and application of modern production practices.

Table (2):Non-Agricultural Expenditure Components as Ratios of Total Expenditure, Development Expenditure and Non-Agricultural Expenditure

	2000-02	2003-05	2006-08	2009/10	2011/1
Expenditure in health :					
Percent of total expenditure	0.25	0.13	0.09	0.12	0.06
Percent of development expenditure	2.30	0.50	0.57	0.75	0.30
Percent of non-agricultural expenditure	6.87	2.43	1.60	0.85	4.75
Expenditure in Education:					
Percent of total expenditure	0.07	0.29	0.11	0.03	0.09
Percent of development expenditure	0.60	1.17	0.60	0.13	0.57
Percent of non-agricultural expenditure	1.83	5.80	2.17	2.25	2.80
Expenditure in roads and bridges:					
Percent of total expenditure	1.00	1.83	2.00	1.45	0.95
Percent of development expenditure	8.30	7.30	13.37	9.40	8.95
Percent of non-agricultural expenditure	26.97	36.93	38.1	24.3	44.2

Source: Ministry of Finance and National Economy of Sudan

3. Methodology and Data

Since the objective of this study is to estimate the effect of Government spending on agriculture's total factor productivity growth, following Alpuerto et al (2009) the paper distinguishes between public expenditure that directly impacts agriculture growth and the other kind which is public expenditure that indirectly enhance agricultural productivity. The direct public expenditures are those kinds of investments that develop science based agriculture such as publicly supported research and extension systems. As noted by Hayami et al. (2005:98), "The experiences in the Philippines and Indonesia show that the 'Green Revolution' was not a one-shot development and diffusion of the 'miracle rice' variety. Instead, it was a continuous process of technological improvement through application of science……". A good and reliable irrigation system is another direct public investment that greatly enhances productivity. For example in the case of Sudan lack of adequate irrigation was identified as one of the critical causes of low yields and drops in cultivated areas. As for the indirect public investments AgTFP "is often linked to public goods or services that generate positive externality in the growth process to benefit private agents such as farmers" (Alpuerto et al. 2009:6). A prototype example is government expenditure on education which enhances investment technologies. Also, the appropriate supply of public goods, such as roads for efficient transportation, laws for efficient market transactions of farm products and inputs, improvement of human capital through investments in education and health are among the indirect investments that positively impact agricultural productivity.

3.1 The Econometric Model

Based on the above conceptual framework, we assume that AgTFP is a function of direct public expenditure on agriculture which we denote as agricultural expenditure (AgExp) and indirect public expenditure which we denote as non-agricultural expenditure (NagExp), thus the functional form of the above relationship can be written as:

$$AgTFP=f(AgExp, NagExp) \quad (1)$$

Where the variables are as defined above. Since this study mainly considers the effects of public spending in the agricultural and nonagricultural sectors on growth in agricultural TFP, in our analysis we ignore the possible impact of other variables on agricultural total factor productivity in the case of Sudan such as availability of rainfall. Further assuming a non-linear relationship between the dependent and explanatory variables the econometric model in log format can be defined as:

$$Log\ AgTFP = a_0 + a_1\ Log\ AgrExp + a_2\ NAgExp + \varepsilon \quad (2)$$

In equation (2), a1 and a_2 stand for the agricultural TFP elasticity with respect to direct agricultural expenditure and the agricultural TFP elasticity with respect to indirect non-agricultural expenditure respectively and ε is an error term. Following some of the findings in the literature the two kinds of expenditure are expected to be productive in the sense that they lead to a positive growth in TFP. Accordingly both coefficients, a_1 and a_2, are expected to have positive signs.

3.2 Method of Estimation

Estimation of the model in equation (2) entails as a first step generation of the AgTFP indices. Growth theory suggests that the AgTFP indices can be estimated employing the Growth Accounting model. Generally, there are three main methods applied in the literature to measure total factor productivity (TFP). One estimates a non-parametric TFP index initially introduced by Hicks (1961). The most common productivity indices in empirical applications either employ geometric indexes or arithmetic measures (Nadri's, 1970). One of the former types of indices uses the Tornqvist-Theil index to compute TFP (see for example Rosegrant et al. (1995) and Desai et al. (1997)). A second common measure depends on computation of Malmquist TFP indices based on Farrell's (1957) who introduced the production frontier estimation method and measurement of production efficiency. These TFP indices assume that production is either efficient and hence points lie on the estimated production frontier, or production is inefficient and points lie below the production frontier. Thus the index has the advantage of decomposing TFP into components of technical change (TC) and technical efficiency change (TEC). The Malmquist TFP and its components are estimated by two methods – Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) which use linear programming methods to estimate a stochastic frontier production function. Agricultural technical change and technical efficiency is one area that received wide applications of the DEA method. Dinh (2012: 41) provides a summary of studies that applied DEA in measuring TEC and productivity in agriculture.

A third popular method for computing TFP indices, and which this paper adopts, is based on an aggregate production function and assumes that there is no technical inefficiency. All production combinations are located on the production frontier and thus growth of TFP only includes technological change. This approach mostly employs the Growth Accounting method first introduced by Solow (1957) which empirically accounts for growth in output by measuring factor inputs and an unexplained residual, generally attributed to technological change. In the general

production function approach the most widely used form of the production technology is the Cobb- Douglas one with labor and capital inputs and takes the form:

$$Y(t) = A(t)\, L(t)^{\alpha} K(t)^{\beta} \qquad (3)$$

where Y(t) is agricultural output, L(t) and K(t) respectively represent the labor and physical capital inputs into production during the same period, and A9t) is a shift parameter showing that output increases A-times over time with technological progress. As is well known, this multiplicative shift assumes a neutral technological change and constant marginal rates of substitution between labor and capital. An additional restriction invoked in the literature is that factors operate in competitive markets and also that the production technology is subjected to constant returns to scale $(\alpha + \beta = 1)$.

The above specified production function has been subjected to a number of criticisms in that it involves strong technical and economic assumptions. An obvious one is that it accounts only for factors included in the function, which usually are the traditional inputs of labor and capital, but ignores other ones that contribute toward production increases.

Another disadvantage associated with this approach is that it imposes a specific functional form on the production technology. However as rightly stressed by Hulton (2001) "The residual is still, after more than forty years, the work horse of empirical growth analysis. For all the residual's flaws, real and imagined, many researchers have used it to gain valuable insights into the process of economic growth. Thousands of pages of research have been published, and more are added every year (for, example, the TFP residual is central to the recent debate over the role of computers in stimulating economic growth)..... Not bad for a forty-year-old". It has also been argued by Fuglie (2011: cited in Dinh (2012) "that imposing more structure could be an advantage when dealing with data with a high degree of measurement error as it can help produce more plausible results". Since the seminal work of Solow considerable research on the measurement of TFP has been undertaken employing the Growth Accounting method (see among others Akitoby & Clinyabuguma 2006; Ali 2006 ; Anguyu & Mugume 2004; Ben 2006; Khaniet & Yazdani 2012; Odhiambo et al 2004; Moursi & Khier-El-Din 1998; Nassir 2008; Nechega & Fontaine 2006; Nin-Pratt et al 2015; Senhaji 2002; Sachs & Warner (1997); Shamboul 2006).

Another reason why this paper follows the Growth Accounting method despite the above noted conceptual and empirical concerns is that the main objective of this paper is to compute the impact of government expenditure on agricultural total factor productivity (AgrTFP) rather than production efficiency concerns. According to the theoretical framework to construct the series of agriculture's TFP indices, based on the Growth Accounting method, equation (3) is logarithmically differentiated with respect to time and invoking the constant returns to scale assumption yields:

$$G(Y)=G(A) +(1-\beta)G(L) + \beta G(K) \qquad (4)$$

Where (1-β) and β are the shares of labor and capital respectively. Under the assumption that labor and capital markets are competitive these shares also stand for the labor and capital production elasticities. Rearranging equation (4) gives:

$$G(A) = G(Y) - (1-\beta)G(L) - \beta G(K) \qquad (5)$$

In equation (5), G(A) represents TFP. It is the remainder of the change in total output after taking into account changes in the application rate of inputs, which earned it the name 'Solow Residual'. Given this equation and data on its components, the time series of A and hence of TFP can be calculated.

3.3 Data

To estimate the agricultural total factor productivity (AgTFP) indices for the period we follow the literature in assuming that the shares of labor and capital in the production process are 0.65 and 0.35[12] respectively. Using these shares and the annual growth rates of agricultural labor and capital the contributions of these factors of production to real agricultural GDP growth are computed. Applying the Growth accounting model as outlined above, generates the AgTFP series as the residual. The time series data covers the period 1984-2012.

Coming now to the econometric model, time series covering the same 1984-2012 period on government expenditure in agriculture and agriculture related non-agriculture will be used. It would have been informative for policy making to look into the response of AgTFP individually to expenditure on health, education, roads, and electricity. However, as we noted above disaggregated consistent data for government expenditure on agriculture related non-agriculture categories are available only for 13 years (2000-2012) which does not provide enough degrees of freedom for econometric analysis .Thus data shortcomings limited the analysis to the broad category of aggregate expenditure on non-agriculture. Time series of the explanatory variables are given in Tables A.1, A.4 and A.5.

In empirically applying the above methodology, the first task is to check whether the dependent and independent variables are stationary or not. The visual inspection of the movements in the three variables in Figures (A.7.1-A.7.3) in the appendices suggests that AgrTPF might be stationary while the other variable exhibit non-stationary trends. To check the presence of unit root i.e non-stationarity or otherwise, we apply the Augmented Dickey-Fuller (ADF) test. The ADF test relies on a null hypothesis of unit-root in favor of the alternative hypothesis of stationarity. The ADF test consists of estimating the following regression:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + \varepsilon_t \qquad (6)$$

[12] *For the case of Sudan Tahmad (2013) estimated capital and labour shares of 0.64 and 0.36 respectively*

where Y is the variable under consideration; Δ is the first difference operator; ε_t is a pure white noise error term. Thed ADF tests the null hypothesis that $\delta = 0$ i.e there is a unit root or the time series is nonstationary against the alternative hypothesis that $\delta < 0$ i.e the time series is stationary, possibly around a deterministic trend. To determine the proper lags for each variable, the lag length is chosen by Akaike Information Criterion (see for example Gujarati & Porter (2009)).

4. EMPIRICAL RESULTS

4.1 The Growth Accounting Model Results

Table (3) summarizes the estimated Growth Accounting results during the whole period 1984-2015 and different time periods. The time periods reflect significant episodes in Sudan's economy which are: 1984-1991, prior to economic liberalization; 1992-1998 (+), economic liberalization: 1999-2011, the advent of oil exports; the cession of South Sudan, reduction in oil revenue and deceleration of the economy, 2012.

How did then AgrTFP perform in the different sub-periods and how much of total agriculture's GDP is explained by growth in its different components. The table shows that agriculture GDP, agricultural raw labour and agricultural physical capital growth rates showed fluctuating trends with cumulative growth rates in the whole period (1984-2012) of 5.4 percent, 1.6 percent and 8.4 percent respectively. The two time periods 1984-1991 and 1992-1998 witnessed the best and high AgrGDP growth rates which reached 7.1 percent and 9.3 percent on average respectively. An important milestone within the time period 1999- 2011is that, Sudan as an oil exporter became one of the fastest growing countries in the world and yet AgrGDP growth rate dropped to 2.8 percent. As contended earlier, this reflects the lack of linkage between overall GDP growth and agriculture GDP growth. Lastly with the flight of oil revenue, because of South Sudan secession, the rate turned negative and very low (-0.6 percent) in 2012. The data also shows that agricultural physical capital growth rate experienced large fluctuations. The growth rate on average turned from a considerably negative magnitude (-7.2 percent) during 1984-1991 to a very high 27.4 percent after economic liberalization (1992-1998) , then slowed down to a still positive and high rate of 9.8 percent in the advent of oil exports and dipped to a negative rate of 13.4 percent in 2012.

The table also has the computed contributions of labour, capital and TFP to AgrGDP growth. Not surprisingly agricultural capital growth was the prime driving force of total agricultural factor productivity with an average contribution of 53.8 percent for the full time period. The close relationship between physical capital and AgGDP growth is further emphasized in the year 2012 as the negative growth and contribution of capital caused AgrGDP growth to slip to a negative rate.

Table (3): Contributions of Labour, Capital and TFP to Agricultural GDP Growth in 1984 - 2015

	1984-1991	1992-1998	1999-2011	2012	1984-2012
Growth rate of Agr-GDP	7.1	9.3	2.8	-1.5	5.4
Growth rate of Agr- labour	2.0	2.3	0.9	2.2	1.6
Growth rate of Agr- capital	-7.2	27.4	9.8	-18.9	8.4
Contributions of TFP and Factor Inputs to Agricultural GDP Growth 2					
Contribution of labour to AgrGDP growth	1.3	1.5	0.6	1.4	1.1 (20.3%)
Contribution of capital to AgrGDP growth	-2.5	9.6	3.5	-6.6	2.9 (53.8%)
Agr. TFP growth	8.3	-1.8	-1.3	3.7	1.4 (25.9%)

Source: **Ministry of Finance and National Economy of Sudan.**

Notes- The contributions are obtained using the conventional shares of capital and labor inputs in total output of 0.35 and 0.65 respectively and employing equation(4) ; Percentages in the last column are show the percentage contributions of labour growth, physical capital growth and TFP growth to agricultural GDP growth respectively.

As for TFP it accounted for around 31 percent of agricultural output growth on average for the full time period. Its growth rate changed from 8.3 percent in the first time period to negative rates in 1992-1998 (-1.8 percent) the economic liberalization period and 1999-2011 (-1.3 percent) the advent of oil. These results are consistent with the very low share of public expenditure in agriculture and agriculture related non-agriculture factors we alluded to earlier in the paper. Other studies also reported low or negative growth rates of AgrTFP. For example Belloumi & Mohamed (2009) found a rate of -0.5 percent in 1970-2000, with-2.7, -2.9 and 3.0 percent during the sub periods 1970-1980, 1981-1990 and 1991-2000, respectively; Nin et al. (2003) estimated a 0.39 growth rate of AgrTFP during 1965-1994; and Tahmad (2014) found a negative rate of -12.2 percent for TFP when estimating contributions to labour productivity in agriculture.

There are many possible explanations for the observed increase in the role of capital input in the agricultural sector from 1992 on words. In 1992 a liberalization of the economy was effected, with policy components such as currency devaluation, privatization etc, with the main objective of boosting agricultural production and exports. By the end of that decade up to 2011 oil has emerged as a major source for economic growth and oil exports increased providing hard currency to finance imports. Also during this period the Government declared the Agricultural Revitalization Program (ARP) to enhance sustainable growth in agricultural and industrial production inducing more dependency on physical capital and imports.

The results highlighted that the policy choice in Sudan regarding the agricultural sector development during the study period has been one of capital accumulation. It is corroborated by our earlier findings that, during the study period, expenditure on technological progress enhancing factors such as research, health and education has been far below those on capital related expenditure. However evidence showed that developing countries that followed strategies of enforced capital accumulation to accelerate agricultural growth ended up with poor economic growth performance (Hayami et al. 2005). A fact-based explanation to such an outcome, which

also applies to the case of Sudan, is that when countries apply rapidly accumulated capital with little technical progress they end up trapped by severe decreasing returns to capital and hence slower growth.

4.2 Unit Root Test Results

The ADF test result indicates that the hypothesis of nonstationarity of the agricultural Total Factor Productivity variable at level is rejected at the 1 percent confidence interval and hence it is integrated of order I(0). As for the real agricultural spending and that of the real non-agricultural spending, the ADF test indicates that the nonstationarity hypothesis cannot be rejected hence they are tested at first difference. As table (4) shows the hypothesis of nonstationarity is rejected at the 1 percent confidence level, suggesting that these variables are integrated of order I(1).

Table (4) : Statistics for the ADF Unit Root Tests

Variables	t-ADF	Lag Length
AgTFP	-5.71*	1
Real agricultural spending^{-2}	-10.27*	1
Real non-agricultural spending^{-1}	-6.45*	1

Source: Authors' estimations

Notes: Varaibles are as defined in the text. * and ** denote rejection at the 1 percent and 5 percent

Critical values; The AgrTFP variable is tested at level while the other two variables are tested at the first difference.

4.3 Econometric Mode Result

Having established that the dependent and independent variables are stationary we proceed in what follows to analyze the impact of Government expenditure on agriculture and non-agriculture on agricultural total factor productivity. The OLS estimated long-run equation takes the following form:

$$LogAgTFP = 2.86 - 0.57\ LogRAgEx + 0.56\ LogRNagExp \qquad (7)$$

$$(7.23) \qquad (-3.330 \qquad (2.11)$$

$$R^2 = 0.86 \qquad D\text{-}W = 1.79$$

The results in equation (7) show that the coefficient of direct spending on agriculture is significant at the 1 percent level and that of indirect spending is significant at the 5 percent level. The R2 value indicates that the two independent variables explain 86 percent of the change in agricultural total factor productivity (AgTFP) and the Durbin Watson statistics suggests that no autocorrelation exists. However, though the coefficient of the indirect non-agriculture spending has the expected positive sign that of the direct public spending in agriculture has a negative sign. What the negative sign says is that direct public spending in agriculture during the period under consideration led to negative growth in agricultural Total Factor Productivity. Before trying to look for explanations for this negative causation, we tried first to check the plausibility of the result by running a number of other regressions with different explanatory variables and lags as shown in specifications 2-4 in table (A.7) in the appendices. Notwithstanding the low

explanatory power of the choice variables (as reflected by the low values of R2, in all these regressions the coefficient of direct public spending on agriculture appeared with a negative sign and, except for specification 2, is also highly significant. The consistently negative sign of the coefficient across all four specifications implies that the results of specification 1(which is our reported result in equation (7) above) are robust and hence we can proceed with the analysis.

The detrimental impact of direct government spending on agricultural TFP growth is in contrast to findings of other studies on the impact of public spending on agricultural growth. For example the estimated agricultural growth-agricultural expenditure elasticity was positive in Sub-Saharan Africa (Benin et al. 2007: 0.15); agricultural development expenditure in Rwanda (Diao et al. 2007: 0.17); agricultural research in Uganda (Fan et al. 2004: 0.19); and agriculture development expenditure in Africa (Fan & Rao 2003: 0.36). Despite this contrast, the result for Sudan would not be surprising if we juxtaposed the important contribution of some components to agricultural growth with the share of these components in government expenditure in agriculture such as research. We have shown above that for the period 2000-2012 expenditure in agriculture research was on average just 0.1 percent of agriculture GDP. Thus it is imperative for the Government of Sudan to give due recognition to the very important contribution of research and extension to agricultural growth and allocate resources compatible with its role. As also noted above the right sequencing of public expenditure will ensure the best possible returns (Govereh et al.2009). This is emphasized by the consistently negative response of AgTFP to spending in agriculture in all specifications because what it says is that if government's budget allocation remains as inefficient as in the past the agricultural-led- growth paradigm will remain only a slogan.

Equation (7) also shows that for every one percent growth in government non-agricultural spending, agricultural TFP grows by 0.57 percentage points. The positive impact of non-agricultural expenditure on AgTFP has also been noted by other studies which found magnitudes similar to ours. For example Benin et Al. (2008) found an agricultural growth-non-agricultural expenditure elasticity of 0.50 for Malawi and Alpuerto et al.(2009:14) established an elasticity equal to 0.46 for Nigeria and contended that "Given that a lion's share of public good provision, including investment in infrastructure and spending on education and health, is all counted as part of non-agricultural spending, such an estimation result is not surprising as such spending has definitely benefited the entire economy, including the rural economy and the agricultural sector".

5. Concluding Remarks

One of the purposes of this paper was to estimate the drives of the real agricultural production growth in Sudan over the 1984-2012 time periods. This was motivated by the deterioration in the performance of the agricultural sector which culminated into negative growth rates in recent years. The decomposition was done using the well-known Growth Accounting method. The second objective was to examine the impact of public spending in agriculture and in agriculture related non-agriculture on agricultural total factor productivity growth in Sudan. The least- square method was employed in the analysis.

It transpired from the Growth Accounting analysis that the bulk of growth in agricultural GDP was largely due to capital growth averaging a contribution of 53.8 percent. On the other hand the contribution of TFP to agricultural GDP growth was only 26 percent and labour, one of the historically important inputs, contributed around 20.3 percent. Empirical results of the econometric model showed a significant and negative elasticity (-0.57) of agricultural output growth to direct public allocations to the sector reflecting inadequacy and misplacement of agricultural expenditure. Another key finding of the paper is that there has been a positive association between public spending growth in related non-agricultural factors and agricultural productivity (an elasticity of 0.56). Detailed statistical analysis of public expenditure allocations to the agriculture sector for the 200-2012 time period showed that the share of payments it obtained were about two-tenth of its contribution to the overall output of the economy. Much less than 10 percent of aggregate spending went to the sector. The story does not end there. Disaggregation of agricultural budgetary allocations revealed that the bulk was spent on building dams or covered wages and salaries. Expenditure on an important input such as research stagnated at around 0.1 percent of the budget. Also expenditure on vital productivity enhancing factors such as health and education as a ratio of total outlays stood at 0.15 percent, and 0.16 percent on average respectively.

The results for this study have shown that the growth of agricultural productivity is determined largely by capital accumulation. However, the higher capital input growth rate than agricultural output implies decreasing returns to capital during the time of analysis. Moreover, given the poor performance of the agricultural sector despite capital input expansion, leads one to conclude that to achieve better future growth there is need to enhance other inputs. Experience in other countries, particularly Asia, shows that the contribution of technology is not only important but that countries which succeeded in achieving high rates of technological development or growth in TFP are the ones whose economies' growth accelerated the most. Our results show that growth in agricultural technological development or TFP declined sharply from the 1980's to either negative or very low rates during the last two decades. Reversing this trend is a key to achieve the level of agricultural growth rate needed to effect overall growth of the economy.

An important determinant of agricultural productivity is government expenditure that goes directly to services within the sector such as research, extension, credit, fertilizer use etc. or indirectly to health and education. In this respect, studies in Africa have overwhelmingly demonstrated that low agricultural productivity resulted from low and misplaced agricultural expenditure priorities. In Sudan expenditure in research as a ratio of agricultural GDP remained stagnant around 0.1 percent compared with 0.72 percent for SSA and 0.53 percent for developing countries. Experiences elsewhere have also proved that augmented human capital is an essential prerequisite for factor productivity growth. Expenditure on health and education constituted a very low share of 0.15 percent, and 0.16 percent respectively. Therefore, maintaining an adequate budget to enhance these inputs is crucial for productivity growth.

In conclusion we note that inadequate allocation of resources in the sector was a key constraint to increasing agricultural productivity and growth rates. To start the ball rolling, the government should reconsider not only its budget allocations for the agricultural sector as a whole, but also its distribution within the agricultural sector as well. It is also imperative for the Government to take into account the strong inter-linkages between agricultural growth and non-agricultural spending.

Moreover, the agriculture's development strategy might well be one of the main causes of failure of Sudan to achieve structural transformation till now. The shift from a pattern of agricultural growth based on capital accumulation towards one based on improvements in productivity could be a step in the right direction. Though the analysis in this paper was restricted to agricultural expenditure and agricultural TFP in its broad sense, as noted by Zahlan, et. al. (1986:6) "the farmer and policy-maker are linked by a vast and complex network of institutional, infrastructural, technological, economic and social relationships. .....The farmer functions in an ecological environment, in an institutional setting and within a policy framework". Thus given the current status of Sudan economy there is a pressing need to depart from the traditional modes of thinking about agriculture in Sudan and to look for new visions of the future and new concepts. Thus given the current status of Sudan economy there is a pressing need to move ahead and search for new visions and relevant and effective approaches that relate to the farmer, to the political economy of agriculture, and to managerial aspects of the agricultural sector i.e that will lead to better allocation of resources.

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Annexes

Table (A.1): Agricultural Expenditure, Development Expenditure, Consumer Price Index, Non Agricultural Expenditure, Real Agricultural Expenditure, Real Non-Agricultural Expenditure and Growth Rates of Real agricultural Expenditure and Non Agricultural Expenditure (million SDG)

Year	Agr. Exp (1)	Dev.exp. (2)	Nagr. Exp (4)	CPI (3)	Ragr.Exp (5)	Rnagr.Exp (6)	GAgr.Exp (7)	GNagr.Exp (8)
1988	0.55	2.227	1.667	2.158	0.26	0.77	0.00	0.0
1989	0.54	5.063	4.533	3.562	0.15	1.27	-42.66	64.7
1990	0.48	2.664	2.184	3.908	0.12	0.56	-17.45	-56.1
1991	3.18	10.821	7.641	7.899	0.40	0.97	-68.20	73.1
1992	2.20	33.965	31.765	17.182	0.13	1.85	-68.20	91.1
1993	2.20	25.622	23.422	34.583	0.06	0.68	-50.32	-63.4
1994	5.00	18.477	13.477	74.521	0.07	0.18	5.47	-73.3
1995	3.00	17.485	14.485	125.479	0.02	0.12	-64.37	-36.2
1996	25.00	779.440	754.440	292.142	0.09	2.58	257.93	-14.9
1997	18.00	1052.530	1034.530	428.423	0.04	2.41	-50.90	-6.5
1998	55.00	1734.300	1679.300	510.708	0.11	3.29	156.32	36.2
1999	95.00	2331.505	2236.505	581.195	0.16	3.85	51.78	17.0
2000	170.00	3694.260	3524.260	628.696	0.27	5.61	65.43	45.7
2001	155.00	4728.660	4573.660	659.329	0.24	6.94	-13.06	23.7
2002	165.60	1408.000	1242.400	714.269	0.23	1.74	-1.38	-74.9
2003	446.8	1729.000	1282.200	769.345	0.58	1.67	150.49	-4.2
2004	976.70	3103.000	2126.300	834.112	1.17	2.55	101.63	53.0
2005	986.50	3412.000	2425.200	904.924	1.09	2.68	-6.87	5.1
2006	1216.40	3540.000	2323.600	970.079	1.25	2.40	14.99	-10.6
2007	1746.50	3567.900	1821.400	1047.669	1.67	1.74	32.95	-27.4
2008	1329.00	3260.800	1931.800	1197.318	1.66	1.11	-33.42	-7.2
2009	1013.00	3915.200	2902.200	1332.101	0.76	2.18	-31.49	35.0
2010	1258.60	4161.900	2903.300	1505.144	0.84	1.93	9.96	-11.5

2011	1877.80	3334.400	1456.600	1777.486	1.06	0.82	26.34	-57.5
2012	1279.70	3337.000	2057.300	2409.377	0.53	0.85	-49.72	4.2

Source: Ministry of Finance and National Economy of Sudan

Notes: 1- Agr.Exp, Dev.exp, CPI, Nagr.Exp, Ragr.Exp, Rnagr.Exp, G(Agr.Exp) and G(Nagr.Exp): indicate agricultural expenditure, development expenditure, Consumer Price Index, non agricultural expenditure, real Agr.Exp, real Nagr.exp, growth rate of Agr.Exp and growth rate of Nagr.Exp respectively. 2- Non agricultural expenditure in column (4) is the sum of spending on roads and bridges,energy (electricity) , education and health.

Table (A.2): Real Total Expenditure, Real Development Expenditure, Real Agricultural Expenditure, and Agricultural and Non Agricultural Expenditure in million SDG , (2000-2012).

Item	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Real Expenditures:													
Real Total Expenditure	5.61	6.35	7.26	9.57	13.2	15.8	18.81	19.5	21.7	18.73	18.82	18	12.29
Real Development Expenditure	0.512	0.79	1.97	2.25	3.72	3.77	3.649	3.41	2.723	2.939	2.765	1.88	1.385
Real Agricultural Expenditure	0.27	0.24	0.23	0.58	1.17	1.09	1.254	1.67	1.11	0.76	0.836	1.06	0.531
Real Non-Agricultural Expenditure	0.242	0.56	1.74	1.67	2.6	2.68	2.68	2.4	1.613	2.179	1.929	0.82	0.854
Agricultural Expenditure :													
Total Agricultural Expenditure	170	155	166	447	977	987	1,216	1,747	1,329	1,013	1,259	1,878	1,280
A. Current Expenditure	40.2	40	51.3	58.2	79.1	45.5	100.9	116	157	161.8	164.3	165	159.8
A.1 Wages and Salaries:	21	26.7	49.6	47.9	63.3	35.3	80.1	94.3	119.5	128.5	136.4	147	147.9
Total of Agriculture, Irrigation, Livestock and Research													
Agriculture	3.1	3.5	4	5.1	4.9	2.7	8.2	9.2	14	16.3	16.5	18	18.9
Irrigation	10	12.7	20	21	29.6	16.6	39.9	45.1	50	47.9	53.5	57	55
Livestock	1.6	1.8	2.1	2.3	3.8	3.2	9.4	10.6	15	15.7	16.9	19.2	20.4
Research **	6.3	8.7	14.5	19.4	25	12.7	22.7	29.5	40.9	48.6	49.5	52.7	53.6
A.2 Purchase of Goods and Services :													
Total of Agriculture, Irrigation, Livestock and research	19.2	13.3	10.7	10.3	15.8	10.3	20.8	21.9	37.5	33.3	27.9	18.1	11.9
Agriculture	1.8	1.3	1.2	0.9	1.4	1.2	2.4	2.5	2.9	3	2.6	7.2	5.5
Irrigation	9.3	6.9	5.2	4.2	7.1	4	6	6.3	16	15.9	12.7	6.6	3.1
Livestock	2.8	1.8	1.8	1.7	2.1	1.2	3.9	4.1	2.6	4	3.8	1	0.8
Research	5.3	3.3	2.5	3.6	5.2	3.8	8.6	9	16	10.5	8.8	3.3	2.5
B. Development Expenditure: Agriculture, Irrigation, Livestock And Research	**129.8**	**115**	**114**	**389**	**898**	**941**	**1,115**	**1,630**	**1,172**	**851**	**1,094**	**1,713**	**1,120**
Irrigation	67.6	83.6	84.3	326	786	834	889.6	1,462	1,143	785	809	1,390	1,099
Agriculture	60.8	28.5	25.8	49.7	99.7	100	216.2	161	18.9	47.4	269.6	296	18.6
Livestock	1.4	1.8	3.4	13.2	10.6	5.4	5.8	7.1	10.3	19	16.2	27.1	2.6
Researches	0.1	1.1	0.8	0.2	2	1.5	3.8	0.4	0.2	0.2	0	0	0
C. Non-Agriculture Relevant Expenditure:													

Total of Roads, Electricity, Health and Education	**115.6**	**167**	**233**	**274**	**645**	**742**	**776.3**	**1,190**	**1,575**	**2,103**	**831**	**883**	**397**
Roads and Bridges	46.7	40.4	38.2	87.6	205	348	336.2	291	731.8	567.1	179.7	451	148.3
Energy (Electricity)	54.9	105	194	171	376	324	410.4	834	812.3	1,493	616.6	382	211.8
Health	11.3	17.5	1	1.6	19.9	26.9	7.6	24.8	26.6	37.4	22.7	17.7	14.2
Education	2.7	5	0.5	13.3	43.5	43.3	22.1	40.9	4.7	5.3	11.5	32.5	23

Source: Ministry of Finance and National Economy of Sudan

Table (A.3): Growth Rates and Shares of Agricultural Expenditure

Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Growth Rates													
Agricultural GDP	4	14.9	16.1	0.6	-6.9	6.1	4.1	7.1	-4.5	-2.8	3.1	-3.7	-1.5
Agricultural Expenditure	-8.8	6.8	169.8	118.6	1	23.3	43.6	-23.9	-23.8	24.2	49.2	-16.5	-100
Non-agricultural Expenditure	44.9	39.3	17.4	135.5	15.1	4.6	53.3	32.4	33.5	-60.5	6.4	-55	-100
Share of Agricultural Expenditure (%)													
In total expenditure	4.8	3.7	3.2	6.1	8.8	6.9	6.7	8.5	5.1	4.1	4.4	5.9	4.3
In Development Expenditure	52.8	29.7	11.8	25.8	31.5	28.9	34.4	49	40.8	25.9	30.2	56.3	38.3
Share of Agricultural Expenditure on Research(%)													
In Agricultural GDP	0.1	0.08	0.09	0.11	0.13	0.06	0.1	0.09	0.13	0.13	0.11	0.09	0.07
In Total Expenditure	0.3	0.3	0.3	0.3	0.3	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
In Development Expenditure	3.6	2.3	1.2	1.3	1	0.5	0.9	1.1	1.7	1.5	1.4	1.7	1.7
In Agricultural Expenditure	6.8	7.7	10.3	5.2	3.1	1.7	2.6	2.2	4.3	5.8	4.6	3	3.6
In Development in Agriculture	9	10.4	14.9	5.9	3.4	1.8	2.8	2.4	4.9	6.9	5.3	3.3	5
Share of Non-agricultural Expenditure (%)													
In Total Expenditure	3.3	4	4.5	3.7	5.8	5.2	4.3	5.8	6.1	8.4	2.9	2.8	1.3
In Development Expenditure	35.9	32.1	16.6	15.8	20.8	21.7	21.9	33.4	48.3	53.7	20	26.5	11.9
Share of Health, Education and Roads and Bridges (%)													
Health in Total Expenditure	0.32	0.42	0.02	0.02	0.18	0.19	0.04	0.12	0.1	0.15	0.08	0.06	0.05
Education in Total Expenditure	0.08	0.12	0.01	0.18	0.39	0.3	0.12	0.2	0.02	0.02	0.04	0.1	0.08
Health in Development Expenditure	3.5	3.3	0.1	0.1	0.6	0.8	0.2	0.7	0.8	1	0.5	0.5	0.4
Education in Development Expenditure	0.8	1	0	0.8	1.4	1.3	0.6	1.1	0.1	0.1	0.3	1	0.7
Health in Non -agricultural Expenditure	9.8	10.4	0.4	0.6	3.1	3.6	1	2.1	1.7	1.8	2.7	2	3.6
Education in N-on agricultural expenditure	2.3	3	0.2	4.9	6.7	5.8	2.8	3.4	0.3	0.3	1.4	3.7	5.8
Roads and Bridges in Total Expenditure	1.3	1	0.7	1.2	1.9	2.4	1.8	1.4	2.8	2.3	0.6	1.4	0.5
Rroads and Bridges in Development Expenditure	14.5	7.7	2.7	5.1	6.6	10.2	9.5	8.2	22.4	14.5	4.3	13.5	4.4
Roads and Bridges in Non-agricultural Expenditure	40.4	24.1	16.4	32	31.9	46.9	43.3	24.5	46.5	27	21.6	51.1	37.3

Source: **Ministry of Finance and National Economy of Sudan**

Table (A.4): The Evolution of Real Agricultural GDP, Real Agricultural Capital, and Agricultural Labor 1984- 2012

Year	Agricultural GDP (m SDG)	Agricultural labor (million)	Agricultural Capital (m SDG)	GDP deflator	Real agricultural GDP (m SDG)	Real Agricultural Capital (m SDG)
1984	3.6	4.31	0.06	170	0.02	0.000353
1985	4.2	4.43	0.06	237	0.02	0.000253
1986	6.3	4.54	0.10	345	0.02	0.000289
1987	4.7	4.64	0.05	251	0.02	0.000199
1988	17.9	4.73	0.11	676	0.03	0.000163
1989	33.3	4.82	0.14	980	0.03	0.000143
1990	39.0	4.93	0.13	1525	0.03	0.000085
1991	79.5	5.05	0.47	2852	0.03	0.000165
1992	168.5	5.17	1.02	5396	0.03	0.000189
1993	363.0	5.30	4.51	10252	0.04	0.000439
1994	774.1	5.43	4.24	19479	0.04	0.000218
1995	1799.2	5.62	4.58	41476	0.04	0.000110
1996	4218.5	5.69	26.74	97884	0.04	0.000273
1997	7363.3	5.83	40.65	143889	0.05	0.000283
1998	8698.5	5.96	44.66	169789	0.05	0.000263
1999	9929.9	6.10	35.97	196955	0.05	0.000183
2000	12066.6	6.23	34.12	230185	0.05	0.000148
2001	14547.9	6.35	25.55	241449	0.06	0.000106
2002	17986.3	6.48	23.01	257208	0.07	0.000089
2003	21411.0	6.60	65.45	304290	0.07	0.000215
2004	23369.4	6.73	68.27	356860	0.07	0.000191
2005	28454.7	6.89	85.87	409440	0.07	0.000210
2006	31276.6	7.07	137.57	432210	0.07	0.000318
2007	42743.0	7.14	127.39	427960	0.100	0.000298
2008	45032.4	7.25	139.62	472310	0.095	0.000296
2009	44969.6	7.40	199.74	485350	0.093	0.000412
2010	52691.4	7.51	261.24	551710	0.096	0.000474
2011	63609.1	6.66	269.73	691440	0.092	0.000390
2012	80804.1	6.80	281.95	891620	0.091	0.000316

Source: Ministry of Finance and National Economy of Sudan

Table (A.5): Growth Rates of Agricultural GDP, Agricultural Labor and Agricultural Capital; Their Contribution to Real Agricultural GDP Growth and Agricultural Total Factor Productivity (1984-2015)

Year	Growth rate of Agricultural GDP G(Y)	Growth Rate of Agricultural Labor G(L)	Contribution of labor to AgrGDP Growth (1- β)*G(L)	Growth Rate of Agricultural Capital G(K)	Contribution of Capital to AgrGDP Growth β *G(K)	Agricultural Total Factor Productivity
1984	-9.60	0.00	0.00	-34.9	-12.2	2.6
1985	-15.55	2.79	1.81	-36.1	-12.6	-4.7
1986	2.52	2.46	1.60	19.2	6.7	-5.8
1987	2.73	2.23	1.45	-27.1	-9.5	10.8
1988	41.14	2.05	1.33	-20.2	-7.1	46.9
1989	28.31	1.90	1.24	-14.5	-5.1	32.2
1990	-2.40	2.28	1.48	-39.4	-13.8	9.9
1991	8.95	2.37	1.54	95.5	33.4	-26.0
1992	11.99	2.40	1.56	14.5	5.1	5.4
1993	13.41	2.44	1.58	133.6	46.8	-34.9
1994	12.24	2.46	1.60	-50.5	-17.7	28.3
1995	9.15	3.52	2.29	-49.3	-17.2	24.1
1996	-0.65	1.32	0.86	147.3	51.6	-53.1
1997	18.74	2.41	1.57	3.4	1.2	16.0
1998	0.11	2.34	1.52	-6.9	-2.4	1.0
1999	-1.59	2.27	1.47	-30.6	-10.7	7.6
2000	3.98	2.15	1.40	-18.8	-6.6	9.2
2001	14.94	2.01	1.30	-28.6	-10.0	23.6
2002	16.06	1.94	1.26	-15.5	-5.4	20.2
2003	0.62	1.87	1.21	140.5	49.2	-49.8
2004	-6.93	1.93	1.25	-11.1	-3.9	-4.3
2005	6.12	2.48	1.61	9.6	3.4	1.1
2006	4.13	2.51	1.63	51.8	18.1	-15.6
2007	7.10	1.04	0.68	-6.5	-2.3	8.7
2008	-4.54	1.53	1.00	-0.7	-0.2	-5.3
2009	-2.82	2.04	1.32	39.2	13.7	-17.9
2010	3.08	1.58	1.03	15.1	5.3	-3.2
2011	-3.68	-11.40	-7.41	-17.6	-6.2	9.9
2012	-1.49	2.19	1.42	-18.9	-6.6	3.7

Source: Ministry of Finance and National Economy of Sudan

Notes: 1- [β = 0.35] and [(1- β) = 0.65] stand for the shares of capital and labor in production respectively. 2-TFP was calculated using equation (5) section four.

Figure (A.1): Evolution of Agricultural Total Factor Productivity, Real Agricultural Expenditure and Real Non- Agricultural Expenditure over Time, 1984-2015

Fig (A.1): AgrTFP

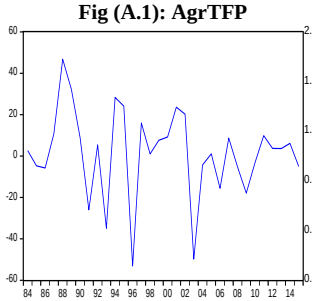


Figure (A.2): Agr- EXp

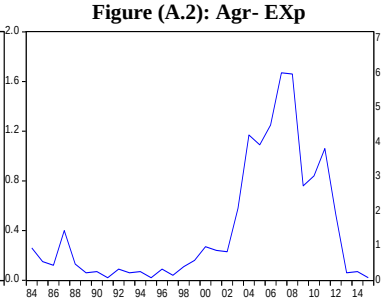
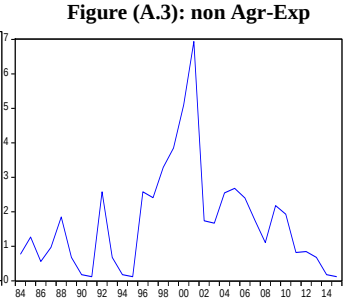


Figure (A.3): non Agr-Exp



Source: Authors' calculations

Table (A.6): Regression results of Specification (1)

Dependent Variable:LOG(TFP)
Method: Least Squares
Date:04/22/16 time 14:04
Sample(adjusted)1991:2012
Included observations:22 after adjusting endpoints
Convergence achieved after 365 iterations
Backcast: OFF(Roots of MA process too large for back cast)

Variable	Coefficient	St.Error	t-Statistic	Prob
LOG(RAgExp(-1))	-0.570543	0.17103	-3.335856	0.0039
LOG(NAgrExp(-2))	0.567812	0.26857	2.114233	0.0496
C	2.857194	0.39497	7.233932	0.0000
AR(1)	0.412741	0.25984	1.588443	0.1306
MA(1)	-1.753459	0.46023	-3.809896	0.0014
R-squared	0.859019	Mean dependent var	2.555155	
Adjusted R-squared	0.7077611	S.D.dependent var	1.101417	
S.E. of regression	0.625377	Akaike info criterion	2.095791	
Sum squared resid	6.648630	Schwarz critrrion	2.343755	
Log Likelihood	-18.05370	F-statistic	12.03469	
Durbin- Watson stat	1.789270	Prob(F-statistic	0.000080	
Inverted AR Roots	41			
Inverted MA Roots	1.75			
	Estimated MA process is noninvertible			

Source: Authors' estimation.

Table (A.7):Impact of Agricultural and Non-agricultural Expenditure on Agricultural Total Factor Productivity (the dependent variable: log AgTFP)

Specifications	Explanatory Variables	Coefficient
Specification (1)	Real Agricultural Spending-2	-0.57**
	Real Non-Agricultural Spending-1	0.56*
Specification (2)	Real Agricultural Spending -3	-0.36
	[Real Non-Agricultural Spending]-5	0.74*
Specification (3)	[Agricultural Spending / GDP] -2	- 0.50***
	[Non-Agricultural Spending / GDP] -2	0.32*
Specification (4)	[Agricultural Spending / GDP]-1	-0.50***
	[Non-Agricultural Spending / GDP]-2	0.35***

Source: Aouthors'computations

Potential Uptake Determinants of Climate Smart Agricultural Practices to Supply Carbon Emissions Offsets in Drier-Agro Ecological Zones of Ethiopia

Nigussie ABADI[13] and Girmay TESFAY[14]

Abstract

While the benefits of agro-environmental services using climate smart agricultural practices have been well documented in the literature, landowners' preferences and willingness to accept (WTA) compensation to supply such benefits have been much less studied. To avoid conflicts often associated with mandatory regulations, it is crucial to motivate and incentivize landowners to participate in voluntary conservation programs. To investigate landowner preferences and WTA, we conduct a contingent valuation survey of smallholder farmers in north highlands of Ethiopia. We find that WTA conservation tillage is negatively related to ownership of livestock, irrigation, distance to local market, extension service and membership to a farmer group, and positively related to age and education of the household head, awareness of climate change by the household, ownership of land and income, hired labor and off-farm income such as PSNP. We also find indications that landowners in the region demand higher compensation, and the overall mean WTA per year per timid of land is estimated at ETB 2,400 (117 USD) and ETB 3, 750 (183 USD) for minimum and zero tillage's respectively. Results are potentially important both for our understanding of landowner preferences and for the costs of voluntary climate change mitigation schemes currently in use in many countries. Our findings also suggest that the unique needs of mixed crop-livestock farming systems hinder further diffusion of conservation tillage. Future policy should consider addressing the needs of Ethiopian farmers, particularly crop producers heavily engaged in livestock activities.

Keywords: *conservation tillage, mitigation, compensation, willingness to accept, Ethiopia*

1. Introduction

Currently Sub-Saharan Africa is home to 76% of the world's ultra-poor (121 million people) who live on less than 50 cents a day (Grabowski, Kerr, Haggblade & Kabwe 2014). Most of these people live in rural areas and agriculture is their primary livelihood strategy (Barrett, 2010). However, Agriculture is also a major emitter of greenhouse gases (GHGs). Global greenhouse gas (GHG) emission derived directly from agriculture amounts to approximately 5.1 to 6.1 GT CO_2 equivalent to per year (Smith et al. 2007). It also accounts for 14% of global GHG emissions or 25% if agriculture-driven deforestation is included (Schaffnit-Chatterjee et al. 2011). Moreover, it has been estimated that around 74 per cent of emissions from agriculture originate in low and middle income countries (FAO 2009c) such as Ethiopia.

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As agriculture is a major contributor of GHG emissions, recent studies have highlighted the potential for mitigation from this sector (de Boer 2009; FAO 2009a; FAO 2009b; Smith *et al.* 2007). In fact, agriculture offers tremendous potential to mitigate climate change, 18% of total emissions together with forestry, or 1/3 of the total abatement potential. This makes agriculture/forestry one of the three major areas of GHG abatement opportunities (along with energy efficiency and low-carbon energy supply) (Schaffnit-Chatterjee et al. 2011). Moreover, mitigation efforts in agriculture such as enhancing soil carbon could potentially offset 24 to 84 percent of current agricultural climate change by selecting agricultural practices that reduce greenhouse gas emissions or store carbon (Smith et al. 2008).

Accordingly, there has been a growing advocacy in recent years that Climate Smart Agriculture (CSA) such as Conservation Tillage (CT) practices is important in establishing household food security for poorer farmers in Sub-Saharan Africa (SSA) and Asia , an approach that can help attain the United Nations' Millennium Development Goal on food security (Hobbs 2007) and mitigation of climate change. In line with this international call, the Ethiopian government in its Climate Resilience Green Economy (CRGE) strategy took initiatives that can be introduced to lower the greenhouse gas emissions from agriculture. Such initiatives include changing the conventional farming practices into climate smart agricultural practices such as conservation agriculture (introduction of zero or minimum tillage, water shed management (WSM), nutrient and crop management) in order to reduce carbon emissions from agriculture by 40 Mt in 2030 (Sulser etal. 2010).

However, from economic point of view, the implementation of changes in farming practices to sequester carbon in soils would be a cost to smallholder farmers and land managers, while the benefits largely accrue to the wider public. As a result, compensation would need to be provided to smallholder farmers if they are to change their conservation practices towards mitigating climate change (Shaikh et.al. 2005). To this end, there have been calls to include incentives for emissions reductions in agriculture in developing countries within a future climate change treaty (FAO 2009b). Surprisingly, despite the increasing importance of CA in the world and interest that many lab-and field-based academics have had in CA technology, there is little, solid empirical research that documents an evidence on the incentive payments (or subsidies) that would be needed to induce farmers to adopt conservation farming . Thus, there is little evidence on which the likely effectiveness of CSA can be evaluated to provide agri-environmental services in Ethiopia and similar developing countries.

Because of the gap in the literature, there are many unanswered questions, including the following: Are smallholder farmers in Ethiopia willing to adopt conservation Agriculture technology? What is the extent of willingness to adopt the technology? Why do some farmers willing to adopt CA but not others? More importantly, what are the challenges of adopting CA technology, given the nature of Ethiopian farmers' socio-economic and natural endowments?

The overall goal of our paper is to answer some of the questions in order to provide a better understanding of the potential uptake of CA technology and to identify constraints that might be limiting its diffusion. Our paper focuses on three specific objectives. First, we seek to provide a profile of farm households' willingness to adopt specific CA practice or not. Second, we estimate

the mean willingness to accept for adopting specific CA technology. Third, we identify the determinants of willingness to accept and the extent of willingness specific CA technology in order to measure those factors that influence farmer's options when choosing specific tillage practices.

Because this is such a broad topic, we necessarily must limit its scope. First, we only study Northern Ethiopia. Although CA could be used in the climatic regions of the other parts of Ethiopia, the technology's ability to improve the environment and conserve soil and water resources appear to be more appropriate for northern parts of the country. Furthermore, we focus on areas dominated by dryland agriculture. Therefore, the estimates of WTA conservation agriculture should be treated as an upper bound. Second, we need to limit the scope of our analysis in terms of the specific type of CA technology that we are studying. In fact, conservation tillage is of particular interest because of the large technical potential to expand use of the practice to sequester atmospheric carbon and its cost-effectiveness as a means of carbon abatement (McCarl and Schneider 2001).

However, determining incentives for converting conventional farming into conservation farming is not straightforward because: (1) there is uncertainty about the costs of conservation farming and , actual yields as compared to conventional farming ; (2) some returns in terms of yield increase from conservation farming accrue in the distant future, causing disruptions in income flows that could increase incentive demanded; (3) landowners have varying preferences towards conventional farming versus conservation farming . Non-market values and risk attitudes play a significant role in farming decisions, so compensation set equal to carbon storage may not be appropriate for convincing landowners to change their conventional farming into conservation farming. Information from a contingent valuation survey is valuable in this context, because it is able to incorporate non-market values and risk attitudes, as well as unobservable transactions costs, into the compensation amount (Shaikh et al. 2005).

To this end, our survey explicitly asked landowners about their willingness to accept (WTA) compensation for participation in Climate Smart Agriculture (CSA) program. The purpose is to compare the costs of climate mitigation in agriculture when compensation demanded is used instead of using the international carbon price and determine if conservation agriculture is a cost-effective means of achieving food security and climate change mitigation as well as feasible given the local condition in Ethiopia and similar developing countries.

The rest of the paper is organized as follows. The next section gives a brief overview on why Northern Ethiopia is appropriate for CA. Section 3 develops the analytical framework formally defining WTA and relating it to key categories of explanatory variables that will be investigated empirically. Section 4 outlines the survey design, content, motivates, and explains the choice of variables for empirical analysis. Section 5 presents the econometric approach to the data and the main results. In Section 6 we offer some conclusions, discuss policy, and research implications

2. Why is Conservation Agriculture Relevant to Ethiopian Higlands

Tigray is the northern most region of Ethiopia located at latitude of 12 to 15 degree North and Longitude of 36 c 30" to 41 30" East and covers an area of 53,000 square kilometres (Hagos et al., 1999; and Tesfay, 2006). Tigray's population is around 4.3 million and growing at 2.5 percent,

where 80.5 percent resides in rural areas (FDRE, 2007). Administratively, the region has 35 *woredas*, 12 town woredas, and 665 *tabias*. Each woreda is subdivided into tabias and each tabia is divided into *kushets*. The region is relatively dry and is subject to frequent drought (Haward and Smith 2006). Average annual rainfall ranges between 500 and 900 mm yr^{-1}, with a unimodal pattern except in the southern and eastern highlands where a second, smaller rainy season allows local growing of two successive crops within one year (Nyssen et al.2005). Taking into account rainfall, atmospheric temperature, and evaporation, more than 90 % of the region is categorized as semi–arid (Taffere 2003). The rainfall is characterized by high spatial and temporal variability, and by frequent occurrence of drought. Poor soil quality and moisture stress are the two major constraints of agricultural productivity in Tigray. Studies indicate that the soils in highlands of Tigray are deficient in major soil macronutrients and organic carbon (Hailemariam et al. 2008).

A number of studies indicate that environmental degradation and the deterioration of the natural resource base have become serious problems in Ethiopia, mainly in the Ethiopian highlands. For instance, on the basis of the Ethiopian Highland Reclamation Study (EHRS) (FAO 1986), by the mid-1980s, about half of the highland area (27 million hectares) was "significantly eroded". Fourteen million hectares (over one-fourth) was "seriously eroded" and over 2 million hectares are described as "beyond the point of no return". Estimates indicate that the physical gross annual soil loss ranges from 42 –103 t/ha/yr (FAO, 1986). In the absence soil and water conservation measures, the rate of mean annual soil loss from cropland is estimated to be 57 t/ha/yr (Gebremichael et al. 2005).It was estimated that in 1990 alone, 57,000 to 128,000 tons of grain production was lost due to reduced top soil depth caused by soil erosion (Demel 2001).

Therefore, considering the potential environmental benefits of CA particularly, Conservation tillage (i.e. it is an efficient use of land and it saves water). It is fair to say that conservation agriculture is more appropriate technology in the region than elsewhere in Ethiopia.

3. Survey Design and Adminstration

A questionnaire was filled in 2014 to randomly selected 330 farmers selected from 3 districts in the Tigray Regional State of Ethiopia (see Figure 1 for geographic location). Farmers with no land were omitted from the survey sample since farmers without land were unlikely to participate in the conservation agriculture practices. The survey included a brief, personalized cover letter explaining the purpose of the questionnaire, a definition of conservation agriculture practices such as MT, and ZT as well as carbon offset credits. In addition to willingness to accept compensation for changing conventional tillage into conservation tillage, the actual survey also elicited detailed information on a farmer's agricultural operations including opinions about and awareness of climate change issues and carbon credits, and personal characteristics and demographics. Farmers were informed about conservation farming and its benefit in minimizing disturbance of soil by tillage, reduction of land and water pollution and soil erosion, reduction of long-term dependency on external inputs, enhancing environmental management , improving water quality and water use efficiency, and reduction of greenhouse gases.

The first series of questions in the survey was meant to reduce information biases by familiarizing respondents with the topic and issues under investigation before asking them about their willingness

to accept specific conservation farming practices. Landowners were presented a hypothetical climate smart agriculture program that aims mitigation of climate change and achieving food security through promotion of conservation farming practices such as MT and ZT while also compensating for the loss of agricultural production at the initial stage[15]. They were also informed that the program would give training and equipment for using specific farming practice to ensure that they enter into a 5-year commitment to adopt a particular tillage system.

Immediately following this was a question about whether the landowner would consider enrolling the whole or parts of their agricultural land given sufficient compensation in the Climate Smart Agriculture program (CSA). Following these questions, was an open-ended question about the approximate land in "tsmidi" to enroll in the program and the minimum compensation per "tsimdi" as annual payment to set aside for specific conservation tillage practice? However, farmers were also informed that only a limited number of households in the village would be selected and the smaller the amount of compensation they require to participate in the program, the higher are the chances of being selected.

Methodologically, it was challenging to ask landowners their WTA in the CV format we used. One problem we have discussed is the difficulty farmers likely had in conceptually combining both a rough estimate of yield loss when they adopt conservation tillage and their own preferences for conventional versus conservation tillage practices, yielding potential uncertainty in WTA responses. Another challenge, sometimes raised in the CV literature, is potential strategic bias. Although we explicitly stated that the answers would not be used to calculate actual compensations, and the program would enroll only few households and the smaller the amount of compensation they require to participate in the program, the higher are the chances of being selected, we cannot rule out that some land owners may have answered strategically by inflating WTA responses.

4. Modelling Decision to Convert Conventional Farming Into Conservation Farming

In this study, a discrete-choice random utility maximization (RUM) framework is used to model the decision of a landowner to convert conventional farming into conservation farming. The landowner will accept a compensation to adopt conservation tillage (CT) so as long as the compensation offered is at least as much as the opportunity cost of changing tillage practice plus any positive or negative non-market/risk benefits that he/she gets from conservation tillage. This decision can be modeled as follows: Landowner i will accept a conservation tillage (a = 1) as long as $v_{i,1}(m+\Delta m, \mathbf{s})+\varepsilon_{i,1} > v_{i,0}(m, \mathbf{s}) + \varepsilon_{i,0}$, where Δm is the compensation offered minus forgone expected annual net returns from conventional tillage (OC). Since utility is a random variable, the probability that a farmer's choice to accept the bid can be written (suppressing subscript i) as (Hanemann 1984; Greene 2000):

[15] *conservation tillage usually leads to lower yields in early years before soil nutrients build up (Kurkalova et al., 2006)*

$$\Pr(a=1) = \Pr\{v_1(m+\Delta m, \mathbf{s})+\varepsilon_1 > v_0(m, \mathbf{s})+\varepsilon_0\} = \Pr\{(\varepsilon_1 - \varepsilon_0) > -[v_1(m+\Delta m, \mathbf{s}) - v_0(m, \mathbf{s})]\} \quad (1)$$

Replacing $[v_1(m+\Delta m, \mathbf{s}) - v_0(m, \mathbf{s})]/\sigma$ with Δv and $(\varepsilon_1 - \varepsilon_0)/\sigma$ with ε, where $\varepsilon \sim N(0,1)$ is i.i.d. because ε_1 and ε_0 are i.i.d., yields the probit model:

$$\Pr(a=1) = \Pr(\varepsilon > -\Delta v) = F_\varepsilon(\Delta v), \quad (2)$$

where F_ε is the normal cumulative distribution function (cdf).

The decision to accept the proposed compensation is based on the returns from parcel of land that is, assumed the one a landowner would commit to conservation tillage. Thus, the landowner will compare $v_1(m+B-OC, \mathbf{s})$ against $v_0(m, \mathbf{s})$, where B is the compensation and OC is the opportunity cost of foregone agricultural production on a per acre basis and $\Delta m = B-OC$. While the opportunity cost represents foregone agricultural net returns from accepting conservation tillage, the total compensation required by the farmer may be increased by other non-market values associated with keeping the land in conventional tillage (e.g., the landowner may prefer conventional tillage or feels a commitment to adopt previous technology) and/or reduced by non-market values associated with conventional tillage . Compensation demanded is also affected by landowners' perceptions about the reduced risk of fixed annual payments (at least over the contract period), increased risks associated with payment for agri-environmental services (assuming these develop) after the initial contract period, and so on.

However, while the willingness to adopt conservation agriculture can be modelled in a single equation, modelling the extent of compensation for conservation agriculture in a single equation creates a selection bias. The extent of compensation is conditional on first willingness to adopt conservation agriculture, and therefore, there is need to control for the factors that affect adoption before assessing determinants of extent of compensation. Single equation approaches to these types of problems fail to capture the logical two-step decision process that potential participants undertake. We therefore employ a two-step discrete-continuous modelling approach to capture this decision-making. Specifically, we use a two-step Heckman sample selection-correction model (Heckman 1979) where we first model the willingness to adopt conservation agriculture and then, conditional on the willingness to adopt conservation agriculture, assess the determinants of the intensity of adoption in the second stage.

$$Y_i = X_i\beta \quad \text{if } i^* = X_{2i}\beta_2 + \mu_i > H, \quad (3)$$

$$Y_i = 0 \quad \text{if } i^* = X_{2i}\beta_2 + \mu_i < H,$$

Where Y_i is the probability of willingness to adopt conservation agricultural practices, i^* is the unobservable latent, H is unobservable threshold value, and X_{2i} are the independent variables that are used to explain the extent of compensation needed.

As explained in the empirical model above, two sets of dependent variables, for selection and outcome equations were chosen for statistical analysis. The dependent variable (Willingness), for the selection equation was binary in nature, taking the value of "1" if landowners were willing to adopt conservation tillage given compensation, and "0" if otherwise. Similarly, the dependent

variable (intensity of conservation farming), for the outcome equation was also designed as continuous variable.

The independent variables, contained in the selection and outcome equations were grouped into three categories: socio-demographic variables, factor endowments, and access to institutional factors. The first category included variables that capture socio-demographic variables such as: gender, age, education, family size, number of hired labor and distance to markets. Since landowner's willingness to accept conservation tillage or not was likely be guided by their socio-demographic conditions, it was assumed that these variables could determine landowner willingness to accept conservation tillage.

The definition and descriptive statistics of all variables are presented in Table 1. Among the vector of socio-demographic variables, GENDER was expected to have a positive relationship with the outcome dependent variable because male-headed households tend to have more social ties compared to their women headed counterparts and women are in general more risk averse than men (e.g. Jianakoplos and Bernasek 1998). Similarly, the variable AGE was expected to have a negative association with landowner willingness to accept conservation tillage. This was possibly because older farmers tend to have shorter planning horizons (Gould et al., 2008), tend to be risk averse (Mazvimavi and Twomlow 2009) and are more dogmatic in farming practices and it is difficult to induce them to change their mindset from existing agricultural practices (Kumar et al. 2010). With higher levels of education, it would be easier for the operators to obtain and understand information with respect the applicability of CT to their farming environment and determine the potential impacts on long-run profits (Gould et al.2008). Hence, a positive association of the variable EDUCATION was expected with landowner willingness to accept climate smart agricultural practices such as conservation tillage. Larger families, where labour is sufficiently available, adoption of CT may not bring much benefit especially in resource poor areas (Kumar et al. 2010).

Therefore, a negative association of the variable FAMILY SIZE and landowner's willingness to accept conservation farming was expected. MODEL FARMER was used to represent the importance government recognition for progressive farmers in willingness to accept conservation tillage made by landowners. It takes a value of '1' for those landowners who were recognized as model farmer by local administration and '0' if otherwise. While progressive farmers are smarter in adopting new technology, they may also need confirmation or verification to ensure conservation tillage is useful and profitable (Hussain et al. 2010). Therefore, the sign of MODEL FARMER in the willingness to accept CSA was uncertain and had to be found empirically.

The second category of variables included factor endowments such as size of land (LAND), livestock in TLU (LIVESTOCK), household expenditure per adult equivalent (EXPENDITURE) and hired labor (LABOR). All variables were measured in a continuous scale. Earlier research indicated that landowners owning larger tracts of agricultural land have a greater output over which to spread the cost of new technology; therefore it is economically more viable for them to adopt earlier as compared with a small farms, *ceteris paribus* (Davey & Furtan 2005). Moreover, large land size also implies that farmers can diversify into other crops and reduce the inherent risk in agricultural production.

Hence, a positive association of the variable LAND was expected with landowner willingness to accept climate smart agricultural practices such as conservation tillage. While farm households with more livestock may give priority to reserving crop residue for livestock feed rather than preserving for use as mulch on conservation farming plots (Mazvimavi and Twomlow, 2009), farmers with access to draft power may be reluctant to practice most components of conservation farming as they can opt for a conventional draft animal tillage system. Therefore, the sign of LIVESTOCK with the willingness to accept CSA was uncertain and had to be found empirically. Similarly, the variable EXPENDITURE was expected to have a positive relationship with the outcome dependent variable because conservation tillage involves some potential yield loss and investment into new machinery (Wang et al. 2010), therefore farmers with less wealth may be less willing to accept conservation tillage. A major reason for adopting conservation tillage, in addition to its effect on soil loss, is the lower labor requirements when compared to traditional cultivation methods. This characteristic could be important for the producer who hired labor. Therefore, the variable HIRED LABOR was expected to have a positive relationship with the willingness to accept conservation tillage practices.

The third category was composed of institutional variables such as credit, PSNP, extension service, access to irrigation service and institutional membership. Earlier research (Hussain et al. 2010) indicated that agricultural farms where the ground water is not fit for irrigation have vast potential for adopting NT system because poor quality of water requires that the farmers may adopt water conservation technologies. Therefore, IRRIGATION which was assigned a value of '1' for those farmers who have access to irrigation and '0' if otherwise, was also expected to have a negative association with both sets of dependent variables.

EXTENTION was used to represent the importance of extension service as a source of backup technical support in willingness to accept conservation tillage by the landowners. It takes a value of '1' for those landowners who had access to extension service in farming and '0' if otherwise. Since access to a government agricultural extension service can be a learning tool, a positive association was expected between the variable EXTENSION and both sets of dependent variables. Similarly, aadoption of CT is hypothesized to be information–intensive, information and learning –related variables including membership in a farmer group. It takes a value of '1' for those landowners who were a member of a farmer group in their village and '0' if otherwise. MEMBERSHIP in a farmer group is therefore, expected to contribute positively to the willingness to accept conservation tillage. Moreover, previous research (Wang et al. 2010) indicated that families who have more members in the off-farm labor market look for ways to save labor and thus adopt conservation tillage more often. PSNP which is a public works program run by the government was included to capture how access to off-farm work could affect the willingness to accept conservation tillage. PSNP was binary in nature, taking the value of "1" if landowner is targeted for the public works program and '0' if otherwise, was also expected to have a positive association with both sets of dependent variables.

5. Results and Dicussions

5.1 Descriptive Statistics Results

Table 1 presents the definitions and sample statistics of the variables used in the analysis. Also presented in the table is the difference in means of the variables used in the econometric analyses along with their significance levels. The significance levels suggest that there are some differences between households willing to adopt conservation tillage and that are not with respect to many variables. Out of the total 330 sample households 186 (53.3%) and 144 (43.6%) were willing to accept MT and ZT respectively. Concerning the descriptive statistics of the variables that expected to influence the willingness to MT and ZT, there appear to be statistically significant differences in gender and, age of the household head, ownership of land, household expenditure, and access to institutional support in terms of credit, PSNP, irrigation and information related to climate change. There are also significant differences memberships of any organization, being a model or progressive farmer, having an official position in the village and distance to a local market between households willing to adopt zero tillage and that are not.

Table 1: Mean separation tests of households willing to accept no-till and not willing to accept

Variable name	Willing (n=144)	Not Willing (n= 186)	p-value*
	Mean (SE)	Mean (SE)	
Gender of the household head (= 1 if male,0 otherwise)	0.87 (0.03)	0.78(0.03)	0.0509*
Age of the household head in years	49.8(1.09)	46.6(0.91)	0.0226**
Educational level of the household head in years	3.25(0.28)	3.04(0.25)	0.5848
Family size of the household	6.10(0.18)	5.78(0.16)	0.1858
Size of land owned in Tsimdi (= 0.25 ha)	5.00(0.23)	3.31(0.18)	0.0000***
Number of Livestock owned in TLU	7.54(0.19)	7.00(0.18)	0.0407**
Model Farmer (= 1 if the household head is a model, 0 otherwise)	0.38(0.41)	0.24(0.03)	0.0067***
Awareness of Climate Change (= 1 if the household is aware of CC)	0.76(0.04)	0.74(0.03)	0.6536
Hired labor	0.39(0.04)	0.13(0.03)	0.0000***
Distance to local market in munities	55.8(3.78)	71.6(3.78)	0.0039***
Distance to major market in munities	127(4.18)	124(3.68)	0.5699
Distance to DA office in munities	44.7(3.72)	50.0(3.09)	0.2844
Access to agricultural extension (= 1 if yes , 0 otherwise)	0.97(0.02)	0.96(0.01)	0.889
Access to irrigation (= 1 if yes , 0 otherwise)	0.53(0.04)	0.38(0.04)	0.0040***
Access to extension service related to climate change (=1 if yes)	0.43(0.05)	0.28(0.03)	0.0089***
PSNP (= 1 if the household is beneficiary of PSNP)	1.82(0.21)	2.18(0.08)	0.0770*
Access to credit (=1 if yes, 0 otherwise)	0.76(0.07)	0.60(0.04)	0.0246**
Official position (= 1 if yes , 0 otherwise)	0.51(0.04)	0.40(0.04)	0.0681*
Membership in an organization (=1 if yes , 0 otherwise)	0.43(0.04)	0.75(0.32)	0.0000**

* Significant at 10%; ** significant at 5%, *** significant at 1 %

Quite interesting is the significant difference between households willing to adopt zero tillage and those not willing regarding hired labor. 39 % of the households willing to adopt zero – tillage hired labor while the corresponding figure for non-willing households is 13 %, revealing how conservation tillage might reduce labor usage as compared the conventional tillage. There are also significant differences between households willing to adopt zero-tillage and non-willing households in terms of gender and age of the household head. On average, 87 % of the households willing to adopt zero tillage tend to be male headed, while the corresponding figure for non-willing households is 87%. Male-headed households tend to be more willing to adopt conservation tillage because they to tend to have more social ties compared to their women headed counterparts and women are in general more risk averse than men (e.g. Jianakoplos and Bernasek 1998). Thus, one would expect the risk premium to be smaller for men than for women.

Many researchers argued that younger farmers may exhibit higher likelihood of adopting conservation farming than their older counterparts (Amir 2006), possibly because older farmers tend to have a shorter planning horizons (Gould et al. 2008), tend to be risk averse (Mazvimavi and Twomlow 2009) and are more dogmatic in farming practices and it is difficult to induce them to change their mindset from existing agricultural practices (Kumar et al. 2010). In contrast to this traditional view, our survey indicated that older farmers are more willing to adopt zero-tillage than their younger counterparts are. Our finding is similar to Mazvimavi et al. (2009). Furthermore, households willing to accept MT and ZT have significantly larger size of agricultural land than their non-willing counterparts do. Landowners owning larger tracts of agricultural land have a greater output over which to spread the cost of new technology (Davey & Furtan 2009).

Table 2 shows that households the total expenditure of households willing to accept MT and ZT is significantly higher than those who did not. This could possibly because CT technology involves some potential yield loss and investment into new machinery (Wang et al. 2010). The findings from the previous section that simply compare mean differences in the outcome variables and other household variables between land owners who were willing to accept conservation tillage and that did not accept suggest that landowners who are willing to accept conservation tillage practices are generally better off than those who were not. To this end, Multivariate approaches that account for selection bias arising from the fact that landowners who were willing to accept conservation tillage and those did not may be systematically different are essential in providing sound estimates of the determinant and intensity of willingness to accept conservation tillage.

Table 2 Mean separation tests of households willing to accept minimum –tillage and not willing to accept

Variable name	Willing (n= 144)	Not Willing (n= 186)	p-value*
	Mean (SE)	Mean (SE)	
Gender of the household head (= 1 if male,0 otherwise)	0.87 (0.03)	0.78(0.03)	0.0509*
Age of the household head in years	49.8(1.09)	46.6(0.91)	0.0226**
Educational level of the household head in years	3.25(0.28)	3.04(0.25)	0.5848
Family size of the household	6.10(0.18)	5.78(0.16)	0.1858
Size of land owned in Tsimdi (= 0.25 ha)	5.00(0.23)	3.31(0.18)	0.0000***
Number of Livestock owned in TLU	7.54(0.19)	7.00(0.18)	0.0407**
Model Farmer (= 1 if the household head is a model, 0 otherwise)	0.38(0.41)	0.24(0.03)	0.0067***
Awareness of Climate Change (= 1 if the household is aware of CC)	0.76(0.04)	0.74(0.03)	0.6536
Hired labor	0.39(0.04)	0.13(0.03)	0.0000***
Distance to local market in munities	55.8(3.78)	71.6(3.78)	0.0039***
Distance to major market in munities	127(4.18)	124(3.68)	0.5699
Distance to DA office in munities	44.7(3.72)	50.0(3.09)	0.2844
Access to agricultural extension (= 1 if yes , 0 otherwise)	0.97(0.02)	0.96(0.01)	0.889
Access to irrigation (= 1 if yes , 0 otherwise)	0.53(0.04)	0.38(0.04)	0.0040***
Access to extension service related to climate change (=1 if yes)	0.43(0.05)	0.28(0.03)	0.0089***
PSNP (= 1 if the household is beneficiary of PSNP)	1.82(0.21)	2.18(0.08)	0.0770*
Access to credit (=1 if yes, 0 otherwise)	0.76(0.07)	0.60(0.04)	0.0246**
Official position (= 1 if yes , 0 otherwise)	0.51(0.04)	0.40(0.04)	0.0681*
Membership in an organization (=1 if yes , 0 otherwise)	0.43(0.04)	0.75(0.32)	0.0000**

* significant at 10%; ** significant at 5%, *** significant at 1 %

5.2 Econometric Results and Discussions

Tables 3 and 4 present the results of Heckman selection model for Minimum Tillage (MT) and No-tillage (NT) respectively. The correlation between the error terms and the WTA of MT and NT in Table 3A and 4A is significant. This indicates a problem of selection bias, which justifies the use of Heckman selection model for willingness to accept MT and ZT. The Wald Chi2 test is also significant, so the null hypothesis stating that all variables can be jointly excluded can be rejected, confirming that the model fits well. Many of the coefficients of the control variables in the equations (column 1 of Table 3 and 4) are statistically significant. For example, farmers with old age were more willing to accept minimum tillage and no tillage than their young age counterparts. This is contrary to our expectation. However, as farmers grow older, they become more skilful, through learning by doing (Mazvimavi and Twomlow 2009). In addition, a farmer who is involved in farming for a longer time may be more aware of how soil fertility is decreasing and its negative effect on yield over time. Hence, older farmers are more conscious of the benefits of conservation farming and tend to be more willing to accept conservation tillage (Kumar et al. 2010). Similarly, education of the household head significantly increases the probability of willingness to accept MT but the impact is significant for NT. With higher levels of education, it would be easier for the operators to obtain and understand information with respect the applicability of CT to their farming

environment and determine the potential impacts on long-run profits (Gould et al. 2008). An interesting observation is the significant and positive effect of awareness about climate change for the willingness to accept MT and ZT technologies. This is possible because with awareness on climate change farmers might use difference adaptation strategies including conservation farming practices.

Table 3. Regression results of Willingness to accept Minimum Tillage (HECKMAN RESULTS)

Variable definition	Selection equation	Outcome equation
Age of the household head	0.018**	0.017**
	(0.009)	(0.008)
Education of the household head in years	0.066*	0.044
	(0.035)	(0.032)
Gender of the household head (= 1 if Male , 0 , otherwise)	-0.042	0.008
	(0.255)	(0.245)
Family size of the household	0.626**	0.065
	(0.273)	(0.143)
Model Farmer (= 1 if model , 0, otherwise)	0.162	-0.164
	(0.160)	(0.199)
Distance to local market in munities	-0.005**	-0.004**
	(0.002)	(0.002)
Awareness of climate change (= 1 if yes , 0, otherwise)	0.075**	0.048
	(0.022)	(0.207)
Land owned by the household in Tsimdi	0.170***	0.167***
	(0.047)	(0.045)
Number of livestock owned in TLU	-0.586**	-0.019
	(0.271)	(0.138)
Total household Expenditure	0.157***	0.001**
	(0.000)	(0.001)
Number of hired labour	0.574*	0.119
	(0.316)	(0.247)
Dummy if the household is targeted for PSNP (=1 if yes , 0, otherwise)	0.706**	0.195
	(0.345)	(0.241)
Access to Irrigation (= 1 if yes , 0 ,otherwise)	-0.147	-0.322
	(0.096)	(0.364)
Access to credit (= 1 if yes , 0 ,otherwise)	0.003	0.002
	(0.002)	(0.003)
Access to extension service (= 1 if yes , 0 ,otherwise)	-0.018	0.058
	(0.481)	(0.472)
Membership to a farmer group (= 1 if yes , 0 ,otherwise)	-0.917***	0.137***
	(0.200)	(0.185)
Official position in village/ tabia(=1 if yes , 0, otherwise)	-0.127	0.106
	(0.204)	(0.152)
Constant		0.626
		(0.182
Rho	-0.734*	
	(0.224)	

* Significant at 10%; ** significant at 5%, *** significant at 1 %

Most importantly, our Heckman selection model result shows that the willingness to accept CA is affected by the factor endowments at the household level. For example, farmers with larger plot size were also likely willing to accept MT and ZT. The results are supported by similar studies on the effect of farm size and technology adoption .Where, Mazvimavi and Twomlow (2009), Gould et al. (2008) and Kumar et al. (2010) have all concluded that the bigger the plot size, the greater the chances of adopting CA. This is mainly because farmers with large arable land have the opportunity to spare some sections to try out new practices at less risk and large land size implies

that farmers can diversify into other crops and reduce the inherent risk in agricultural production. Similarly, ownership of livestock will constrain the willingness to accept minimum tillage. This finding is consistent with the fact that farmers with access to draft power may give priority to reserving crop residue for livestock feed rather than preserving for use as mulch on conservation farming plots (Mazvimavi and Twomlow 2009)

We also see evidence from Table 4A and 5A, the coefficient of the variable EXPENDITURE (which is positive and significant) suggests that rich farmers more likely willing to accept conservation agriculture technology than poor ones. This suggests that –keeping other factors constant- a policy that seeks to assist farmers in financing their initial adoption indeed appears to enhance the willingness to accept conservation tillage practices. The coefficient of the variable measuring for number of HIRED LABOUR is positive and statistically significant in both the willingness to accept ZT and MT technology. This finding is consistent with the fact that CT technology is labour saving. Hence, factor endowments appear to be one of the most important determinants on the willingness to accept of conservation tillage

Interestingly, the coefficient of access to irrigation was significant but negative for both MT and ZT, providing support for the notion that conservation agriculture saves water and increase water use efficiency, while it might also indicate that farmers with access to irrigation are already diversified towards high value vegetables.

Table 4. Regression results of Willingness to accept Zero- Tillage (HECKMAN RESULTS)

Variable definition	Selection equation	Outcome equation
Age of the household head	0.015*	0.017**
	(0.008)	(0.008)
Education of the household head in years	0.016	0.044
	(0.030)	(0.032)
Gender of the household head (= 1 if Male , 0 , otherwise)	0.023	0.008
	(0.243)	(0.245)
Family size of the household	0.381	0.065
	(0.261)	(0.143)
Model Farmer (= 1 if model , 0, otherwise)	0.162	-0.164
	(0.160)	(0.199)
Distance to local market in munities	-0.001	-0.004**
	(0.002)	(0.002)
Awareness of climate change (= 1 if yes , 0, otherwise)	0.624**	0.048
	(0.285)	(0.207)
Land owned by the household in Tsimdi	0.170***	0.167***
	(0.047)	(0.045)
Number of livestock owned in TLU	-0.586**	-0.019
	(0.271)	(0.138)
Total household Expenditure	0.157***	0.001**
	(0.000)	(0.001)
Number of hired labour	0.702**	0.119
	(0.295)	(0.247)
Dummy if the household is targeted for PSNP (=1 if yes , 0, otherwise)	0.193	0.195
	(0.322)	(0.241)
Access to Irrigation (= 1 if yes , 0 ,otherwise)	-0.147	-0.322
	(0.096)	(0.364)
Access to credit (= 1 if yes , 0 ,otherwise)	0.002	0.002
	(0.003)	(0.003)
Access to extension service (= 1 if yes , 0 ,otherwise)	-0.203***	0.058
	(0.199)	(0.472)

Membership to a farmer group (= 1 if yes , 0 ,otherwise)	-0.818***	0.137***
	(0.179)	(0.185)
Official position in village/ tabia(=1 if yes , 0, otherwise)	0.190	0.106
	(0.148)	(0.152)
Constant		0.626
		(0.182
Rho	-0.734*	
	(0.224)	

*** Significant at 10%; ** significant at 5%, *** significant at 1 %**

5.3 Mean WTA Measures for Conservation Tillage

In order to get an estimate of how much it would cost to reach climate change mitigation through conservation tillage technologies, we first calculate and report the mean WTA for the two conservation tillage practices i.e. for Minimum tillage (MT) and zero tillage (ZT). The mean minimum compensation for accepting MT and ZT was found to be 2,400 Birr (117 USD) and 3,750 Birr (183 USD) per tsimad \year respectively. McCarthy et al. (2011) estimated that the cost of investment and maintenance costs for minimum tillage in Ghana to be 220 and 212 US$\ha\year respectively, while an investment and maintenance costs for medium –scale no tillage was 600 and 400 US$\ha\year respectively. Given this, the WTA minimum compensation for voluntarily agri-environmental service in Ethiopia to mitigate climate change is higher than the actual investment and maintenance costs in Ghana and Morocco.

6. Conclusion and Policy Recommendations

This paper has made a rare contribution to the analysis of Ethiopian smallholder farmers' preferences and willingness to accept conservation tillage for enrolling their agricultural land in a voluntary Climate Smart Agriculture (CSA) program. We have shown how in principle their WTA can be defined as a sum of compensation for yield reduction at the initial stage of adopting and a non-market welfare measure depending on his/her preferences for conventional versus conservation tillage. The theoretical approach is developed to link the CV approach we use to analyze WTA, with the standard valuation literature. We then conducted a representative CV survey of 330 smallholder farmers in the three districts of the Tigray Regional State of Ethiopia, analyzing the factors determining WTA conservation agriculture and its intensity, and deriving mean WTA. These results about 53 % and 43 % of the land owners are willing to participate (adopt) minimum and zero tillage practices respectively. Using a rich dataset, we further find that WTA conservation tillage is negatively related to ownership of livestock, irrigation, distance to local market, extension service and membership to a farmer group, and positively related to age and education of the household head, awareness of climate change by the household, ownership of land and income, hired labor and off-farm income such as PSNP. This finding shows that, while incentives offered influences willingness of landowners to adopt or participate in climate smart agricultural practices, it is clearly not the sole driver of participation decision. Increasing the annual payment may induce participation but other changes to the program may be necessary as well. The model results also identified potential constraints to conservation tillage adoption in the region, such as shortage of livestock feed ,suggesting that the unique needs of mixed crop-livestock farming systems, hinder further diffusion of conservation tillage. Future policy should consider

addressing the needs of Ethiopian farmers, particularly crop producers heavily engaged in livestock activities.

We also find indications that landowners in the region demand higher compensation, and the overall mean WTA per year per timid of land is estimated at ETB 2,400 (117 USD) and ETB 3, 750 (183 USD) for minimum and zero tillage's respectively. Methodologically, it was challenging to ask landowners their WTA in the CV format we used. One problem we have discussed is the difficulty forest owners likely had in conceptually combining both a rough estimate of yield loss when they adopt conservation tillage and their own preferences for conventional versus conservation tillage practices , yielding potential uncertainty in WTA responses. Another challenge, sometimes raised in the CV literature, is potential strategic bias. Although we explicitly stated that the answers would not be used to calculate actual compensations, and the program would enroll only few households and the smaller the amount of compensation they require to participate in the program, the higher are the chances of being selected, we cannot rule out that some land owners may have answered strategically by inflating WTA responses.

In general, the findings of the econometric model were consistent with expectations based on theoretical expectations and findings from previous studies in adoption literature. These findings are critical for the researchers and the extension agents prior to planning the dissemination. In order to achieve maximum adoption, effective targeting of the population as well as packaging of information and the messages is necessary to suit the socioeconomic setup of the farmers. Generalized information dissemination without prior consideration of the observed relationships is likely to lead to non-adoption.

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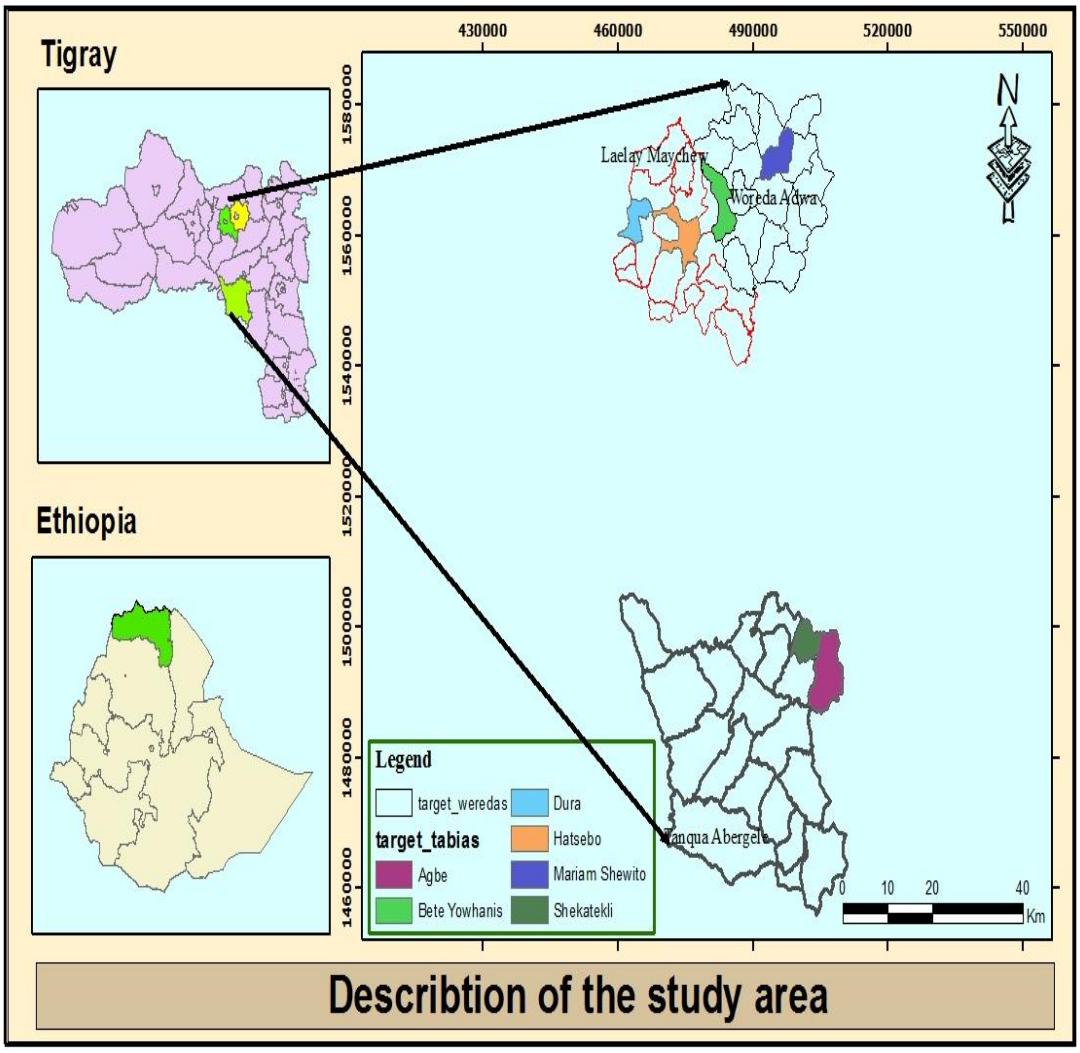
FIGURE 1A: Map of the Study Area



Remittances and Africa's Agricultural Technical Efficiency: Panel Data Analysis

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Abstract

The paper examines the impact of international remittances on agricultural technical efficiency across 35 African countries. Panel data that covers 17 years was used to estimate the stochastic production frontier. To check our estimation against alternative specifications, different models are estimated and results remained almost qualitatively similar, showing result robustness. All the determinants of technical inefficiency (our main focus), were found to have the expected sign and three of them were significant: mobile phones per 100 persons and real exchange rate (1% level of significance) and official development assistance (10%). While the variable of interest international remittances as percentage of GDP, contrary to most widely available literature, they neither positively nor negatively affected technical efficiency of agricultural (cereal sub-sector) in Africa. However the three significant variables were found to affect inefficiency negatively. The negative relationship between mobile infrastructure, official development assistance and real exchange rate has important policy implications in supporting the efforts to achieve fast economic growth and reduce poverty in the continent.

1. Introduction

Most Africans who are in poverty (76% of the total poor) live in rural areas, and almost all rural households depend directly or indirectly on agriculture (World Bank 2007). Given the sector's large contribution to the overall economy, its substantial indirect impact on growth in other sectors, and the extent to which poor people participate in the sector, agriculture's role remains indispensible in fighting against poverty (Christiaensen, Demery & Kuh 2011). The current development thinking, both at the international forum and African Development Agenda, (Millennium Development, Sustainable Development by 2030 and Africa Agenda 2063) focuses on poverty reduction rather than economic growth per se. Hence, a robust agricultural growth is a key factor to address the pervasive poverty and food insecurity in Sub-Saharan Africa (SSA).

In the past decades a new momentum have seen observed in the continent to transform African agriculture, driven by national governments and multilateral institutions, such as specialized civil society organizations like the Alliance for a Green Revolution in Africa (AGRA), the United nation's Consultative Group on International Agricultural Research (CGIAR) and others (Africa Progress Panel, 2010). Block (1994) reported a recovery of aggregate agricultural productivity in Sub-Saharan Africa during the 1980s. The finding was subsequently, confirmed by a number of studies (Thirtle, Hadley & Townsend 1995; Lusigi & Thirtle 1997; Nin-Pratt & Yu 2008).

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According to FAO, gross agricultural production in Sub-Saharan Africa (SSA) grew at an average annual rate of 2.6 per cent between 1961 and 2008. Since 1991 agricultural growth has been higher at 3.1 per cent per year. However, when we compare the growth of SSA's, agricultural production with the population growth rate (nearly 2.7 percent per annum) of the same period, and the growth rate in food production per person in Asia, Africa's food production per person barely improved at all (Africa Progress Panel 2010). Hence, the poor performance of the agricultural sector explains much of the slow progress towards reducing poverty and hunger in Africa. African agriculture's historically poor performance might reflect long-term underinvestment in Research and Development, poor infrastructure, poor agricultural and macroeconomic policies (such as, credit constraint, low pricing of agricultural commodities, etc.), and lack of political stability rather than its growth potential of the sector (Block 2014).

It seems against these backdrops, the African Head of States come-up with a new initiative called The New Partnership for Africa's Development (NEPAD), which adopted in 2003 in Maputo. To achieve its objectives, the NEPAD stressed to focus on the key pro-poor sectors, such as, health, education, infrastructure and agriculture. Recognizing the role of agriculture for the alleviation of poverty and hunger in the continent, African Governments (NEPAD) in collaboration with the United Nations Food and Agricultural Organization (FAO) developed, the Comprehensive Africa Agriculture Development Programme (CAADP). Accordingly, Heads of State in 2003 pledged at Maputo to devote at least 10% of national budgets to agriculture in an effort to raise agricultural growth to 6% a year, a rate that is need to reduce poverty by half.

Recognizing the role of agriculture as central for the alleviation of poverty and hunger on the continent, African Governments'in collaboration with the United Nations Food and Agricultural Organization (FAO) developed the Comprehensive Africa Agriculture Development Programme (CAADP). They pledged to devote at least 10% of national budgets to agriculture in an effort to raise agricultural growth to 6% a year, a rate that need to be achieved to reduce poverty by half. While several countries have increased the share of total spending allocated to the agriculture sector, comparing the pre-CAADP (1995–2003) and post-CAADP (2003–2010) periods, only a handful of countries stand achieved the target resulting in the low performance seen for Africa as a whole(Benin et al., 2011). With the exception of Kenya and South Africa, the big agricultural economies in SSA[18] covered in this study (Nigeria, Sudan, Ethiopia, Tanzania and Cote d'Ivoire) spent less than 0.5% (Benin et al. 2011). Grossly, this means agriculture is under-financed in terms of extension services, credit for inputs, research support, etc. Hence, among other things, investment/finance is becoming a critical factor for the renaissance of African Agriculture.

On the other hand, one strategy of escaping poverty that Africans employ is migration. Its scale has risen with almost 4% of the total African population or 31 million international migrants, and there has been a concomitant increase in the amount of remittances leading some scholars questioning the effects of this migration on agriculture (Castles & Miller 1998; Ratha,

[18] *The largest agricultural economies are Nigeria, Egypt, Morocco, Algeria, Sudan, Kenya, South Africa, Ethiopia, Tanzania, and Cote d'Ivoire.*

Mohapatra & Scheja 2011). In order to, understand how remittances affect receiving countries economy, we first review the tdominan theories and views on migration-development nexus. According to the neo-classical theory, returning migrants were considered as important agents of change and innovation in their countries of origin (Beijer 1970; Kindleberger 1965; Frankel 2006). Migration was understood as a process of moving labor from low productivity sectors/areas to high productivity sectors/areas. Such process would contribute to the optimal allocation of production factors for origin and destination areas, a term known as factor price equalization, which would lead to migration ceasing once wage levels converge in the origin and destination areas. From this perspective, the re-allocation of labor from rural/agricultural areas to urban and industrial sectors (internal migration), and from developing to developed countries (international migration) was considered as an essential prerequisite for economic growth (Todaro 1969). The free movement of labor in an unconstrained market environment is eventually expected to lead to the increasing scarcity of labor, which would then lead to a higher marginal productivity of labor and increasing wage levels in migrant-sending societies. Capital flows are expected to go in exactly the opposite direction of labor migration. So, in a strictly neo-classical world, the developmental role of migration is entirely positive.

In the late 1960s, the neo-classical migration theory was challenged by a paradigm shift in social sciences towards structuralist views (partly the dominance of socialist thinking in the 1960s) which questioned the proposition of the positive role of migration on development. An increasing number of academics lent support to the hypothesis that migration sustains or even reinforces problems of underdevelopment instead of the reverse (De Haas 2010). These "migration pessimists" argued that migration leads to the withdrawal of human capital and the breakdown of traditional, stable village communities and economies. This would then lead to the development of passive, non-productive and remittance-dependent communities. Besides the "brawn drain"—the massive departure of young, able-bodied men and women from developing countries—is typically blamed for causing a critical shortage of agricultural labor, depriving countries of their most valuable work force (Penninx, 1982; Lewis 1986). Migration and remittances were also viewed to further exacerbate inequality in the communities of origin through the Dutch Disease phenomenon (Lipton 1980).

Migration opponents have also argued that remittances were mainly spent on conspicuous consumption and "consumptive" investments (such as houses) rather than invested in productive enterprises. Skepticism about the use of migrant remittances for productive investments became the common thread of the migration and development debate. Besides weakening local economies and increasing dependency, increased consumption and land purchases by migrants were also reported to be the cause of inflationary pressures and soaring land prices (Russell 1992; Appleyard 1989; Rubenstein 1992). Furthermore, from a socio-cultural perspective, the effects of migration and remittances were increasingly seen as detrimental. Exposure to the wealth of migrants was assumed to contribute to a change in rural tastes that would increase the demands for imported urban or foreign produced goods (Lipton, 1980). Migration was held responsible for the loss of community solidarity and undermining the socio-cultural integrity of migrant-sending communities (Hayes 1991). From this perspective, South-North migration was perceived as discouraging the autonomous economic growth of migrant-sending countries (Durand et al., 1996). Such views conform to the historical-structuralist paradigm on development that perceives

migration as one among many other expressions of the developing world's increasing dependency on the global political-economic systems dominated by the powerful Western states.

In the 1980s and 1990s, the new economics of labor migration (NELM) emerged mainly as a response to neo-classical and structuralist theories. According to the NELM, the two approaches were seen as too rigid and determinist to deal with the complex realities of migration and development interactions. The NELM offered a much more subtle view of migration and development which links causes and consequences of migration more explicitly, and in which both positive and negative developmental responses are possible (De Haas 2010; Stark 1978; Taylor 1999). This new approach revitalized the academic thinking on migration by placing the behaviour of individual migrants within a wider societal context, and focusing on the household rather than the individual (Taylor 1999). It models migration as risk-sharing behaviour of households. Migration is perceived as a household's decision to diversify income portfolios and mitigate income risks because migrant remittances serve as income insurance for households in the country of origin (Lucas & Stark 1985). This partially explains why people migrate even in the absence of substantial income differentials. Furthermore, the NELM argues that migration, in addition to its contribution to more stable and secure household livelihoods, plays a vital role in providing a potential source of investment capital, which is especially important in the context of imperfect credit and insurance markets that exist in most developing countries (De Haas 2010). Such markets are often weakly developed and inaccessible to non-elite groups. Hence, migration can be considered as a livelihood strategy to overcome various market failures, potentially enabling households to invest in productive activities and improve their livelihoods.

The NELM can be said to be conceptually similar to the livelihood approaches that evolved in the late 1970s among geographers, anthropologists and sociologists conducting micro research in developing countries. The livelihood approach group argued that poor people cannot be seen only as passive victims of the global capitalist forces (as neo-Marxist and dependency approaches tended to think), but are actively engaged to improve their livelihoods within the constraining conditions in which they live (Lieten and Nieuwenhuys 1989). This view is consistent with the NELM theory which sees migration as one of the main elements of strategies to diversify, secure and improve livelihoods. Hence, migration and thereby remittance is expected to provide rural households an additional resources, in the face of market failure, to buy modern agricultural inputs and technologies.

The rest of the paper is structured as follows. Section 2 discusses relevant literature. Section 3 discusses the data utilized and the model specification. Section 4 presents and discusses the empirical results and section 5 concludes.

2. Literature Review

There are few empirical works both at macro and micro level studies that have been undertaken on the impact of migration on agriculture. Using two surveys performed in the Senegal River valley, in Mali and in Senegal, Azam and Gubert (2006) found that remittances helped to smooth household consumption during adverse shocks. They also found this insurance system involved some moral hazard, as those remaining behind tend to exert less effort to take

care of themselves, knowing that the migrants will compensate any consumption short fall. Using cross country macro data (sample countries drawn from Latin America, Asia, Europe, Middle East and North Africa), Taylor (1996) reported a dynamic role international migration could play in promoting economic growth and national development in a given economy, provided that it does not bring the selective emigration of scarce human capital. Analyzing the impact of remittances on poverty using cross sectional data from 71 developing countries, Adams and Page (2005) found that10 % increase in the share of international migrants in a country's population helps to reduce by 2.1% people living on less than $1 per person per day. A paper studying the effect of remittance on poverty and financial development in Sub-Saharan Africa finds that remittances being stable private transfers have a direct poverty-mitigating effect (Gupta, Pattillo & Wagh 2009).

In their study on how labor migration affects farm technical efficiency in Lesotho, Mochebelele & Winter-Nelson (2000) found a slightly greater technical inefficiency among non-migrant households, implying that they are at some disadvantage in their ability to apply the resources that they allocate to farming. Hence, remittances do positively helped to follow a consistent and timely farm management than those without migrants among their household members. Mendola (2008) who examined how migration and technical change interact in rural households in Bangladesh found that households who are able to engage in costly high-return migration (i.e. international migration) are more likely to employ modern farming technology, thereby achieving higher productivity. Poorer households, on the other hand, were unable to overcome the entry costs of cross-border movement and fall back on low net-return domestic migration, which does not drive production enhancements and may act as a poverty-trap.

It has been also reported that earnings of international migrants to have a positive impact on crop productivity, and may also serve as a source of capital accumulation in rural households (Lucas 1987; Rozelle et al. 1999). For example, Stark and Taylor (1989) found that in rural Mexico "relatively deprived" households are more likely to engage in international migration than are "better-off" households (1989). Similarly, Adams (1991) found that in rural Egypt, the number of poor households declined by 9.8% when household income included international remittances, and that remittances accounted for 14.7% of total income of poor households.

In Zimbabwe, for instance, households with migrants have less cultivated land but tend to be slightly better educated (De Haan 2000). Using data from a large household survey Adams (2006) found that international remittances significantly relieved poverty among the "poorest of poor households." Ratha (2003) suggests that remittances that raise the consumption levels of rural households might have substantial multiplier effects, because they are more likely to be spent on domestically produced goods. Some studies have found evidence for "forward" linkages between remittances, and human capital formation in Latin America (Edwards & Ureta 2003; Hanson & Woodruff 2003). Koechlin & Leon (2006) found that as migrant communities form close networks in a foreign country, the cost of migration falls, and remittances no longer reinforce inequalities in the recipient country. Other localized studies have concluded that remittances tend to improve the welfare of poorer rural households (Adams 1991; Stark & Taylor 1989). Studies covering a larger sample of countries have found evidence that remittances tend to lower the poverty (Adams & Page 2005; Freund & Spatafora 2005).

Contrary to the positive contribution of international migration on the origin economy; Lipton, in his study of 40 villages in India focusing more on internal than international migration; found that migration increases intra-rural inequalities. According to his argument, better-off migrants are pulled torward better jobs (in a city or abroad), whereas the poor are pushed‘by rural poverty and labor-replacing methods (1980). Similarly, it has been found that migration patterns in East European and former Soviet Union countries are such that richer households receive greater remittances than do poorer households (World Bank 2007). The evidence on the direct effect of remittances on poverty, and inequality seems to vary according to the sample (Adams 1991; Barham & Boucher 1998). Earlier studies posited that migration was likely to increase rural inequality, because only relatively better-off households were able to finance a member‘s search for better employment in urban areas, or abroad (Lipton 1980; Stahl 1982).

As opposed to positive and negative effects of remittance, mixed and neutral effects are also common in the literature. Azam and Gubert (2006) using two surveys performed in the Senegal River valley, in Mali and in Senegal found some mixed results, remittance helped to smooth household consumption through buttressing the family‘s consumption in case of adverse shock. Equally they also found this insurance system involved some moral hazard, as those remaining behind tend to exert less effort to take care of themselves, knowing that the migrants will compensate any consumption shortfall, with a high probability.

A study conducted in Ecuador to examine the effects of international migration on agricultural production and land-use showed that migrationhas neither led to agricultural abandonment nor have remittances been dedicated to agricultural improvements (Jokisch 2002). Using a tracked sample of migrants in Ethiopia, Brauwet et al (2013) found that migrants appear to remit for self-insurance rather than to insure the home households; migration does have any impact on migrant on home agricultural productivity or efficiency. While the findings of these past studies are instructive by their own, their conclusions are of limited usefulness due to a small sample size, cross sectional nature of the data, and most of them one country case study. Moreover, we could not come across any literature, which addresses how the increasing remittances is affecting agricultural technical efficiency in view of the absence of developed credit market and farm household liquidity constraints in Africa. That is to say, how does migration affect home country households' production behaviour and their ability to achieve technical efficiency in agricultural activities?

This paper contributes to the literature on the impact of international remittances using a sample of almost over 65% of the African countries. Mobile penetration is also used as the predictor variables of infrastructural development to explain agricultural efficiency/inefficiency.This is in recognition of the high penetration of mobile access and its effect on reducing the cost of agricultural product price information (reducing transaction cost). Land per capita, net official development assistance (which includes research and development), and real exchange rate are also hypothesized to affect the level of agricultural technical efficiency. Also, it is hypothesized technical efficiency to be positively related with land size (in view of fast declining in per capita land size of more than 22% within the last 17 years from 0.3ha per person to 0.23 ha) (source?). Net official development assistance, which has registered a sustained annual growth rate of 6.8% over the study period on one hand, and very low public expenditure on

agriculture (as percent of total expenditure 6.7%) on the other hand is hypothesized to positively affect our dependent variable (technical efficiency) (source?). Remittances as percentage of GDP (our main interest variable) is also included as one of the explanatory variable of technical efficiency

While the direction of influence of remittances on technical efficiency is difficult to hypothesized priori, mobile penetration is hypothesized to affect positively efficiency (Lio & Liu 2006). Regarding the relationship between productivity or technical efficiency and farm size the literature remains mixed. For instance, Berry and Cline (1979) and Barrett (1996); found an inverse relationship between productivity and farm size andSteven and Helfand (2003) found anon-linear relationship, with productivity first falling and then rising with size. However, a positive relation between farm size and productivity was reported by Rahman, Mia & Alam (2012). With regard to net official development assistance, many empirical works which studied the effect of foreign aid on recipients's c o n o m i c performance have come-up with divergent results. Some found evidence to the argument that aid spurs economic growth unconditionally or in certain macroeconomic environments (Collier & Dollar 2002; Dalgaard, Hansen & Tarp 2004). Others argue that it is growth-neutral (Boone 1996; Easterly 2005). Bobba & Powell (2007) even argue that foreign aid as growth-depressing. Guided by the relatively good performance of the continent the past two decades, we hypothesize that foreign aid to positively influence Africa's agricultural technical efficiency. Another important variable in our model is the real exchange rate (RER)[19]. The relationship between the exchange rate and economic development is certainly an important subject in development policy arena. Indeed, a stable RER and properly aligned exchange rate is a key factor in improving the trade sector, and in enhancing overall economic performance. On the other hand, RER misalignment has been considered as the main cause of economic instability and the dismal of countries economic performance. Hence, we hypothesize that a properly aligned exchange rate is expected to positively affect the level of technical efficiency.

3. Data and Methodology

3.1 Data

The data for this paper was generated from the World Bank database and (World Development Indicator). We use data of 35 African countries (see Table 1) covering 17-year period (1995-2011). The selection of countries was based on the availability of data for the four variables of the production function, viz.: total cereal production (tons); total arable land under cereal production (ha); rural labor force and total fertilizer used. The variables used to explain technical efficiency includes remittance as percentage of GDP (our interest variable), is mobile cellular subscriptions (per 100 people); arable land per person, net official development assistance; and real exchange rate. The missing/non-availability of data issues resulted in the exclusion of very

19

important variables such agricultural capital (for agricultural production), rainfall and other from our analysis.

3.2 Model specification

Farrell (1957) in his seminal paper defined output of the most efficient firms as the production frontier for all firms, as opposed to the neoclassical theory that assumed all firms to be fully efficient in their use of technology. A stream of research over the last 30 years has produced a number of innovations in specification and estimation of the model (Greene 2002). Pitt & Lee (1981) were the first to adopt the cross sectional specification to longitudinal data (cited in Daidone et al. 2013). Progress has also been observed in panel data estimation and specifications (Pitt & Lee 1981; Battese & Coelli 1988; Cornwell, Schmidt & Sickles 1990). As a result, some of the problems related to distributional assumptions encountered in the cross-section approach are avoided in panel data. The panel approach also gives, a large number of data points and have the advantage of separating individual and time-specific effects from the combined effect (Heshmati et al 1995)

Another advantage of panel data is that if inefficiency is time-invariant one can estimate inefficiency consistently without distributional assumptions (Schmidt & Sickles 1984). The assumption that inefficiency is time-invariant is quite strong. The assumption might hold true if the time period of the panel is short and the production technology needs more time to change (Battese & Coelli 1988; Pitt & Lee 1981). However, if T (time) is large it become plausible to allow inefficiency to vary across time. Hence, to capture the time-varying nature of the efficiency by introducing time-varying (both random and fixed in nature) models are specified (Greene 2005a; Greene 2005b; Kumnhakar 1990; Schmidt & Sickles 1990; Battese & Coelli 1995)[20]. A common issue for all these models is that inefficiency is individual-specific. Accordingly, we will estimate both time-invariant and time-varying models.

Among the time-invariant models included are ML random-effects model (Pitt and Lee, 1981) and GLS random- effect model (Battese & Coelli 1988). Pitt & Lee (1981) were one of the first to extend the cross sectional Stochastic Frontier (SF) to panel model. They proposed the following maximum likelihood estimation SF model:

$$y_{i\,t} = \alpha + x_{i\,t}^{'}\beta + \varepsilon_{i,t}, i = 1, \dots, N, \quad t = 1, \dots, T_i \tag{1}$$

$$\varepsilon_{i\,t} = v_{i\,t} - u_i$$

$$v_{i\,t} \sim N(0, \sigma_v^2)$$

$$u_i \sim N^{+}(0, \sigma_u^2)$$

The method imposes distributional assumptions on the random components and estimates by the maximum likelihood (ML) and generates higher efficiency in the estimation. The major weakness

[20] *For detail review see Kumbhakar, S. C., Lien, G., & Hardaker, J. B. (2014). Technical efficiency in competing panel data models: a study of Norwegian grain farming. Journal of Productivity Analysis, 41(2), 321-337; and Rashidghalam, M., Heshmati, A., Dashti, G., & Pishbahar, E. (2016). A Comparison of Panel Data Models in Estimating Technical Efficiency.*

of the model is the higher efficiency in estimation is at the cost of strong assumptions of normality of the random error term, and assumes that technical inefficiency to be individual-specific and time-invariant. Hence, applying time-varying models relaxes some of the stated assumptions.

From the group of time-varying models included are: Modified-LSDV time-varying fixed-effects model (Cornwell, Schmidt & Sickles 1990), ML random-effects time-varying fixed-effects (Kumbhakar 1990), ML random-effects time-varying efficiency decay model (Battese & Coelli 1992), True fixed-effects model (Greene 2005a) and True random-effects model (Greene 2005b).

To relax the time-invariant restriction Cornwell, Schmidt and Sickles (1990) proposed a SF model with individual-specific slope parameters,

$$y_{it} = \alpha + x_{it}^{'} + v_{it} \pm u_{it}, \; i = 1, \dots N, t = 1, \dots, T_i \qquad (2)$$

$$u_{it} = w_i + w_{i1}t + w_{i2}t^2$$

Hence, u_{it} allows estimating unit specific temporal pattern of inefficiency. Lee and Schmidt (1993) introduced a slightly different estimation approach and they specified u_{it} as follows:

$$u_{it} = g(t) * u_i \qquad (3)$$

where $g(t)$ is represented by a set of time dummy variables (=T). This specification is more economical in terms of parameter estimation (N*1) (compared to N*3) of equation (2); and it does not impose any parametric form. But it is less flexible because it restricts the temporal pattern of u_{it} to be the same for all productive units (due to temporal constancy of, u_i).

Kumbhakar (1990) and Battese & Coelli (1992) further push the SF model specification and proposed the ML estimation of a time-varying model. The common feature of all of these time-varying SF models is that the intercept α is the same across countries (but not across time), thus generating a specification bias in the presence of time-invariant unobservable factors. Therefore, the effect of these factors may be captured by the inefficiency term, producing biased results

Greene (2005a; 2005b) was the first to propose a time varying SF normal –half normal model (to address the above stated specification issues) with unit specific intercepts, by modifying the Pitt and Lee (1981) model and specifying as follows,

$$y_{it} = \alpha_i + x_{it}^{'}\beta + \varepsilon_{it} \qquad \text{where; } \varepsilon_{it} = v_{it} - u_{it} \qquad (4)$$

Compared with previous models, this specification allows disentangling time-varying inefficiency from unit-specific time invariant unobserved heterogeneity. For this reason Greene (2005a) termed these two variant models True Fixed Effects (TFE) and True Random Effects (TRE). To compare how our estimations runs across the different specifications Table 2 shows the results of the different models.

4. Results and Discussion

4.1 Descriptive statistics

In order to get an idea on the relative importance of the within and between variation, the decomposed variance is reported in Table 1 below. When we compare the distribution of the variance the between variation is dominant as compared to the within variation. Most of the changes observed in the covariates are due to differences among countries, rather than the potential path dependence (overtime variation). Hence, applying within estimation may lead to considerable efficiency losses. However, to compare the performance of various panel data models in estimating technical efficiency in production, in our result estimation section, different model specifications have been estimated, result compared, and tested before results used for final analysis.

Table 1 summary statistics of the covariates

Variable		Mean	Std. Dev	Min	Max	Observations
Ln Cereal Production(ton)	overall	13.603	2.388	4.719	17.224	N = 594
	between		2.395	5.855	16.965	n = 35
	within		0.338	12.454	15.097	T-bar = 16.971
Lnlandundercereal	overall	13.428	2.365	2.639	16.781	N = 594
	between		2.385	4.005	16.680	n = 35
	within		0.239	12.062	14.517	T-bar = 16.971
Lnruralpoulation	overall	15.590	1.469	12.119	18.330	N = 594
	between		1.486	12.208	18.230	n = 35
	within		0.092	15.261	15.872	T-bar = 16.971
Lnfertilizer(t)	overall	9.727	2.152	4.382	14.604	N = 594
	between		2.064	5.881	14.078	n = 35
	within		0.693	6.769	12.020	T-bar = 16.971
u_tfe_~t	overall	0.189	0.188	0.021	1.463	N = 594
	between		0.106	0.117	0.664	n = 35
	within		0.156	-0.453	1.100	T-bar = 16.971
lnmobi~p	overall	1.895	1.603	0.000	5.009	N = 594
	between		0.635	0.616	3.352	n = 35
	within		1.476	-0.911	4.710	T-bar = 16.971
lnNODA	overall	19.894	1.141	16.381	23.288	N = 594
	between		1.030	17.735	21.397	n = 35
	within		0.517	18.170	22.702	T-bar = 16.971
Lnremgdp	overall	1.041	0.879	0.001	4.143	N = 594
	between		0.821	0.115	3.772	n = 35
	within		0.339	-0.090	1.992	T-bar = 16.971
ln~erate	overall	4.471	2.411	-2.121	8.804	N = 594
	between		2.421	-0.518	7.798	n = 35
	within		0.349	2.868	5.477	T-bar = 16.971
Lnlandpp	overall	0.222	0.129	0.034	0.926	N = 594
	between		0.128	0.040	0.775	n = 35
	within		0.024	0.091	.373	T-bar = 16.971

Source: The World Bank, World Development Indicator and own calculation

4.2 Model Results

Our analysis of technical inefficiency is concerned primarily understanding how the variable of interest (remittances as percentage of GDP) and other variables are affecting agriculture's technical inefficiency of each country. However, before proceeding to the inefficiency analysis a few observations about the parameter estimates presented in Table 2 are in order. The first section of Table 2 gives the production functional coefficient estimates which measure the proportional change in output when all inputs included in the model are changed in the same proportion. It is interesting to note that African farmers are operating at increasing returns to scale, as the summation of the elasticities is just 1.20 which also confirms the increasing trend in productivity in Africa. The inputs of rural labor force, fertilizer (NPK) and land under cereal production were found to be significant indicating the three inputs' importance in crop production in the continent.

Table 2 Estimations of the production functions

	Time-Invariant		Time-Varying			
Variables	**Model 1-R**	**Model 2-F**	**Model 3-R**	**Model 4-R**	**Model 5- F**	**Model 6-F**
Frontier						
Lnruralpopulation	0.494***	0.830***	0.589***	0.376***	0.907***	0.101
Lnfertilizer	0.015	0.007	-0.005	0.122***	-0.009	0.006
Lnland_under_cereal	0.790***	0.860***	0.758***	0.723***	0.830***	0.824***
Elasticity	1.299	1.697	1.342	1.221	1.728	0.931
Number of observations	594	594	594	594	594	594
Prob>χ^2	0.000	0.000	0.000	0.000	0.000	0.000
Sigma_u	0.460***	0.935***	0.177***	0.533***	0.189***	0.634
Sigma_v	0.239***	0.238***	0.163***	0.069***	0.139***	0.233
γ	79	94	54	98	65	88

Source: The World Bank, World Development Indicator and own calculation

Our objective was to understand which variables are the most important in affecting farmers' production inefficiency. Accordingly, we estimated the technical inefficiency model using the alternative specifications specified above. Results are consistent with our expectations (except remittance as % of GDP, where we do not put a priori expectation). The results show that remittances as percentage of GDP (though insignificant) was found to be positively related agricultural inefficiency.

The second variable is mobile (proxy for infrastructure and information). Mobile technology offers an invaluable support to agriculture, by providing information pertaining prices, technology availability, best practices and weather conditions directly to farmers. Especially for those farmers who do not have physical or financial access to information through conventional extension services. Mobile phones and applications can act as a conduit for locally relevant information. A number of other studies have also indicated that rural telephony helps farmers to receive better prices for their crops and leads to significantly increased earnings (Forestier et al.2002; Antle 1983; Hayami & Ruttan 1970). Hence mobile which is normally assumed to have negative effects on inefficiency remained consistent with our expectation and significant at 5% (level of significance). Therefore, mobile technology can serve as substitute; for farmers could not be reached by the conventional extension system and play complementary role where the outreach is there.

Table 3 Determinants of inefficiency

Variables			
Inefficiency	Coefficient	Bootstrap SE	p-value
Ln remittance_gdp	0.007	0.124	0.568
Ln mobile_pp	-0.015	0.006	0.010***
Ln land_pp	-0.134	0.376	0.721
Ln NODA	-0.013	0.008	0.100*
Ln RER	-0.246	0.0856	0.002***
$Lnlandpp^2$	0.062	0.558	0.912
_cons	0.509	0.161	0.002
Number of observations			593
Prob>χ^2			0.000***
Wald $\chi^2(5)$			33.10
Sigma_u	0.094	0.025	0.000***
Sigma_v	0.142	0.022	0.000***

Source: The World Bank, World Development Indicator and own calculation

Our third variable is official development assistance. We found a negative and significant relationship with inefficiency. Implying, foreign development assistance is plying significant and positive impact on the continents economic growth, especially improving agricultural performance. Minoiu and Reddy (2010) in their analysis of growth impact of official development assistance to developing countries, reported developmental aid promotes long run growth. And the effect was significant, large and robust to different specifications and estimation technique. Focusing on Sub-Saharn Africa, Bräutigam and Knack (2004) found evidence which indicates that, high levels of aid are the cause rather than the result of deteriorating governance and low tax collection capacity in Africa. Rajan and Subramanian (2008), using cross-sectional and panel data, covering 3288 observations tried to examine the relationship between foreign aid and economic growth. After controlling the possible bias, they found little robust evidence of a positive (or negative) relationship between aid inflows into a country and its economic growth.

Real exchange was found to be negatively and significantly affecting inefficiency at 1% level of significance. Hence the maintenance of a realistic exchange rate, other things remaining constant gives the right signal and incentives to agricultural producers and enhances agricultural competitiveness. Our results concurs Amin's (1996) findings for Cameroon.

Finally we found an inverse relationship (though in significant) between farm size (arable land per capita) and inefficiency. The relationship may reflect the economies of scale of farm production, and the resourcefulness of large farmers in undertaking relatively better farm management practices and their risk bearing capacities. The second possible explanation could be the average farm size which was about 0.3 ha per person in 1995 have declined to about 0.2 ha per person in 2011, implying the farm size is becoming already too small (see Annex B). Hence efficiency increases until a peak 0.93 ha per person, and then decline. Reddy and Bantilan (2012), in their competitiveness and technical efficiency of groundnut producers in India, reported similar to our result. However, Chang and Wen (2011) findings for Taiwan rice producers arrived at contradictory to our results. Similarly, studies with mixed results are also available (Carter 1984; Dyer 2004)

The distribution of countries in terms of their average efficiency performance is reported in Table 4. Countries were grouped into five arbitrary efficiency blocks. Accordingly, the fist pack of poor performers is indicated in the first column. As can be observed from Table 4 and Annex A, the technical indices ranged from 22 % to 88%, with an average efficiency level of 80%. Although it is evident the reported average efficiency level is higher, results show that the production and income level of the farming communities can be increased by 20% simply improving farm management practices and without the introduction of new technologies yet.

Table 4 Group of Countries by their Mean Efficiency

Efficiency Range				
0.22-0.74	**0.77-0.82**	**0.83-0.84**	**0.85-0.86**	**0.87-0.88**
Cabo Verde,	South Africa	Egypt, Arab Rep.	Niger	Cameroon
Swaziland	Algeria	Senegal	Ethiopia	Kenya
Morocco	Tunisia	Mali	Cote d'Ivoire	Burundi
Gabon	Namibia	Sierra Leone	Uganda	Ghana
Mauritius	Malawi	Tanzania	Nigeria	Congo, Rep.
Botswana	Rwanda	Sudan	Madagascar	Togo
Lesotho	Guinea-Bissau	Mozambique	Burkina Faso	Guinea

Source: The World Bank, World Development Indicator and own calculation

In terms of intertemporal efficiency performance of countries, as indicated in Table 5 and graph 1, it shows the average level of inefficiency is declining from its highest level of 23.4% (1995-1997) to 18.5% for the sample countries. This trend can also be observed from Graph 1.

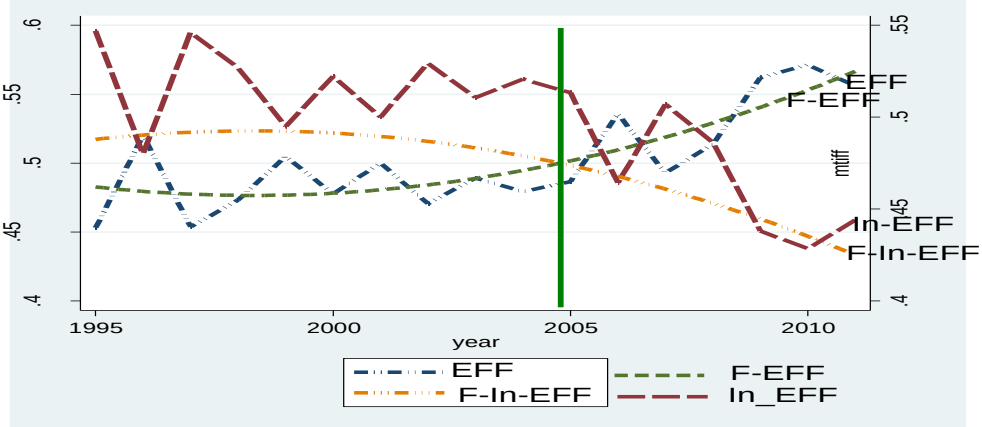
Table 5 Average inefficiency Distribution

Years	**Mean efficiency**
1995-1997	0.234
1998-2000	0.233
2001-2003	0.197
2004-2006	0.187
2007-2011	0.185

Source: The World Bank, World Development Indicator and own calculation

Block (1994) was the first to report the recovery of aggregate agricultural TFP in sub-Saharan Africa during the 1980s, a result confirmed by a number of subsequent studies. Block attributed up to two-thirds of this recovery to investments in agricultural R&D and to macroeconomic policy reform. It is an important finding to report that 2005 was the year in which Africa's agricultural technical efficiency and inefficiency intersected each other, and the efficiency rate started to increase to show its upward sloping, which is approximately after two years of the Maputo declaration. This shows that if African agriculture is supported by appropriate policy, finance and research, green revolution is still possible in Africa.

Graph 1 Efficiency-Inefficiency trend



Source: The World Bank, World Development Indicator and own calculation

5. Summary and Conclusions

In this paper we used stochastic frontier analysis (SFA) to estimate the technical efficiency of cereal production for 35 African countries and 17 years data, and tried to identify the determinants of efficiency/inefficiency using region (Tobit) method. Future research should be done to replicate, using alternative models, such as Data Envelopment Analysi (DEA) to check the robustness of the results. According to the technical efficiency estimates, output levels could have been maintained while reducing overall input use by an average of 20% for the average country in the sample and about 80% for the most technically inefficient countries, such as Cabo Verde, Swaziland, Morocco, and Gabonr. The second question that was addressed is which variables explain efficiency differences among countries and across time. Based on the stochastic frontier estimates, the differences in efficiency were explained by variables such as mobile subscription, official development assistance and real exchange rate. Fortunately, all these variables are behavioural variables in nature, where government intervention can improve the way they could positively influence technical efficiency outcome variable. Hence, African governments should further invest on infrastructural development such as mobile so as to reduce the cost of market information to farmers. Secondly, on one hand the positive effect of official development assistance and on the other, African agriculture being still underfinanced (as almost all countries have failed to fulfil their Maptu pledge of 10% of the total expenditure), governments should commit themselves to channel foreign development assistance to play a complementary role to local finance. Finally, the positive/negative relationship between real exchange rate and efficiency/inefficiency clearly shows how a proper policy framework in a given country can enhance economic performance. Hence, governments should push in this (positive) direction to support and help agriculture to play its role in reducing poverty

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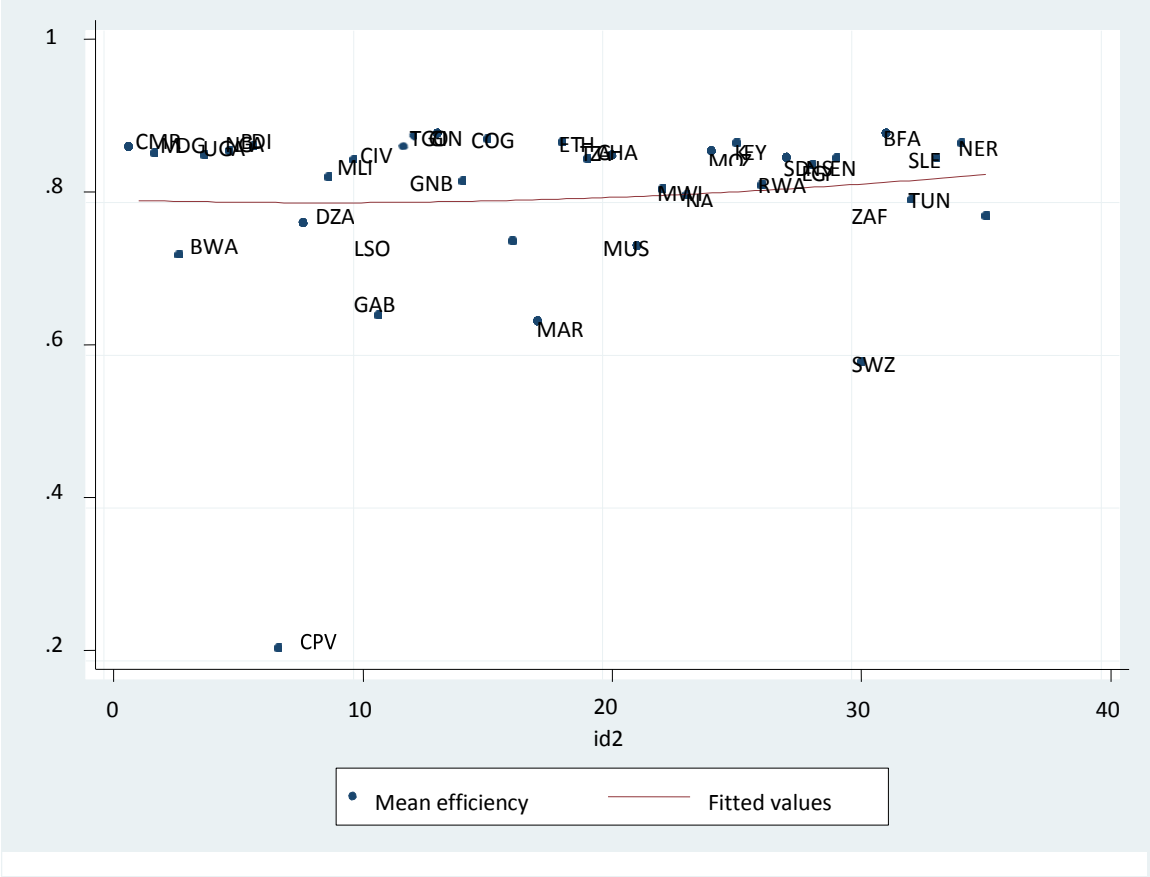
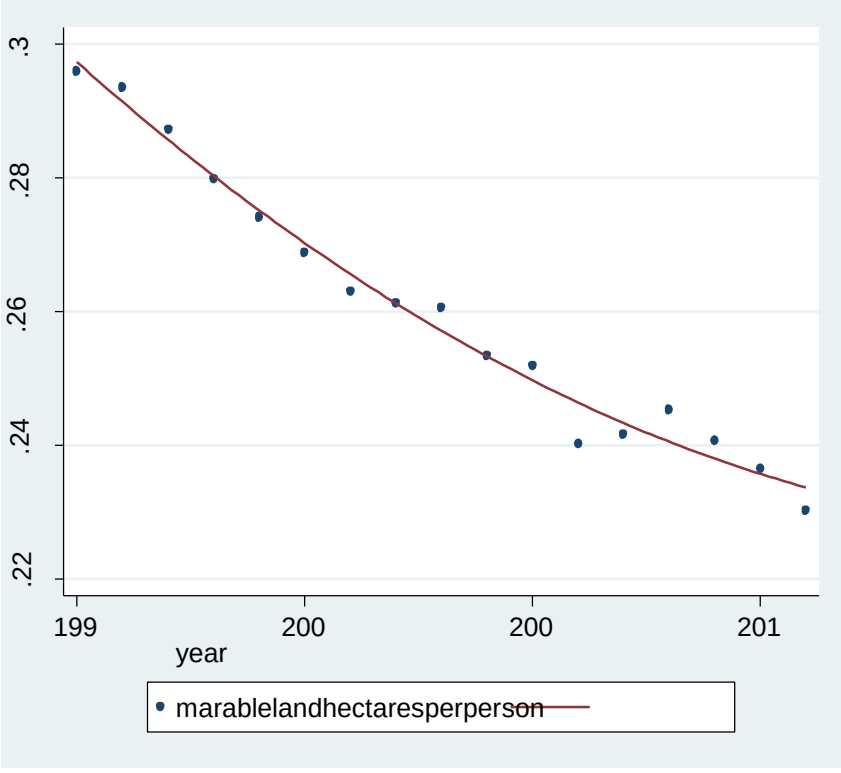
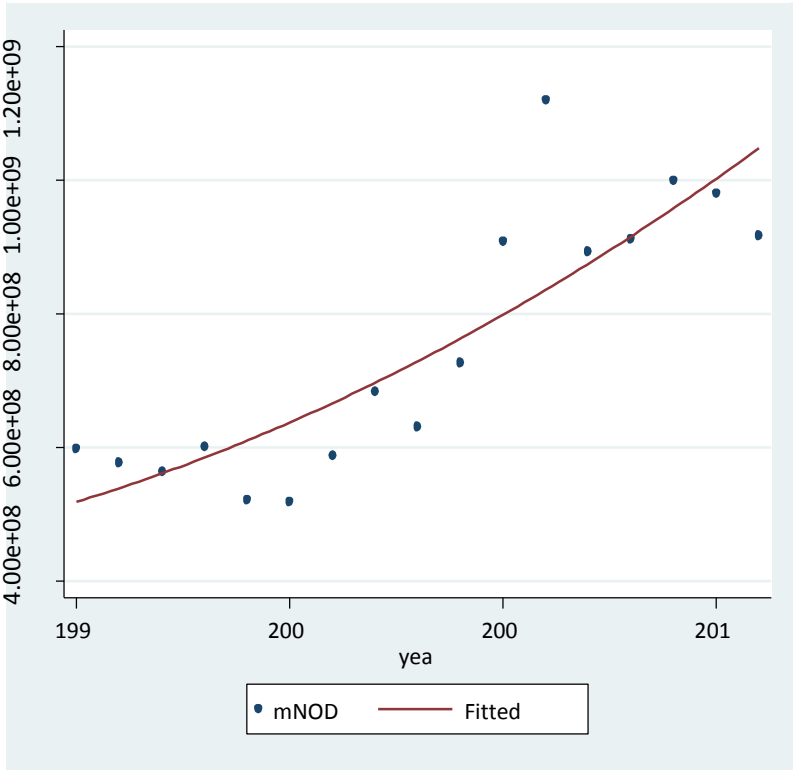
Annex A: Mean efficiency by Countries



Annex B: Arable land per person Trend



Annex C: Net Official Development Assistance to sample Countries



Youths and ICTs: Shaping the Future of Family Farming Towards Agenda 2030

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Abstract

This paper examines how ICTs are used in engaging youths in family farming for effective public agricultural extension services and rural development in in Butaleja district in Uganda. The specific objectives were to establish: the information needs of family farming youths district, the roles played by the youths in family farming, the contribution of ICTs to the provision of family farming information to the youths, the challenges faced (if any), in applying ICTs in family faming, finally, policy recommendation of applying ICTs in the development of family farming are made. For decades, family farming has been contributing significantly to global food and nutrition security. Seventy percent (70%) of the world's food supply today comes from more than 500 million family farms over the world, which are supporting rural employment in many developing countries. This kind of farming is highly characterized by the youth and women. The World Bank estimates that by 2030, demand for food in rapidly growing urban areas will create a market for food products worth US $1 trillion. This market needs to be owned and operated by young African farmers. Subsequently, over the next thirteen years the world will mobilize efforts to end all forms of poverty and hunger through the UN 2030 Agenda, while ensuring that no one is left behind. Data was collected through focus group discussions, field visits and document reviews. Findings were: Youths play a vital role as intermediary for ICT adoption by agricultural communities in capturing, documenting and disseminating and accessing local agricultural knowledge; identified challenges include: lack of involvement of the youths in agriculture related decision-making, poor access to agricultural knowledge and education, poor access to ICTs and limited access to financial services among others. Policy recommendations are: for the youths involvement in family farming, there is need to translate content in local languages, produce geographic specific content and ICT tools that are easy to adopt by the youths farmers; developing ICT training and capacity building programmes for youths farmers, strengthening rural telecentres and rural ICT access points, developing and using ICT tools and applications adapted to rural conditions, using ICT to support extension delivery as well as strengthening the role of rural youth as agricultural information brokers via ICTs. The findings of this study would benefit: development partners, rural farmers, researchers and policy makers from the IGAD region and beyond in attaining agenda 2030.

Key Words: Family Farming, ICTs, Rural Development, SDGs, Youths.

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1. Introduction

Ever since the beginning of agriculture, family farming has been contributing significantly to global food and nutrition security. Indeed, 70% of our food supply today comes from more than 500 million family farms over the world, which are supporting rural employment in many countries (FAO 2014). However, despite the important role and contribution of family farms to global food production, this type of agriculture is threatened by several challenges, including competition with industrial farming. If family farming is not revitalised soon, its impact on future food security can be huge. Among the different challenges that family farms are facing, the ageing farming population and the lack of youth's interest and engagement in family farming are of major concerns.

The Republic of Uganda, is a landlocked country found in East Africa bordered to the East by Kenya, South Sudan in North, West by Democratic Republic of the Congo, southwest by Rwanda and Tanzania in south. Uganda is the world's second most populous landlocked country after Ethiopia, home to Lake Victoria, shared with Kenya and Tanzania, situating the country in the African Great Lakes region. Uganda has a total population of 34.9 (United Nations Population Fund (UNFPA 2014). According to Kwesiga (2002), agriculture is Uganda's main economic activity and the country's largest employer. Over 80 per cent of women are employed in the sector and contribute about 75 per cent of agricultural production. Plantains, cassava, sweet potato and maize are major subsistence crops while the major export crop is coffee, but tea, tobacco and cotton are also important. And while some steps are being taken to provide insurance against crop failures, access to finance for small scale farmers is limited. The high cost and limited availability of improved farm inputs, including hybrid seeds and post-harvest technology, over-stretched extension services, poor transport networks, a lack of market information, inadequate production and post-harvest facilities, and weak value chain linkages all hinder and frustrate subsistence farmers in Uganda (Kwesiga 2002). Despite the enormous progress in poverty reduction, about 40 per cent of all rural people still live below the poverty line; the poorest regions being in the north and north-eastern Uganda, where civil conflict has severely disrupted the lives and agricultural production of small farmers. When relative peace returned in 2006, the task of rebuilding the region's agriculture sector began, with the distribution of seeds, livestock and tools. Many organizations have also provided training to pass on agricultural skills to a generation of young people who have grown up in protected camps. With many people returning to their homes and finding that boundaries have been moved and entire swathes of land have been grabbed, resolving conflict has remained a major challenge to farming activities in the area (Mijumbi 2002).

2. Literature Review

2.1 The ICT Innovation Framework

For the last two decades, there has been an upswing of the global information society. As a result, acceleration of information flow, communication and the rapid development of technology have delivered a fresh phenomenon called Information and Communication Technologies (ICT) (Koutsouris 2006). These ICTs have subsequently affected different fields such as medicine, education, agriculture and business and provided competitive, social and political opportunities

for users world over (UN 2006). It is readily accepted that increased information flow has a positive effect on the agricultural sector (Adamides et al. 2013). However, collecting and disseminating information is often difficult and costly. Information technologies (IT) offer the ability to increase the amount of information provided to all participants in the agricultural sector and to decrease the cost of disseminating the information to farmers.

There are contrasting opinions in existing literature on the question of drivers, decisions and outcomes regarding Information and Communication Technology (ICT) adoption. These opinions concern the impact of parameters such as lifestyle, age (Hernández-Encuentra et al. 2009) and gender (Venkatesh et al. 2003). While such studies are numerous and have traditionally been placed in organisation studies, some scholars such suggest that family farming is no more different in terms of the role ICT has to play in both their operations and productivity. For this reason, it should be noted that questions on whether general theories and principles of firms' use of technology can be applied to the agriculture industry remain relevant in this era.

2.2 The adoption of ICTs in Agriculture

As earlier stated, numerous studies such as (Mustonen-Ollila and Lyytinen, 2003; Wainwright and Waring 2007) have argued that traditional diffusion of technology innovation theories which were based on earlier works by Rogers (1962; 1995) who articulated the process of ICT adoption. From a country perspective, the history of ICTs in Uganda is a diminutive but a robust one. Uganda started embracing ICTs as part of its economic development strategy when the first mobile phone service came onto the Ugandan scene in December 1994. The telecom company Celtel, using the GSM 900 technology mainly targeted high end users like business people and the diplomatic community. The cost of owning and maintaining a mobile phone was so high that that having a car was estimated to be a cheaper undertaking. Owning a mobile phone was a status symbol. Things began to change however, with the entry into the market, of the South African giant Mobile Telecommunications Network (MTN) in 1998. Calls became cheaper, and the network was extended to rural areas, going beyond Kampala as the hub for the mobile telephone industry. More players like Airtel, Warid and Zain entered the marked with more diversified products making communication even cheaper. More internet providers also came on the scene and the cost, while still one of the most expensive in the world, and became much cheaper than before.

Since then, the ICT sector has grown swiftly. The industry Grew by 30.3% in the 2009/10 financial year accounting for 3.3% of the GDP. Over 50% of the population are subscribed to mobile phone service provider and the number of internet users increased from 2,475,812 in 2008 to 4,178,085 in 2010 (168% of growth). Internet users were estimated at 6.5million as of 2012, accounting for 18.5 percent of the country's population of 35 million. The increase in internet usage has been further fueled by the country's youth's prominence. Uganda has the world's youngest population, with over 78% below 30 years. These are more embracing of ICTs than their older, and inevitably old school, parents. To date, access and usage of ICT equipment and devices in terms of tele-density (number of telephone liner per 100 people) has increased from 55.7% to 90% especially in rural areas and from 27.8% to 40.9 percent in rural areas according to the Ministry of ICT Report of 2015.

Despite such admirable improvements, there have been a number of factors that have affected the ICT adoption in Uganda. According to Sekabira et al. (2012), mainstream factors affecting adoption of ICTs are generic in nature. These include cost effectiveness and speed of information transfer, organizational characteristics like occupational size, system characteristics like availability and access to ICT services, and internal and external characteristics of the business household like agriculture, past experience in using ICTs, attitude towards ICTs, occupational goals and incomes among others (Berranger 2002).

Sekabira et al., (2012), further states that farmers with knowledge of ICT and those rational that ICTs benefit agriculture are more likely adopters of ICT- based information services. Furthermore, family size and land farmed influenced farmers' adoption, age, farming experience, family size, monthly expenses and health influenced farmers' ICT adoption. For instance, Jacobs and Herselman (2006) said that the perceived lack of need for ICTs by smallholder farmers is responsible for farmers' failure to adopt ICTs and their services. On the contrary, Khalil Moghaddam and Khatoon-Abadi (2013) found that the existence of ICT center, various funding sources, individual and social factors, as well as households' informative & communicative initiatives easily reinforce the adoption of ICT. And while Khalil Moghaddam and Khatoon-Abadi (2013) found that there were connections between adoption and the ICT characteristics, presence of preparedness among users and access of facilities, are major factors influencing use of mobile phones in communicating agricultural information. They further stipulate that sex, education level, incomes, mobile phone ownership, type of farming practiced, type of agricultural information needed, and network coverage are factors that affect ICT adoption y family farmers.

For purposes of this study, it is set in the eastern part of Uganda. The eastern part of Uganda is dominated by agriculture, mainly family farming and Butaleja in particular is predominantly a rice growing district, home to Doho Irrigation Rice Scheme. If there is a critical social challenge that needs to be committed to in the District, ICT diffusion in farming should be the issue. The agricultural sector remains the backbone of Uganda's economy as its main source of livelihood and employment for over 60 percent of the population, thus making it a vital element of the Ugandan economy. The Ugandan agriculture industry is notably characterised by low yield and productivity which are caused by numerous factors such as underinvestment, low ICT adoption, social factors and inefficiencies in supply chains, among others. Thus, the importance of Information and Communication Technologies (ICT) to the sustainability (growth) of small scale family farming cannot be under-emphasised (Rao 2007). The reality however is that most enterprises that operate in developing countries (especially those operating in the agricultural business) face major restrictions in terms of their access to appropriate productivity-enhancing ICT.

2.3 ICT diffusion Framework

This study is based on the first ICT diffusion of innovation Framework which is grounded on the early works of Rogers (1962; 1995) and then informed by more current studies of ICT adoption. This framework as indicated in (Figure 1) considers, as its main theory, the context and content of innovation. The main impact of this framework is that it provides considerable insight into the complexities of ICT innovation across 3 divergent steps. This model is of particular interest to this research, because a key element of the model resides in the exploration of patterns of

communication and relationship between actors in ICT adoption. Secondly, the model moves slightly away from the classic ICT diffusion process which has been criticized for its sequential nature and accompanying high level of instrumentality.

In small scale agribusinesses (family farming), the use of ICT should under all circumstances be regarded as innovative.This is particularly the case for family farms operating in the developing world, thus serving as a reason for noticeable growth of ICT in family farming, especially within the developing countries (Rao 2007). Although this is the case, it appears that motivation for ICT adoption amongst family farmers has not yet been explored extensively. In the case of such rural folks operating in the eastern Uganda, an appreciation of motivational factors for adoption remains critical because of the role agriculture plays in the local economy. One such contribution to the economy is the lowering of transaction costs due to the shortening of the supply chain.

Figure 1: Diffusion of Innovation Framework

Source: Mustonen-Ollila and Lyytinen (2003)

2.4 Importance of ICTs to agricultural development

Information and communication have always mattered in agriculture. Ever since people have grown crops, raised livestock, and caught fish, they have sought information from one another. What is the most effective planting strategy on steep slopes? Where can I buy the improved seed or feed this year? How can I acquire a land title? Who is paying the highest price at the market? How can I participate in the government's credit program? Producers rarely find it easy to obtain answers to such questions, even if similar ones arise season after season. Family farmers in a village may have planted the "same" crop for centuries, but over time, weather patterns and soil conditions change and epidemics of pests and diseases come and go. Updated information allows the farmers to cope with and even benefit from these changes. Providing such knowledge can be challenging, however, because the highly localized nature of agriculture means that information must be tailored specifically to distinct conditions. Agriculture is facing new and severe challenges in its own right.

With rising food prices that have pushed over 40 million people into poverty since 2010, more effective interventions are essential in agriculture (World Bank 2011). The growing global population, expected to hit 9 billion by 2050, has heightened the demand for food and placed pressure on already-fragile resources. Feeding that population will require a 70 percent increase in food production (FAO 2009). Filling the stomachs of the growing population is only one reason agriculture is critical to global stability and development. It is also critical because one of the most

effective ways of reducing poverty is to invest in and make improvements in the agricultural sector. Even after years of industrialization and growth in services, agriculture still accounts for one-third of the gross domestic products (GDP) and three-quarters of employment in sub-Saharan Africa. Over 40 percent of the labor force in countries with per capita incomes in the US$ 400 to 1,800 range works in agriculture (World Bank 2008). Because agriculture accounts for the vast majority of the poor's livelihood activities, it is also the sector that holds the most promise for pro-poor economic growth. In fact, agriculture is around four times more effective at raising incomes among the poor than other sectors (World Bank 2008). No less important, improved agriculture also has a direct impact on hunger and malnutrition, decreasing the occurrences of famine, child stunting, and maternal infirmity.

Given the challenges, the arrival of information communication technology (ICT) is well timed. The benefits of the green revolution greatly improved agricultural productivity. However, there is a demonstrable need for a new revolution that will bring lower prices for consumers (through reduced waste and more-efficient supply chain management), contribute to "smart" agriculture, and incentivize farmers (for example, through higher income) to increase their production. Public and private sector actors have long been on the search for effective solutions to address both the long- and short-term challenges in agriculture, including how to answer the abundant information needs of farmers.

ICT is one of these solutions, and has recently unleashed incredible potential to improve agriculture in developing countries specifically. Technology has taken an enormous leap beyond the costly, bulky, energy-consuming equipment once available to the very few to store and analyze agricultural and scientific data. With the booming mobile, wireless, and Internet industries, ICT has found a foothold even in poor smallholder farms and in their activities. The ability of ICTs to bring refreshed momentum to agriculture appears even more compelling in light of rising investments in agricultural research, the private sector's strong interest in the development and spread of ICTs, and the upsurge of organizations committed to the agricultural development agenda.

2.5 Youths as an important force to extension of ICTs usage in the rural areas

Young people are often 'first adopters' of new technologies, and this appears to be the case with ICTs. Evidence from the developing world suggests that young people have widespread access to broadcast technologies and the telephone, but more limited access to the Internet. And even amongst young people, Internet use lags considerably behind Internet access. ICTs, and in particular the Internet, provide opportunities for employment, but it should be noted that there are limits to the economic impact of the Internet in developing countries. Broadcast technologies can be particularly useful tool in both formal and continuing education, the Internet may have a significant role in vocational and further education. There are potential social costs of ICT use amongst the youth, but these can be mitigated. Youth-specific policy recommendations in many developing countries focus on the greater use of ICTs in education and content control.

Looking at the global perspective, it appears likely that the great majority of the world's young people have access to broadcast technologies, the majority has access to telephony, but it is still a small minority that has access to the Web. Access to radio and TV has long been widespread as

many as 80 percent of the population of the developing World listens to the radio at least once a week (Eltzroth and Kenny 2003). The phone is becoming increasingly permeating. Nearly half a billion mobile phones were added to the global network 2000-2003 in developing countries alone (Eltzroth and Kenny 2003). Regarding the Internet, more than one quarter of a billion people in developing countries are users. Nonetheless, computer penetration is very low in developing countries (47 per 1000 people) and so it is clear that the great majority of households in the developing world have no fixed Internet access.

The non-youth-specific surveys from rural areas in Sub-Saharan Africa by (Souter, 2005) suggested that the primary usage of phones was contact with relatives and friends as well as use in family emergencies. The primary use of broadcast technologies is entertainment, with both sets of technologies playing an important secondary role in providing news and information on prices and services. There is little reason to believe that young people primarily use these technologies for dramatically different purposes.

However, Richardson et. al. (2000) recommended ICT as a means for youth job creation and income generation. He notes that ICT service provision and applications may present the opportunity to create significant employment and income-generating opportunities amongst the young in areas like agriculture. ICTs are similarly creating new employment opportunities through business process outsourcing (BPO). And while there will be more opportunities for entrepreneurial youth in developing countries to provide goods and services to a global customer base, it is impossible to separate opportunities to exploit ICTs from the broader economic environment present in developing countries where agriculture is the mainstay (World Bank 2005).

3. Family Farming: Overview

According to FAO (2014), family farming includes all family-based agricultural activities, and it is linked to several areas of agricultural development, namely crop and livestock production, forestry, fisheries, and aquaculture. From various professional engagements and literature searches, it has been observed that the definition of a family farm differs from one country/region to another in terms of farm size, type of production extra but there are some key characteristics in common from all the examples shared.

Family farms represent a large percentage of the total agricultural sector in most African countries. It is a means of organizing agricultural, forestry, fisheries, pastoral and poultry production which is managed and operated by a family and primarily dependent on family labour, including both women and men, the elderly and the youths . This system combines economic, environmental, social and cultural functions. In addition, family farmers are instrumental in selecting a wide range of varieties and breeds, which are more adaptive to the diversity of the agro-ecological conditions (combination of soil, climate, altitude etc.) faced by farmers all over the world. In doing so, family farmers are creating, promoting and conserving the biodiversity of food crops and livestock, transferring this knowledge from the current generation to the next. At the same time, many family farmers are also developing quality products not only for their self-consumption, but that could also be given value in niche markets.

Family farming is a sustainable economic model of agriculture on which most families from many developing countries have been depending on for their food security and livelihood for centuries. And this model has been successful in engaging the youth in farming over generations. Anne-Laure (2014) further notes that, family farming is more than just an occupation. It is a reflection of lifestyle, based on beliefs and traditions about life and work.

While the general idea is that a family farm is characterized by low levels of revenue and practiced on a small-scale, it might not always be the case. Family farms can also operate on large scale, with a focus on agribusiness. However, such farms are not very common to find in developing countries and other regions of the world. With a close look at the current situation, 95% of family farms globally are under 5 ha, with low profitability. They are associated with poverty (since 70% of the poorest in the world are family farmers and herders) and hence are not attractive to young people. But despite this general tendency, young people who are already involved in family farming are playing key roles in contributing to food and nutrition security, and hence there is a need to strengthen their engagement to ensure continuity (Azungi 2002).

3.1 Family farming in Uganda

Uganda has, over the years, put in place a number of development strategies in an effort to create a strong influence on agricultural sector performance especially supporting family farmers. These include: Plan for Modernization of Agriculture, National Agricultural Advisory Services (NAADS), the Economic Recovery Programme, the Poverty Eradication Action Plan (PEAP), National Development Plan (NDP), National Peace, Recovery and Development Plan for Northern Uganda and Microfinance Policy Framework, among others. Despite such initiatives, family farmers in Uganda still face a multitude of constraints along the value chain that limit their ability to increase production and productivity and access markets for their produced.

Some are broader development challenges while others occur at the farm level. The constraints are most pronounced among family farmers both youth and females. Key among these are: low public expenditure for agriculture, limited access to credit for production, inadequate extension services, use of rudimentary farm equipment, low application of modern technologies, and lack of youth interest in agriculture. Others include lack of transport for farm produce, limited access and control over land and climate change. For such reasons, poverty remains highest among Ugandans that are engaged in agriculture as the most important source of income, with the highest poverty levels being in Northern and north eastern Uganda.

3.2 Youths and farming in Uganda

There is a common perception in Uganda today which states that youths dislike agriculture, and do not see it as a viable future. This stems from real concerns that as youths move into formal employment services in cities and other towns, as the Ugandan population continues to grow, and as the percentage of Gross Domestic Product (GDP) contributed by agriculture declines (if productivity remains stable) that Uganda will face increasing food insecurity. A closer look at studies and at youths self-reports suggest a more multi-faceted reality. For example, the study report by Mijumbi (2002) noted that although many youths are engaged in some sort of agricultural

activity they do not see the attractiveness of agriculture as a primary income generating activity. It is further noted that many young Ugandans are interested in agriculture in terms of second income generation and not a priority. They react negatively to subsistence farming, which is the form of agriculture to which most youths are exposed. This distaste for subsistence farming is not unwarranted, as low agricultural yields and the natural vulnerability of crops prompt many youth to perceive diversification of income as a stronger livelihood strategy than a singular focus on farming.

However, in some districts like Butaleja, the youths have actively participated in family farming because of the ICTs that have offered enormous opportunities and they have changed their lives and that of their families as the nation at large. Another example identified in the literature review is that of Mkulima Young in the neighboring Kenya. The website boosts youth to interact and share agricultural and business advice online. Furthermore, the site is used as a marketplace for fresh produce being sold by young farmers in Kenya. Mkulima young is also present on social media (Facebook and Twitter), providing young people in Kenya and beyond a platform for information exchange and marketing of agricultural products. These are just few examples on how ICTs can help strengthen the link between youth and family farming. A lot more still needs to be done at various levels by actors along the value chain (CTA 2014).

3.3 Contribution of ICTs in family farming and rural development

It is generally accepted that 'rural development' is a multi-dimensional concept referring to: Poverty alleviation in rural areas, developing local economies in rural areas, achieving basic standards of health, safety and other developmental infrastructure and services in rural areas, encouraging and enabling rural people to invest in themselves and their communities, cultural regeneration, including the development and integration of indigenous knowledge systems into a rural community's 'ways of doing and learning' and most importantly the long-term sustainability of livelihoods and improvements in quality of life within the rural settings (ICT4D 2015).

According to ICT4D (2015), Information Communication Technologies (ICTs) is a collective term referring to new and old technologies that facilitate the processing and transfer of information across space and time. Examples of ICTs include: TVs, radios and other broadcasting equipment, cellphones, personal digital assistants (PDAs), mobile handheld devices, desktop computers and laptops just to mention all of which are essential in rural development and poverty alleviation.

To improve productivity, family farmers need access to improved technologies, best practices, and to appropriate, timely and comprehensive information and knowledge on production, value addition and markets. FAO (2000) asserts that 'information and knowledge play a key role in ensuring food security and sustainable development'. Thus, ICTs are considered to be cross-cutting drivers of change for rural and agricultural development, by connecting rural and remote communities, and improving healthcare, education and agricultural productivity (Richardson 1997). ICTs can, for example, speed up the extension of development services; can be instrumental in strengthening partnerships and in providing a framework for shared learning (van-Audenhove 2003).

ICTs amplify human ability by enabling people to perform tasks and activities more quickly, efficiently and comprehensively. They also enable people to perform functions that may otherwise be beyond their capabilities. ICTs also enable people to overcome time and space constraints through facilitating the flow of large volumes of information to a wide audience across numerous geographical locations, data can be transmitted instantaneously, significantly reducing the time taken to reach audiences. Furthermore by their very nature, ICTs are subject to continuous innovation, ensuring that new and different approaches to rural development emerge over time (ICT4D 2015).

A networked information economy helps to achieve competitiveness, and although it cannot in itself solve poverty, hunger and disease, it provides new avenues for cultural production, creates new economic opportunity, and facilitates the sharing and dissemination of scientific outputs and innovative linkages between farmers, scientists and other actors (Benkler, 2006). It is not surprising, therefore, that ICTs have led to increased use of a networked information environment and the development of platforms for better sharing and exchange of information and knowledge. However, the International Development Research Centre (IDRC) has recognized the importance of family farmers in Africa, and noted that relatively little attention had been paid to the potential benefits in the broader use of ICTs to family farmers. The situation is not different in Uganda.

ICTs are key enablers for rural development and attainment of the Sustainable Development Goals (SDGs). If conceived and accommodated in locally meaningful ways, ICTs can provide a platform for advancing development agendas in ways that are sustainable in the longer term (Maiye and McGrath, 2010). By reducing the costs of information sharing, improving its timely availability and providing the opportunities to create networks between people sharing particular interests or information needs, ICTs have the potential to contribute to the improvement of socioeconomic conditions in developing countries.

Despite proven effectiveness in helping to reduce rural poverty, priority has not been given to the development of ICTs in rural areas. Demand for ICTs is not perceived as urgent as demand for primary infrastructure and social services, when "actually the poor are hungry for ICT, knowing well that information serves access to education, markets and health services" (von Braun, 2010). The impacts of ICTs for rural households include savings in time and other resources, access to better information leading to better decision making, improvements in efficiency, productivity and diversity, information on new technologies and expanded market reach (von Braun, 2010). Chapman and Slaymaker (2002) also refer to the potential of ICTs to facilitate and improve the already existing exchange of information that takes place in rural communities. This and the use of ICTs strategically to serve community development needs can facilitate the indigenous development of rural communities through pluralistic or participatory approaches (ICT4D 2015).

For example, successful experiences in the application of ICTs in marginalized and rural areas have shown how ICTs enable access to markets, by providing information about prices and other market oriented products and services. Generally, there are numerous potential uses of ICTs within the context of rural development: they range from reduction of poverty through integration into pro-poor policies and poverty reduction strategies, enable service delivery that is citizen-centered & focuses on the needs of the rural poor, ICTs enable social entrepreneurship and economic

development such as the growth of the ICT sector in its own right, the use of ICTs as a tool for gender equality and social inclusion within and across communities and the internal use of ICTs by practitioners to deliver programmes (ICT4D 2015).

3.4 Rural development in the Achievement of SDGs in IGAD region

Poverty in Africa is predominantly rural. More than 70 per cent of the continent's poor people live in rural areas and depend on agriculture for food and livelihood, yet development assistance to agriculture is decreasing. In Sub-Saharan Africa, more than 218 million people live in extreme poverty. Among them are rural poor people in Eastern and Southern Africa, an area that has one of the world's highest concentrations of poor people (Mamo 2014).

The prevalence of poverty in Sub-Saharan Africa is increasing faster than the population. Overall, the pace of poverty reduction in most of Africa has slowed since the 1970s. Only 10 to 20 per cent of rural households in sub-Saharan Africa derive more than three-quarters of their income from the non-farm economy. Over the past two decades in sub-Saharan Africa, rural poverty declined in East Africa and increased elsewhere in the region. On-farm production is a particularly important income source in sub Saharan Africa. At the national level, between 40 and 70 per cent of rural households earn more than three-quarters of their income from on farm sources. The Sub Saharan Africa region is dominated by a young population, with both children and youth comprising 62 per cent of the total population and among poor rural populations their proportions are likely to be even higher (Zikusooka 2006).

Worth noting is that Africa's soils are often of low inherent fertility and they have been degrading. Furthermore, only one in five people in sub-Saharan Africa has access to a national electricity. In Uganda, approximately 80% of all poor people in live in rural areas. According to Zikusooka, (2006), there are widening gaps in income and other development indicators between rural and urban populations, including between poor rural and poor urban households with the former homelands war affected areas of north and north eastern the worst affected by rural poverty. Agriculture, the mainstay of most rural economies, remains mostly subsistence-focused. Few rural households are involved in commercial production and due to general challenges like limited or sometimes no access to water and finance, over reliance on the incomes of other family members usually in the form of remittances from urban areas and poor technology and infrastructural setup (Azungi 2002).

To date, most rural development strategies have focused on: rolling out infrastructure, social programmes, and social projects in both rural and urban centers and agricultural mechanization. However, Waliggo, (2002) observed that these strategies have had limited success because of: narrow definition of 'rural development', insufficient emphasis on the non-agricultural rural economy, non-participatory (top-down) decision-making in the formulation of strategies and policies. Others include uneven implementations across provinces due to: differences in institutional capacity at regional and (in particular) local levels to drive 'bottom up' rural development, differences in the proximity of rural areas to key service providers, rural population sizes, and depth and extent of poverty and other challenges (Sheperd 1998).

According to Nassanga (2001), other factors constraining rural development include: potential of private sector to play a more meaningful role has not been explored, Lack of coordination between government and other role players (e.g. NGOs). All such factors have gravely affected rural development and the IGAD region has seen slow rural development in the wake of SGDs. Therefore, rural poverty is deepening in Eastern and Southern Africa, where most of the region's 130 million poor people live in rural areas. Ten of the 21 countries in the region have an average annual per capita income of less than US$400. The progress of national and rural development is slow. Development assistance to agriculture has declined. This has a negative impact on smallholder farming, the basic source of livelihood for the rural poor. In general, agricultural productivity per worker is stagnating or decreasing (Sacks 2005).

3.5 Information Needs in Rural Areas

Rural people mainly depend on subsistence agriculture and often lack access to basic needs such as water, education, health care, employment and sanitation (Uganda Bureau of Statistics, 2002). These have led to life expectancy at birth of 54.4 per cent and an infant mortality rate of 59 per 1,000 live births in these areas. These conditions also result in their migration into urban areas, often in search of non- existing formal employment and better life. A study of the information needs and information seeking behaviour of rural dwellers in Uganda indicated the following as their information needs (Jacobs Foundation Livelihoods Program 2002):

i. Agricultural Information- from `where to purchase fertilizers' to 'how to use them', information on pesticides, herbicides, storage to information on markets and prices of agricultural produce.

ii. Health Information-how to handle the outbreak of certain epidemics, where to get the best treatment for different ailments to what they can do by themselves to get good health facilities.

iii. Political Information-traditional leadership; civic rights; political parties, voting rights, etc.

iv. Community Development Information – viable self-help projects, how to mobilize people for the projects, what government agencies to contact and to lobby etc.

v. Educational Information-school calendar, opportunities for educational self-development, higher education and how it affects children, adult education, continuing education.

4. Methodology

The study was carried out through review of secondary sources of information covering small scale agriculture and a wide range of ICT-related experiences and initiatives. Primary data was also collected through field visits to Butaleja, four (4) focus groups discussions with family farming youths in Butaleja district were conducted. During the field visits, observations were made at sites where specific initiatives were being implemented. For validity purposes, individual and group interviews with agricultural extension workers were held.

5. Findings of the Study

Presentations of the findings of this study are guided by the specific objectives below:

i. To establish the information needs of family farming youths in Butaleja district,

ii. To establish the roles of youths in family farming,

iii. To examine the contribution of ICTs to the provision of family farming information to these youths,

iv. To identify the challenges faced (if any), by the youths in applying ICTs in family faming in Butaleja district, and,

v. To establish how ICTs can sustain and strengthen youth engagement family farming To propose better strategies towards ICTs application in the development of family farming in Butaleja district

vi. To propose recommendations for youth involvement in family farming

vii. To suggest recommendations on youth engagement in family farming

5.1 Objective One: Information needs of family farming

The investigators asked to the respondent the areas of information which they require for day to day activities related to farming. During the face to face interviews, the farmers indicated that they need information on availability of seeds, crop production, and insecticide availability, fertilizer availability. One farmer asserted:

> *"We need information on where to find good and cheap seeds, which crops to grow in a particular season, where to find insecticide for our crops and animals and fertilizers"*

Based on the observations, many farmers were seen and heard using mobile phones to inquire from colleagues about the market prices and the neighboring Mbale town. They could call and find out who is offering the highest price for their rice. Others areas that were mentioned by youth farmers include water management, weather and climate information, and agricultural equipment's both traditional and modern. These results to a large extent concur with the findings of Bhagachand, (2012) who found out that farmers need information on availability of seeds crop production and insecticide availability among other needs. The study categorized the information needs of family farmers as:

Agricultural Technology - where the farmer needs information on production technology that involves cultivating, fertilizing, pest control, weeding and harvesting.

Agricultural Credit- where he emphasized a point of need for loans and advances granted borrowers to finance and service production activities relating to agriculture, fisheries and forestry and also for processing, marketing, storage and distribution of products resulting from these

activities as well as marketing information where he highlighted that this is information that enables him and other farmers make balanced and relevant decisions.

Market information needs of small scale farmers include:

- Information on product planning. This is information on what crop and variety to grow at a given season with marketability of such a crop as an important deciding factor.
- Information on current prices.
- Information on forecast of market trends. This type of information assists farmers in planning their market products.
- Information on sales timing. This assists farmers in ensuring that they do not cause a market glut. It enables them to stagger harvesting and quantity for marketing.
- Information on improved/ stable marketing practices. It includes information on improved harvesting methods. This information is disseminated by field level extension workers by demonstration on farmer's fields, at local and wholesale markets.

Information on communal marketing- This enables small scale farmers to have organized sales of marketable surplus and bulk transport of produce. This trend is commonly known as cooperative societies.

5.2 Objective Two: Roles of youths in family farming

From the different testimonials shared during the discussions, there was a distinct link between youths involved in family farming and where they undertake their farming activities. Young people in family farming are living and/or operating mostly in rural areas, which makes youth in family farming a bit different from youth and urban farming. Youths are involved in several ways in family farming and have specific roles, sometimes not only on the farm, but in all segments of the agricultural value chain.

Youths as family labour: according to the responses, family farming is seen to be hugely powered by youth. The involvement of youth was clearly evident in all the farms visited. Young people who are involved in family farming work mostly as family labour, contributing to tasks such as weeding, harvesting or spraying. It was also noted that most of these youths start getting involved on family farms by helping with minor tasks, and eventually end up taking over the family farm from the elderly parents or family members.

Income generation for family farming: Many local farmers who could afford some incentive employed hired some youth to help them clear the fields on time or weed and harvest on time. This was mainly done as a result of limited labour in some families either because their family members are still young or few. And when a major harvest arrives, there would be a shortage of labour. The labour constrained families end up sourcing for some youth in the village to help in the processes of planting, weeding or harvesting. When working on the family farm, young people are usually

not paid as employees. They are simply given a small portion of the harvest as a cultural demand especially after harvesting. But when the farm owner can afford to pay them some money, it's taken as a sign of appreciation as well but the service is regarded communal. In addition, if they are involved in other activities outside the farm and generating income, they often invest this money into the farm.

Innovation brokers in family farming: Based on the field responses, many young people play an important role as intermediary in family farming. For example, they acquire knowledge and skills from their elderly family members and apply these techniques in their farming activities, and on the other hand, they bring in technology and innovation from outside to the family farm. Moreover, youth in general socialize more and tend to pick up new and improved technologies and practices faster. These also include the use of traditional and new ICTs, which in turn, enhance agricultural productivity.

Gender specificities: Findings further revealed that in rural areas in particular, young women have specific roles and contribution in family farming. In addition to their help on the farm, they are also involved in care-giving tasks, whereas young men help with or take charge of some of the farming activities left by the father, who is sometimes absent in search for jobs in other cities or urban areas. In both cases, some also seek paid employment to contribute toward the family's income and inversion without abandoning the domestic chores or other tasks at the farm.

Family farming as a lifestyle: Sounds fashioned but based on the responses, family farming is more of a lifestyle to many people. One respondent noted that:

> *"Family farming is more of a lifestyle to them. They have to practice it from January to December. It's something we have learned to live with day in day out. It is only done on normal days and the day you don't do it, there must be something wrong".*

Findings showed that while growing up on a family farm and having been involved in different farm activities, family farming has become a lifestyle for many youths. In an interview with some youth who live and work in urban centers show that they still make time over the weekends to do farming back in the villages. Despite living in urban areas, these young people are still growing their crops in their backyard or roof garden. Some of them even return back to the village after completing their studies or having acquired additional knowledge and skills to scale up the family business back home. For instance, three respondents from shared that they grew up on a family farm, but are now living in the city. During the weekends, they travel back to the village and engage in family farming activities.

Young professionals supporting family farming through voluntary and social works: Despite the high dependence of many developing countries on agriculture, especially family farming, in terms of its contribution to the national GDP, family farmers and their families are the poorest communities. Some young people recognize this issue and have initiated a number of projects to support family farmers along the value-chain. For example, the "the CITARD Foundation and Bananyole Youth Development Agency (BAYUDA) which were all formed on the basis of helping family farms in Butaleja district. With CITARD, a total of 135 youths have participated in this

community project, of which 110 young people were on the ground. As a team, this group of young people has so far helped 200 family farmers including women in their daily work like food processing, rice growing and poultry projects.

Providing paid services to family farmers: Some young people are not directly involved on family farms, but they are providing different services to family farmers. They generally work as input suppliers (seeds, agro-chemicals, etc.) and are also giving technical advice to family farmers. Others are providing ICT solutions like market information, mobile finance, among others, to the farmers. For example, CITARD services in Uganda is proving solar lanterns to rural people in the project called **"Light up a Village"** as well as running a savings SACCO to the local farmers. Their clients include smallholder rice farmers (including family farmers), horticultural farmers, food processing companies, individual farmers and corporate clients, schools and health centers.

5.3 Objective Three: Contribution of ICTs to the provision of family farming information to the youths

The contribution of information and knowledge to youth powered by ICTs in bringing about social and economic development has been well recognized globally. Availability of markets and market information gives youth farmers the potential to bargain and improve their incomes, to seize market opportunities through the adjustment of production plans and better allocation of production factors, and also to use the information to make choices about marketing. The development and use of ICTs are playing a critical role in this regard. ICT enables the youth to transmit commodity price information to other farmers and targeted buyers in real time.

Furthermore, SMS service applies mobile telephony for market information delivery to users. In Butaleja, the market information currently available through SMS includes daily wholesale buying prices for local agricultural commodities. The study also reveals a number of ICT-based initiatives which cater for non-market information and extension services including financial, utilization of best agriculture practices, research, weather, climate, and distribution and supply chain management. Some of the initiatives include: Mobile Money, Airtel Money, M-Pesa, M-Kopa, Mobile Banking and Cente-Mobile all in Butaleja and being utilized by youth in farming.

Furthermore, a real-time call center service staffed by agricultural experts that provide agricultural information, advice and support to smallholder farmers over the phone, using voice and voice call-back to farmers has been set up in Doho Irrigation rice scheme. There are also weekly hour-long radio program featuring agricultural news and responding to a wide range of topics, including market prices and trends, farming techniques, weather and seasonal issues, financing opportunities, inputs, land use, and quality standards. Each program also offers an interactive call-in component where farmers are given the opportunity to pose agricultural questions to a panel of experts either via phone or SMS. Farmers can listen over the radio, a popular medium for information sharing in the area.

5.4 Objective Four: Challenges faced by youth in family farming

Taking into account the current situation, youth involved in family farming are facing various

challenges. The following are some key challenges highlighted during the field visit interviews:

Lack of involvement in decision-making: On a family farm, decision-making and resources are generally concentrated around the farm head, who is usually the oldest man (father, uncle or brother). Most of the times, young people have no say in deciding which crops to grow or animals to rear. Similarly, in farmers' organizations and cooperatives, young people are rarely in leadership positions.

Difficult access to land and land fragmentation: One of the major challenges associated with family farming is the lack of access to sufficient land, on a secure base. Land ownership and land tenure varies from one country to another. But in many cases, land is owned by the community or the government, rather than individuals. In cases of individual tenure, land is mostly acquired by inheritance, taking place later and later over time because of the increase in life expectancy. Furthermore, when land is acquired by youth through heritage, it is usually split into small and also separate pieces among children. Producing profitably and sustainably on such small pieces of land can be a huge challenge. Also, when a land has been cultivated over several years by the family, the land needs to be prepared (ploughing for example), which requires farm machinery that are sometimes not affordable or accessible by youth.

Poor access to knowledge and education: youth in family farming are faced with the challenge of not accessing the right information required for their farming activities at the right time. The lack of access to valuable and timely information is often linked to their geographical location, level of education and capacity building opportunities. Rural youth are often less literate than their urban counterparts and have less training opportunities on farm management and other areas which could help them scale-up their business sustainably.

Poor access to technology*:* in this era, it's not easy to believe that people still face poor access to technology. However, this challenge is still so big in many developing countries such as Uganda. Young farmers especially women have less access to ICT tools that could help them in farm activities. According to one respondent who works with a local radio station in Mbale town, it was observed in a research by the Radio Station that in a typical rural household, men have ownership of household assets such as radios. They bring them out when eating, and after lunch, they carry them to the market, or to the bars.

Limited access to financial services*:* Even if a young person has been able to secure a piece of land, he/she needs to have enough capital or savings to start the production and maintain it until harvest time. The challenge for youth in family farming lies mainly in the way financial services are organized. Financial services vary from country to country, but in general, it is more difficult for young people to have a loan as they are considered as high-risk by financial service providers, and they usually do not have collaterals, making the process more complex. The same applies for cooperative finance system in rural areas, whereby the system is not always well organized or secured.

Poor road infrastructure and unfavorable rural conditions: most youth in family farming are based in rural or remote areas. They have to travel a lot to be able to market their produce and the

fact that the road infrastructure in these regions is not in good condition makes it harder and more time-consuming. Sometimes, the products are no more in good conditions when they arrive on the market. Others challenges linked to the rural setting are the poor socio-economic infrastructures such as low access and coverage of electricity.

Challenges for young women in family farming: Structures in family farming are highly male-driven and these vary from family to family, community to community and culture to culture with production. Generally, women have limited access to the different components described lack of involvement in decision making, difficult access to land, information, education, technology, financial services, markets etc.), and it is more challenging for them when they are young.

Strategies towards ICTs application in the development of family farming in Butaleja district

The study considered the different strategies that can be used towards ICTs' application in the development of family farming in Butaleja district. Respondents clearly indicated that ICT awareness-raising and training are highly valued and lead to empowerment. There is ample potential for effective use of ICT in agriculture and initiatives are promising. However, much still remains to be done. Several strategic trends of great importance are:

a. Link the young farmers in Butaleja to more online platforms that give support to ICT-led agriculture

b. Work with young farmers in Butaleja to implement/test the agricultural mobile applications currently undergoing development by the available projects.

c. Encourage them to use mobile phones, short message services (SMS), GIS applications as well as listen to agricultural programmes on the radio

d. Strengthen existing collaborations with Butaleja district local government, development partners and key stakeholders to ensure continued support to ICT-led agriculture by young farmers

e. Increased web-based storage of agricultural information to promote easy and quick access

f. Cheaper and improved connectivity for rural communities of Butaleja

g. Increased recognition by governments of the importance of the use of ICT in rural development

h. Increased tailor-made, quality agricultural information services.

i. Capacity-building and empowerment of youth in Butaleja

j. Development of infrastructure such as accessible roads and electricity in rural Butaleja.

In so doing, ICTs will enable youth in Butaleja to interact with other stakeholders, thus reducing social isolation. It will widen the perspective of local communities in terms of national or global

developments, opens up new business opportunities and allows easier contact with friends and relatives.

5.5 Objective five: To establish how ICTs can sustain and strengthen youth engagement family farming

Information is a key in agriculture and family farming, and ICTs facilitate access to timely and accurate information needed for improved agricultural production. ICTs can successfully be used to help address some of the challenges identified above through use of mobile phones (SMS), web (or mobile) applications and internet access. But many ICT tools or applications are inadequate to the young family farmer with less or no formal education. Different categories of youth will require different ICT solutions. Youth living in rural areas, without adequate telecommunication networks or electricity, will require other ICT tools than their urban counterparts. In order to ensure effective use of ICT applications by the young family farmer who mainly lives in rural areas, there is the need to further translate contents or produce them in local languages, produce geographic specific content and ICT tools that are resilient and easy to adopt by the rural young farmer. Field interview informed this study that ICTs can be used by youth in family farming in the scenarios described below.

i. Youth role as intermediary for ICT adoption by agricultural communities

Family farming is primarily family-labour based with the division of labour between the head of the household, mostly the man, and the rest of the family - women and young people. As a key member in the family, the capacity of the youth has to be strengthened to support other members of the family but also for them to utilize the innovations in their own farms. This concerns primarily youth who are tech/ICT savvy or have the potential to become one, whether they involved in farming or not

ii. Capturing, documenting and disseminating local agricultural knowledge

One specific characteristic of family farming is the rich source of local knowledge that is produced and transmitted from generation to generation. Different ICT tools (mobile phones, tablets, computers, information systems, web 2.0 and social media tools etc.) can be used effectively in capturing, documenting, disseminating and storing knowledge and skills by family farmers, including youth, thereby preserving and improving these practices and innovations to support agricultural sustainability.

iii. Improving access to Agricultural Knowledge

ICTs can also be used to improve access of young family farmers to extension and advisory services, as well as vocational trainings. One interesting example shared in the debate is that of Noyikila Jean-Bosco, a young farmer from Rwanda, who learned how to produce organic manure from a video he watched several times at the ICT center in his village. This ICT center is a small room, whereby a TV set is installed with hundreds of satellite channels, a DVD player, and a computer with wireless internet connection, a telephone box and a battery charger for mobile phones. All these tools are free of charge for the villagers. This example also demonstrate that

traditional ICTs such as the TV, radio and video tapes are still very relevant and useful to provide agricultural information in the rural setting.

iv. Youth Developing ICT applications and offering ICT services to Agriculture

A number of questions were asked about how young people can use ICT to support agricultural development as a whole, which will also serve family farming. A number of issues were discussed by the interviewees. They noted that youth can develop ICT applications that could be used to improve market access, or favour networking and information exchange among young farmers and youth involved in agriculture. One example shared during the discussions was that of "Connect Uganda" which encourages youth to interact and share agricultural and business advice online across the country and this information can be accessible by everyone globally. Furthermore, in the neighboring Kenya for example, The Mkulima platform is similarly used as a marketplace for fresh produce being sold by young farmers in Kenya. The Mkulima young is also present on social media (Facebook and Twitter), providing young people in Kenya a platform for information exchange and marketing of agricultural products. These are just few examples on how ICTs can help strengthen the link between youth and family farming. A lot more still needs to be done at various levels by actors along the value chain.

6. Conclusions and Policy Recommendations

Recommendations are presented in three categories. Key Recommendations on youth and family farming are the following:

i) Encouraging adequate processes for transition of family farm management from elders to youth

It is important to develop an all-inclusive approach where elders are integrated into the transition of a family farm. As they prepare their young ones to appreciate agriculture and take over the management of the family farm, they should be valued and encouraged. For example, if a son or daughter is going to take on a managerial role for which the family head was responsible for, it has to be ensured that the elder is compensated as required and that his role is recognized if he/she still wants to be involved in one way or another on the farm. Processes for smooth transitions can be encouraged and facilitated by community leaders, public authorities or national and international institutions as required.

ii) Promote role models and success stories of youth in family farming

Family farming should no longer be seen as subsistence farming. If young people who are successfully engaged in business-oriented family farms that generate sufficient revenues are portrayed as role models, other youth will be encouraged to take over the family farms, instead of making their career in other sectors.

iii) More agribusiness training and capacity building for rural young family farmers

Youth in family farming, especially those living in rural areas, face specific challenges. For them

to be better engaged in family farming sustainably, they should have more training opportunities on farm management, agribusiness and other trainings tailored for them.

i v) Strengthen capacity and involvement of young women in family farming

As the pillar of family labour, women have to be resourced with information on production and market for decision making to consolidate the communal role in the family farming. Therefore, the capacity of rural women should be strengthened, notably in ICTs. ICTs can be used to support vocational training for some of these young women as farmers in the family. The role of women in extension and advisory services could also be boosted so that they better encourage young girls to be involved in family farming.

v) Strengthen policies on family farming and youth

In many countries, youth in agriculture programmes have been put in place, but the problem lies either in their implementation or their lack of focus on family farming. It is therefore recommended that policies on family farming are strengthened and on-going monitoring, evaluation and learning activities should be included as part of these programmes, so as to identify what is not working and corrective actions are taken when necessary.

Key recommendations on ICTs and family farming are the following:

i) Develop ICT training and capacity building programmes for youth in family farming

Looking at the encouraging results that the of ICTs are bringing about in the lives of farmers, including youth, it is recommended that more ICT training and capacity building programmes are developed at different levels, that specifically target youth in family farming to that they can improve their farm production and increase profitability in a sustainable manner. For example, the use of ICTs for agribusiness, information access and exchange etc.

ii) **Strengthening rural telecentres and rural ICT access points targeting farming**

The strengthening or establishment of well-managed tele-centers/community ICT centres or ICT4Ag centres in rural communities can offer the young family farmer a one stop place to practically access to ICTs and harness diverse applications to support their activities. This will reduce marketing and management communication costs, improve their knowledge and ultimately increase agricultural productivity. It will also support development of non-farms economic activities.

iii) **Developing and using ICT tools and applications adapted to rural conditions**

When new ICT applications and tools are being developed, the rural setting and conditions under

which family farms operate should be taken into account. For example, applications should be in local languages, and the tools should be resistant ones that can run with low energy. Solar energy should be promoted.

iv) **Using ICT to support extension delivery**

The potential of ICT to be used in e-extension service to bridge the gap of extension officer to farmer ratio has not been fully exploited. ICT providers must focus on using the various ICT tools to bring research findings and farm innovations from the research institutions to family farms owners. Here too, the youth can play useful role by interpreting the messages to the farmers and helping them to adopt the innovations. Young women in particular can benefit of these platforms to get increased agricultural knowledge, if needed via distance learning and interactions.

v) Strengthening the role of rural youth as agricultural information brokers via ICTs

As highlighted throughout the prior discussions, the role of youth as innovation brokers cannot be overlooked. To further encourage them to undertake this role and facilitate the process, the use of ICTs should also be encouraged.

Other universal recommendations:

i) Improve road and market infrastructures

Governments in different countries need to improve infrastructure such as rural roads. They need to be established/repaired in order to make the farms and markets more accessible. This is a major problem for farmers in general, but also affects the activities and livelihoods of youth engaged in family farming.

ii) Encourage Public-Private agricultural Partnerships

A number of ICT service providers have not been able to scale to multiple countries and to reach out to a significant number of users; and are hugely driven by donor funds. The inability of platform owners to post positive net returns has been a major disincentive to attract private financing needed to reach significant scale and guarantee sustainable businesses. Both financial sustainability and scalability can be addressed by effective public-private partnerships where the public sector funds are used to support platform owners to test new markets and extend the services to currently undeserved communities through agri-businesses. Public funds could be used to buy down the risks of these agribusinesses to enable them to see results until they are ready to absorb the cost.

In conclusion, family farming is here to stay. It is still practiced widely in the developed economies, although on a larger scale than in most of the IGAD member states and other low income countries. In agricultural focused countries like Uganda where employment in many sectors is scarce, family farming provides a source of livelihood and stability for the youth. Family

farming must also be viewed as a lifestyle. It remains a strategic model of agriculture through which the increasing quest to engage youth in agriculture can be achieved. It has over the decades proven that it is sustainable, as it does not largely depend on incentives from projects by governmental or non-governmental organisations. The use of ICTs does not only help to make family farming more attractive for youth and curb urban migration, but also encourages excellence and can aid in promoting young people who succeed in agriculture. However, family farming without a strong focus on commercialization/business will not be attractive to the teeming unemployed youth especially in developing economies. While it is not currently the case on the ground, family farming certainly has the potential to operate as a business, and at the same time keeping the same lifestyle and way of living it has always been associated with. It is hoped that the recommendations that came out from this study, will be taken into account by policy makers and other actors along the agriculture value-chain, for food security and improving livelihoods in developing countries and shape our future towards agenda 2030.

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Commodity Warehousing as a Tool for Economic Recovery in Conflict-Affected Areas: Insights from Northern Uganda

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Abstract

Market structures such as warehouses have been considered fundamental for agricultural growth and economic recovery in post-conflict areas. However, experiences from Uganda, indicate that these facilities are often not used or operate below capacity. Yet the government and development partners increasingly show interest by investing in these facilities. This study therefore critically examined the determinants of utilization of warehouse facilities and economic benefits in post-conflict areas. Using cross-sectional and ethnographic study designs, data were collected from 307 randomly selected households, 6 FGDs with 64 participants and 5 key informant interviews. Data were analyzed using probit model and comparative analysis of incomes. The study was clustered around 6 warehouses with an installed capacity of 415 tons. Results showed that only 27% of farmers used warehouses and stored less than 10% of what they produced. Usage of warehouses was only 13% of the average handling capacity. Results further revealed that access to price information, extension services, membership to business associations and credit positively and significantly ($p<0.1$) affected warehouse utilization, whereas distance to warehouse and age of the respondents negatively affected warehouse utilization. There was a significant ($p<0.05$) mean difference in prices received by warehouse users amounting to an average of 55% higher than non-users, in a span of one month after harvest. This implies that commodity warehousing has potential to increase rural household incomes, but should be adequately supported by strong farmer associations and embedded services (e.g. credit and extension) which offer added benefits.

Key words: Agriculture, Probit model, Warehouses, northern Uganda, Recovery

1. Introduction

Sub-Saharan African (SSA) countries depend on agriculture for consumption and income generation. Over 80% of the population in this sub region depends on crops and livestock for their livelihoods and food security. In addition, SSA economies rely heavily on agriculture which contributes on average 15% of GDP and provides employment to more than 60% of the labor force (OECD-FAO 2016). Given its key contribution to economic development, there has been a resolve

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by national governments to develop a vibrant and sustainable agricultural sector. For instance the Comprehensive African Agricultural Development Program (CAADP) within the 2003 Maputo Declaration prioritized Agriculture and Food Security. African heads of state made commitments to allocate at least 10% of national budgetary expenditure towards agriculture, aimed at achieving 6% annual growth. In the Malabo declaration signed in 2014, African Union heads of state further renewed their commitment to the CAADP framework, principles and processes. Commitments were made to end hunger and halve poverty through inclusive agricultural growth and transformation by 2025.

Despite these commitments, the agricultural sector in most of SSA continues to lag other parts of the world. Researchers have attributed the low growth rates to many factors; but in part the fluctuating productivity growth in the region is due to the various political and ethnic conflicts that have erupted across the continent since independence. As a result of conflict, resources, including plant, livestock and labor, are destroyed, economic behaviors are altered, public resources are diverted from productivity enhancing activities and assets are depleted (Kimenyi et al. 2014).

In Uganda, annual growth in agricultural sector is 1.5%, way below the 6% target of the CAADP (MAAIF 2014). Poverty is wide spread in Uganda at 19.7% in 2012/2013, with the Northern region lagging behind at 43% (MFPED 2014). Poverty is also regionalized with the Northern region having higher poverty levels, with Human Development Index (HDI) of 0.430 (UHDR 2015). This is largely attributed to the over 2 decade armed conflict in the region between the Ugandan government and the Lord's Resistance Army (CARE International 2002) that affected agricultural production, despite the area's potential to be a national food basket. The area also suffers extreme weather conditions (in particular droughts) further worsening the food security status.

With peace returning to the region in 2007, many programs were launched aimed at economic recovery of the region. The government's Peace Recovery and Development Plan (PRDP), has been the flagship project aimed at economic recovery of the region. Also other projects like the Northern Uganda Social Action Fund (NUSAF), to enable households once again resume their economic activities. The key focus has been on alleviating market challenges and achieving higher farmer incomes and connecting to various markets. Commodity warehousing aimed at enhancing farmer access to input and output markets, has been widely promoted in the region by both government and non-government organizations. Warehouses are expected to operate as production and marketing hubs where farmers obtain information on market prices, store their produce, and access other services like credit and extension advice.

Empirical evidence suggests that commodity warehousing has potential to boost production, improve rural household incomes and overall agricultural sector growth. For example Kannapiran (2000) shows that bulking, in public warehouses promotes better prices and provides collateral for farmers, which offers confidence for commercial banks to offer credit to farmers. Experiences in Kenya, show that grain bulking centers offer a 'one-stop service' to farmers including input supply, marketing, storage and eventually financial services including insurance (KENFAP 2011). As such, farmers have access to critical information and production inputs required to make informed decisions.

Similarly, Karimi and Namusonge (2014) indicate that an efficient warehouse management system is crucial to an organization's operational performance as it enhances waiting so that farmers can sell their produce when remunerative prices are offered in the market. Farmers can more freely choose the timing of the sale of their crops and therefore sell at remunerative prices. This also stimulates competition (RLDC 2011). Bulking can also help provide a direct link between producers groups and bulk end-buyers or processors, bulked products in a warehouse are attractive for buyers as transactional costs are lower and quality and quantity thresholds are guaranteed.

Despite the good picture of warehouse performance in other countries, the picture in Uganda has been pitiable. Most warehouses constructed in Northern Uganda largely remain un-utilized and/or abandoned. In light of these recent events, it is becoming extremely difficult to ignore the under-utilization of these warehouses. Given the situation on the ground, it is far from clear what the actual or potential contribution of these warehouses in achieving economic recovery of people in Northern Uganda. In addition, factors determining utilization of warehouses are not well documented, to guide future investment or improvements in the way these facilities are utilized to achieve better benefits for farmers. This study addresses this gap by understanding the characteristics of warehouse users, factors determining utilization of warehouses, and economic benefits to farmers using warehouses, compared to non-warehouse users. Results are based on a case study conducted in Lira district, Northern Uganda, but have wider significance to other countries in conflict prone areas like in the Horn of Africa and other east and central African countries.

2. Materials and Methods

2.1 Study Design

The study was a mixed methodology (both qualitative and quantitative) and used cross-sectional and ethnographic study designs. The ethnographic study aimed at exploring inherent cultural or traditions of the people that may influence utilization of warehouses in Lira, considering that implementation of warehouses was done as part of the recovery program for the district.

2.2 Study Area

The study was conducted in Lira District in Northern Uganda. Lira district and lies between Latitudes 1^{o} 21'N and 2^{o} 42"N, Longitudes 32^{0} 51"E, and 34^{0} 15"E. The district covers approximately a total area 1326 km^2 of which 1286.22 km^2 is land area. It has a population of 403100 people (UBOS, 2012). It is one of the Districts that suffered the wrath of the Lord's Resistance Army (LRA) insurgency. Crop production (agriculture) has greatly contributed to the economic growth and development witnessed in Lira in the recent past. Despite under-utilization of the production potential, Lira District still remains a source of food for the nation and has excelled in the production potential, for the production of oil crops, cotton, vegetables and pulses and has attracted big processing industries for example Mukwano Industries and Mt. Meru.

2.3 Data and sampling procedure

Data for this study were collected from three sub-counties in Lira district. These sub-counties were purposively selected so that to the views of these farmers can be generalized across the district, with Aromo sub-county in the north, Barr sub-county in the central and Amach sub-county in the south and the production potential, with Barr having 72%, Amach 67% while Aromo 59% of the people engaged in Agriculture. These sub-counties also have six public warehouses, with Barr having four while Amach and Aromo, each with one warehouse. The research selected these six warehouses from the three sub-counties, with an anticipated number of 1800 farmers to be served by these warehouses and a combined holding capacity of 415 tons. Data were collected from farmers targeted by these warehouses. Lists of target farmers were obtained from organizations that constructed the warehouses and were used as sampling frames. Using Krejcie and Morgan (1970) sample size determination formula, a sample of 327 respondents was derived;

$$n=\frac{N}{1+N(e^2)}$$

Where; n=sample size, N= total number of household anticipated using the warehouses in the area, which was 1800; and e= is degree of error, which will be less than 5%

Using probability proportion to size, sample size per warehouse were obtained (Table 1); based on the population of farmers affiliated to the warehouse.

Table 1: Number of Farmers Interviewed Per Warehouse

Warehouse	Location	Capacity of warehouse	Anticipated number of farmers per warehouse	Sample size
Ayamo	Barr Sub-county	45	300	37
Ober	Barr Sub-county	45	300	46
Olilo	Barr Sub-county	40	300	45
Onywako	Barr Sub-county	35	300	37
Amach	Amach Sub-county	200	300	92
Aromo	Aromo Sub-county	50	300	50
Total		415	1800	307

In addition, five key informant interviews (LC3 Chairpersons of Amach, Aromo, and Barr sub-counties, District Commercial Officer, Lira, and Representative from FAO) were conducted. Six Focus Group Discussions were also conducted, one for each of the six warehouse locations. The data were collected by use of direct face-to-face interviews with the aid of pre-tested questionnaires. The questionnaires captured data on socio-demographic characteristics of the respondents, production data, the volume of produce stored in the warehouse, if any, institutional factors like membership to a business association, access to credit and extension services, in the selected districts and sub-counties.

2.4 The analytical Approach

In order to identify the determinants of warehouse utilization, the Probit model was used. The dependent variable was the use of warehouse. It takes on either of two values 0 and 1, that is yes =1 and 0, otherwise. In this study, the decision was whether to use or not to use a warehouse. The key concern of the issue was to discuss if the farmers are using the warehouse for storage (bulking), and/or the source of finance (collateral). If a farmer uses the warehouse (answering yes to the utilization question), a second question was asked, eliciting some measure of the respondent's extent of participation.

Decisions to use can be motivated by a latent variable model linking unobserved utility derived from utilization of the warehouse. The researcher also used the study to test the hypotheses that prices received by users of warehouses are not significantly different from those earned by non-users of warehouses from alternative markets (agricultural commodity warehousing does not increase household incomes). Formally an individual's decision to use the warehouse can be represented by an indicator function that is the binary outcome model (Katchova 2013)**.**

$$Yi = Xi\,\beta + ei \qquad (1)$$

Where; Yi = is an unobservable indicator variable that determines whether the i^{th} farmer, uses the warehouse (Y_i=1) or not (Yi=0); X_i = is a set of explanatory variables associated with the i^{th} individual farmer, β = is a vector of observed independent covariates that explain the farmer's decision to use the warehouse; and e_i = is an unobserved random variable capturing all factors that influence the decision to utilize the warehouse.

The probit model takes the basic form;

$$Yi = G(Ii) \qquad (2)$$

$$Ii = b_0 + \sum_{j=1}^{n}(b_j\,\text{Xji}\ ) \qquad (3)$$

Where; Yi is the observed response (1 or 0) for the i^{th} household; Ii is the underlying stimulus reasons why the household uses the warehouse or not); G is the functional relationship between the observation (Yi) and the stimulus (Ii); i = 1,2,……m, is the index of observations, the sample size; Xji is the j^{th} explanatory variable for the i^{th} observation; b_j is the unknown parameter; and J= 0,1,2……..,n, where n is the number of explanatory variables.

For the Probit model, G (*) is the standard normal distribution (CDF) and the model becomes

$$Yi = \sum_{-\infty}^{Ii} g(Ii).dZi \qquad (4)$$

Where g(*) is the pdf of the standard normal distribution.

In the probit model, the households are assumed to make decisions based upon an objective of utility maximization. For a given decision, separate models are developed for each decision. The underlying utility function depends on specific attributes X (e.g. age of household head, sex of the

household head, education, membership to an agricultural association, etc) and a disturbance term having a zero mean. The Probit analysis is based on the cumulative normal probability distribution. The outcomes of y are mutually exclusive and exhaustive. The dependent variable, y, depends on k observable variables, which are shown in Table 2.

Table 2: Variables, Descriptions, Expected Sign and Respondents Characteristics

	Variable	Unit	Variable Description	Mean	St. Dev.	Min	Max
Y	Utilization of warehouse	Dummy	yes =1; 0 otherwise	0.27	0.445	0	1
X1	Age of respondent	Number	Chronological age in years	41.7	14.85	17	81
X2	Sex of respondent	Dummy	male = 1, Female = 0	0.49	0.5	0	1
X3	Education level of respondent	Scale	Level of education of HH head (None=1,Primary=2, Secondary=3, Tertiary=4)	2.15	0.77	1	4
X4	Household (HH) Size	Number	Number ofHH members	6	2.72	1	15
X5	Size of Land for production	Acre	Total farm size of the HH	4.03	3.18	1	40
X6	Access to Training/extension services	Dummy	yes= 1; 0 otherwise	0.5	0.5	0	1
X7	Experience in farming	Years	# of years in farming as primary activity	17.2	13.99	1	61
X8	Distance to warehouse	Kilometers	# of Kilometers to the warehouse	2.4	2.3	0.4	20
X9	Access to price information	Dummy	Yes =1; 0 otherwise	0.66	0.47	0	1
X10	Membership to group/cooperatives	Dummy	Yes =1; 0 otherwise	0.30	0.46	0	1
X11	Access to finance through the store	Dummy	Yes=1, and 0,otherwise	0.16	0.36	0	1
X12	# of members active in farming	Number	Number of household members	4	2.14	1	12

3. Results and Discussions

3.1 Respondent's characteristics

The respondents were aged between 17 and 81 years and were from both rural and urban backgrounds, with the mean age of 38 years. There were relatively more young respondents (below 30 years of age) with 29%, followed by middle age (31 – 40), with 26%, and those between 41-55 years were 25%, while above 56 years were only 20% as shown in table 3. At least 51 % of the respondents were men and the rest were women. At least 19% of the respondents did not have formal education, while the majority of the respondents (52%) had primary level education (Table 3).

Table 3: Average Age of Respondents

Sex of respondent	Frequency of Age of respondents (years)				
	Below 30	31 – 40	41 – 55	Above 56	Total
Total number	90	80	76	61	307
Percentage	29	26	25	20	100

Table 4: Education Level of Respondents by gender

Sex of respondent	Education level of respondents				
	No formal	Primary	Secondary	Post -secondary	Total
Males	5	78	61	12	156
Female	53	80	17	1	151
Total	58	158	78	13	307
Pearson Chi square:	73.816;	P-value: 0.000			

3.2 Utilization of warehouses

Less than a third (23%) of those who responded indicated that they were utilizing the warehouses. Maize, soybeans, and sunflower were the major crops taken to the warehouses. 54% of those using warehouses were males while the rest were females, as shown in Table 5.

Table 5: Cross-tabulation of Utilization of Warehouses by Sex of Respondents

		Do you use warehouse?			
		No	Yes	Percentage of users (Yes)	Total
Sex of respondent	Male	111	45	54	156
	Female	113	38	46	141
Total		224	83	100	307

The reasons for low utilization of the warehouses by women could be because most women grow crops for home consumption and therefore may not require keeping in the store and Men might be more engaged in commercial crops. They also have difficulty in accessing labor (because of lack of resources, even most of the oxen for ploughing are owned by men) and extension services, (are often denied the opportunities to attend training because of the many other household responsibilities they have), and as a result limits their productive levels, which they end up selling all on piece meal basis.

This finding is consistent with the review of gender studies and agricultural productivity in Sub-Saharan Africa (SSA) which shows that women are slower than men at certain precision manual tasks, such as adopting new technologies (Quisumbing 1996; Thapa 2009; Peterman et al. 2010; Ragasa et al. 2013)**.** The implication of this is that it is important to understand the factors that affect the adoption of improved technologies by women and men farmers so that key policy interventions that are gender sensitive and needed to improve the productivity of all smallholder

farmers can be in identified. For instance, Labour-saving technologies especially for weeding, use of animal traction and closing the gap in access to productive resources can help increase production.

Farmers indicated that the low level of utilization was attributed to low volumes (quantity) produced, demands for instant payments / cash by the farmers, as well as the lack of trust in the management of the stores and concerns of safety of their crops. These reasons were consistent with a study conducted by Archambault (2004) who found that low volumes of crop production by farmers, and farmers desire to be paid immediately after bringing their produce to the warehouse, contributed to neglecting the warehouses. The study also found out that the low utilization of warehouses has been attributed to delays in produce sales at the stores, the long distances between the location of the stores and residences of the farmers posed a difficulty for transportation, thus, farmers resorted to using their homes for storage; and in some instances previously instituted management committees were dormant, and could not sensitize on the use and benefits of warehouse/bulking. Some warehouses were being hired by middlemen who use them after piecemeal purchase from farmers, a phenomenon which outcompete smallholder farmers who also cannot afford to pay the high rental fees.

There were three warehouses that had more produced bulked (Table 6). These were Onywako (40%), Ober (13%) and Amach (9%). This could be attributed to having functioning cooperatives-Onywako Cooperative society and Ober cooperative society, though with heavy reliance on NGOs. Amach sub-county formed one but was non-functional while Aromo sub-county has none.

Table 6: Percentage and Volume of Commodity Sold Through Each Warehouse in 2014

Warehouse	Location (Sub-county)	Capacity of the warehouse (MT)	Amount of produce stored/sold through the warehouse in (MT)	Percentage of warehouse used in for produce (%)
Ayamo	Barr	45	0.8	1.8
Ober	Barr	45	5.7	13
Olilo	Barr	40	2.34	6
Onywako	Barr	35	13.9	40
Amach	Amach	200	26.9	9
Aromo	Aromo	50	4.4	8.8

3.3 Factors influencing the utilization of warehouses by smallholder farmers

A number of factors that play a role in determining the farm households' adoption of modern agricultural production technologies were grouped into household socio-economic factors which include farm size, farming experience; personal factors which include sex of the respondent, age of the respondent**,** Education level of the respondent; situational factor which include distance of the warehouse from the farmer's house, access to market information (price); institutional/organizational factors which membership of business associations, access to training (extension) services, access to finance and cultural factors. The log-likelihood ratio statistic was significant at 1% (Chi^2=136.29, Prob = 0.000) suggesting that the independent variables taken together influence warehouse utilization decisions. The Pseudo R_squared value, an indication of

goodness of fit, is 0.396. Results from the sampled outcome model, Tables 7 and 8, showed that farmer's decisions to use the stores were driven by a number of factors. Access to price information, access to trainings (extension), membership of business association (cooperatives), access to finance, (these are institutional factors), and number of members active in farming, were found to be significant and positively affected the participation of farmers in the warehouses, and therefore increased the probability of farmers utilizing the warehouses, while distance to the warehouse, age of respondent were found to be negatively significant, and therefore negatively affected the usage of the warehouses.

Table 7: Probit Regression Analysis Results of the Determinants of Utilization of Warehouse

Variables	Coefficient	Standard Error	Z	P>z
Age	-0.029	0.016	-1.82	0.068
Sex of respondents	-0.034	0.240	-0.14	0.887
Household Size of respondents	0.007	0.055	0.14	0.892
Number of members active in farming	0.118	0.064	1.86	0.063
Education Level of respondents	0.015	0.161	0.09	0.925
Farming experience	0.014	0.017	0.86	0.39
Size of land for Production	-0.049	0.044	-1.12	0.263
How far is household from Warehouse	-0.141	0.049	-2.89	0.004
Access to information	1.036	0.268	3.86	0
Received training/extension services	1.134	0.221	5.14	0
Membership of business association	1.016	0.233	4.35	0
Access to finance	1.093	0.280	3.9	0
_cons	-1.618	0.667	-2.42	0.015

Table 8: Marginal Impacts of Various Explanatory Variables on the Utilsizaiton of Warehouses (Number of observations = 288)

Variables	dy/dx	Standard Error	Z	P>z
Age	-0.008*	0.004	-1.83	0.068
Sex of Respondents	-0.009	0.066	-0.14	0.887
Household Size	0.002	0.015	0.14	0.892
Number of members active in Farming	0.032*	0.017	1.87	0.062
Education Level of respondent	0.004	0.044	0.09	0.925
Farming experience	0.004	0.005	0.86	0.389
Size of land for production	-0.013	0.012	-1.12	0.262
How far is household from Warehouse	-0.038**	0.013	-2.94	0.003
Access to information	0.239***	0.049	4.85	0.000
Received training/extension services	0 .304***	0.057	5.38	0.000
Membership of business association	0.316 ***	0.078	4.05	0.000
Access to finance	0.372 ***	0.105	3.56	0.000

This study found age to be statistically significant and negatively correlated, indicating that younger farmers are more likely to use the warehouse. As was observed during the research, many farmers were using bicycles as a mode of transport. Therefore, as one grows old, the ability to ride the bicycles, which is a common mode of transportation in Lira district, reduces as well, hence the ability to utilize the store also reduces. This implies that older farmers are less likely to utilize the warehouse than younger farmers. The finding is consistent with Adesiina and Baidu-Forson (1995), who found that age positively influence adoption of sorghum in Burkina Faso, and McNamara et al. (1991) of Integrated Pest Management (IPM) on peanuts in Georgia. An increase in the age of farmer by one year decreases the probability of a farmer utilizing the warehouse by about 0.78 percent. The implication of this for policy makers is to promote the use of ox-drawn charts since there is relatively a high level of animal traction in the region.

This study did not find a statistically significant relationship between education level and the utilization of the warehouse. This could be because for a farmer to use a warehouse there is no specialized training/skill that he/she has to learn, when you compare with other technologies. This is contrary to studies by Mwanga et al. *(*1998) who carried out a study in Tanzania and found that education level significantly affected the adoption of improved wheat varieties, and also by Asfaw et al. (1997) and Tesfaye and Alemu (2001) indicated a positive relationship between education and adoption. However, the cross-tabulation result showed that those who have no formal education and those who attained only primary education are utilizing the warehouses less, at 25% and 23% respectively. However, those with secondary and Post-secondary education showed a higher percentage of utilization at 33% and 46% respectively. This result is consistent with other analyses (World Bank 2007).

There was a significant positive impact of extension services on the adoption decision of households and confirms that a positive relationship exists between adoption and extension services. A possible explanation for this might be that extension services provide farmers with information on availability and properties of the new technology and technical skills for using it. Such contacts, by exposing farmers to the availability of information can be expected to stimulate adoption (Polson and Spencer 1991), therefore, increases, the tendency for farmers to use the warehouse increases. Many authors reported that enhancing farmers' access to an extension will improve their perception about the warehouses. For example, Namwata et al. (2010) indicated that household heads who had access to extension services were more likely to adopt improved technologies for Irish potato than the ones who do not. Other authors, Chilot *et al*. (1996) and Tesfaye and Alemu (2001) also found the significant relationship of access to an extension to the adoption of agricultural technologies. Marginal analysis showed that improving access to training (extension) services by one unit leads to about 30 percent increase in the probability of utilization of the warehouse. The study found that only 49.8% of farmers of received extension services, and considering this evidence, it seems that this could be a reason for the low utilization of the warehouses in Lira District. A key policy priority should, therefore, be to plan for the long-term care of extension service

Membership of an association was statistically significant. (r= 0.429, significant at 0.01), as well as positively correlated with the utilization of the warehouse. This means that the probability of utilizing the warehouse is higher for farmers who belong to a business association (cooperative)

than those who don't belong to a business association (cooperative). This is because that network effects are important for individual decisions, and that, in the particular context of agricultural innovations, farmers share information and learn from each other. Membership to farmer groups is basically related to social capital and social participation. This finding broadly supports the work of other studies such as done by Dereje (2006) linking social participation with adoption significantly and with a positive relationship. The results of this study indicate that only 30.3% of the farmers sampled belonged to business associations (cooperatives), this, therefore, explains the low level of utilization of the warehouses in Lira District. Increasing membership of a business association by one unit leads to about 32 percent increases in the probability of utilizing the warehouse.

Proximity to market (warehouse) is an important determinant of adoption of technology. Distance to market is assumed to play an important role in technology adoption. According to this study, it was found to be negatively significant, indicating that an increase of distance by one kilometer decreases the probability of utilization by about four percent. This could be because the farmers find it difficult to transport their produce to these warehouses, given that most farmers were observed, during the research, to be using bicycles as the main mode of transport. It, therefore, means that the further the warehouse is from the households, farmers are far are less likely to utilize the warehouse. Distance, therefore, affects the decision of use the warehouse. This also accords with our earlier observations by Bishop and McConnen, (1999) and Daniel (2006) which showed that the farmer closer (nearer) to the warehouse, will have more knowledge about the warehouse and its benefits

Lastly, access to finance/credit was statistically and positively significant. This is because credit can largely help farmers to invest and use improved technologies in their crop production, and more volume produced which can then be stored. This view is supported by Yirga (2007) who writes that participants who reported having access to finance indicated a positive relationship between adoption and availability of finance. Improving access to credit by one unit leads to about 37 percent increase in the probability of utilizing the warehouse, however, most of the respondents who accessed financial services used the Village Savings and Loan Association (VSLA) groups.

3.4 The economic viability of commodity warehouses

The Economic viability of warehousing is measured by prices offered at the warehouse, which is a proxy for better farmer incomes. The hypothesis being tested was that prices offered by warehouses are not significantly different from those earned by non-users of warehouses from alternative markets. Results show that the three main crops that the farmers bulked (took to the stores) were Maize, Soybean, and Sunflower. The study used the 95% confidence level to carry out the t-test on the mean difference of prices of these commodities sold through both at the warehouses and the markets.

Table 9: T-Test Results of the Most Bulked Commodities in the Warehouse

Crop marketed	Mean Warehouse price (UGX per kg)	Mean Market price (UGX per kg)	Mean difference in price (UGX per kg)	t-test	Significance
Maize	791	511	280	3.2157	0.0324
Soybeans	1276	1024	252	2.4270	0.0456
Sunflower	844	706	138	3.1449	0.0163

At a p-value of 0.05, it was found that the p-value of the mean prices of Maize, Soybean and Sunflower were 0.0324, 0.0456 and 0.0163 respectively, as shown in table 9. We, therefore, reject the null hypothesis that warehouses don't offer higher prices and accept the alternative. It was found that farmers who sold at/through the warehouses fetched higher prices than their counterparts that did not. There was a significant ($p<0.05$) mean difference in prices received by farmers using the warehouse and those not using. Similarly, the former category of farmers achieved on average 55% higher prices than the latter, in a span of 1 month after harvest. This is because the bulk amount of products stored in a warehouse was attractive for buyers, which increased the bargaining power of the farmers. This research finding is consistent with study results conducted by Vladimir *et al*. (2014), which found that the strategy of using public warehouses and postponing the sale of grains after harvest is a profitable strategy for agricultural producers.

4. Conclusions and Implications

This study assessed determinants of utilization of warehouses, and the economic viability of the warehouses, in order to build inferences for the potential of warehousing in contributing to economic recovery of conflict-affected communities. Results show that majority of respondents were not utilizing the warehouses, and they attributed this to low volumes produced, the need for immediate money/payment, long distance to the warehouses, lack of trust in the management of the store and delays in selling while at the store. Farmers stored mainly maize, soybean and sunflower, but just less than 10% of what they produced.

The number of family members active in farming, access to price information, extension services, membership to a business association, and credit positively significantly affected warehouse utilization. These attributes reflect resource ownership and access to production inputs, which greatly motivate agricultural production. On the other hand, age of head of household and distance to the warehouse, negatively and significantly affected warehouse utilization. These factors relate to accessibility by farmers, where by long distances would deter farmers to use such facilities even if they anticipated higher returns from using them. Similarly, as farmers grow old, they become less active in group activities, let alone covering long distances to access distant market, Farmers who sold through the warehouses fetched higher prices than their counterparts that did not.

Membership in an association positively influences adoption decisions because it facilitates information dissemination. It also empowers members to mitigate credit market failures. This is because it creates confidence between farmers and financial institutions thus allowing farmers to have access to farm credit from such institutions using their collective grains in a community warehouse as collateral. However, given the fact that lack of trust was mentioned as a deterent to utilization of warehouses, it's important that such organizations are facilitated to operate

professionally and provide required services to farmers. If organized around warehouses, they can provide embedded business development services to members further promoting agricultural production and incomes. Government should promote policies and regulations aimed at supporting and strengthening cooperatives for example Cooperative Development Policy.

The business associations/cooperatives formation should be based on an incentive initiated by the farmers themselves, to increase production and create sustainability. Warehouses should also be adequately supported by strong and trusted farmer associations, credit facilities, and extension services if they are to offer added benefits to the users. This can be through a public-private partnership which promotes of good governance, compliance to laws, regulations, and standards through the dissemination of a cooperative code of best practice document.

The finding of positive impacts associated extension activities points to a strong rationale for increased efforts in the strategically important areas of public agricultural research and extension. Therefore, the extension services should be enhanced at the warehouses, and the farmer groups strengthened to have them realize the intended benefits from the structure put in their community.

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Part Three: Investment and Employment Creation

Employment Impacts of Product Innovations in Sub-Saharan Africa: Firm-Level Evidence

Elvis Korku AVENYO[28]

Abstract

Innovation has become a key interest in recent years in sub-Saharan Africa as it is evidenced to play eminent role in generating employment. There is however dearth of empirical evidence assessing the impact of innovations on firm–level employment growth in sub-Saharan Africa. Extending and applying a novel dose response model under different intensities of innovation, this paper presents new evidence on the impact of product innovations on employment growth using the World Bank's Enterprise Survey (ES) merged with the newly available Innovation Follow-Up Surveys data covering the period 2010-2013 for five(5) sub- Saharan African countries. Our main findings are generally consistent with the stylized facts in the empirical literature with product and joint product and process (JPP) innovations having compensation impacts on employment growth. We however, found these conclusions to be invalid beyond sub-interval of firms' intensity of innovation. In extensions to decent employment, we found product innovations to be creating temporary jobs leading to questions about the sustainability of these new jobs. In terms of policy, the paper recommends extension of social security to all types of workers in line with national and regional innovation policies and the ILO-WHO Social Protection Floor Initiative.

Key words: Decent Employment, Product innovations, Dose response model, sub-Saharan Africa

JEL Classification: J23, J3, O31, O33, L1

1. Introduction

The development discourse in sub-Saharan Africa (SSA) remains wrought with critical issues such as political instability, premature de-industrialization and persistent poverty among others. Some of these issues are being accentuated by the demographic pressure and increasing unemployment and underemployment -particularly youth unemployment-glaring on the continent. ILO (2014) statistics show youth unemployment in SSA to be 12.58% in 2013 but estimates it to have increased to 12.66% and 12.69% in 2014 and 2015 respectively. Development paradigm in terms of evidence favours industrialization as the engine of growth. Evidence of de-industrialization in SSA however questions the feasibility of the industrial sector generating and equitably distributing quality employment for rapid poverty reduction (Szirmai 2012; Szirmai, Gebreeyesus, Guadagno & Verspagen 2013; Tregenna 2009).There is therefore a renewed focus on how to nurture new sources of 'quality' employment that integrates the youth.

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Innovation is widely recognized as a primary driver of economic growth and productivity as well as a major source of employment (Fagerberg, Mowery & Nelson 2005; Schumpeter 1934; van Dijk & Sandee 2002; Verspagen 1992). Empirical evidence indicates the critical role innovation played in leapfrogging productivity, industrial competitiveness and economic prosperity in the 'so called' newly developed countries of South Korea, Singapore, Malaysia and most recently China. Firm-level innovation has been also found to create new jobs (see Harrison, Jaumandreu, Mairesse, & Peters 2014; Hall, Lotti, & Mairesse 2008; Pianta 2005). Advancing firm-level innovation and promoting firm-level innovative activities arguably offers strong prospects for sustainable growth, improvement in productivity and consequently avenues for quality employment creation in developing countries particularly SSA (Gault 2010).

The effects of firm-level innovation and innovative activities have also been argued to be particularly key in resolving some of the challenges Africa faces today and thus an important policy and research area (AU-NEPAD 2010). Consequently, there is a renewed and a growing 'innovation-led' development thinking where policy efforts[29] and strategies are being developed and implemented at the continental, regional and national levels to boost economic growth that translates into quality jobs through Science, Technology and Innovation (STI) (AU-NEPAD 2014). One such continental policy is the implementation of the NEPAD African Science, Technology and Innovation Indicators (ASTII) Initiative aimed at collecting and making available useful innovation indicators across several African countries (see AU-NEPAD 2010 &2014). [30]

Despite the policy efforts, little remains known about the relationship between innovation and employment in Africa. According to AU-NEPAD (2014), one challenge facing African countries is how to "link" innovation to employment creation. The ample literature examining the effect of innovation on employment from other continents remains mixed. As a result, empirical analyses of the relationship still occupy centre stage in the development literature (Peters 2005). The literature mainly from developed countries focuses on innovation in manufacturing firms ignoring to a large extent innovation in service sector firms. With innovation in the service sector evidently exerting more beneficial effects on employment than in manufacturing (Gallouj & Djellal 2010) and being the major contributor to GDP in most SSA economies, it is critical to consider and analyze the innovative activities of service sector firms. Examining the context of innovations and the direct and indirect mechanisms through which innovation affects employment at the firm-level is important for both innovation and employment policies (Hall et al. 2008).

It is in the spirit of closing these evidence gaps and contributing to the understanding of how innovation impacts employment growth that this study becomes vital. This paper aims to shed light on the relevance of product innovation in the design of policies for employment in SSA. This paper however employs a counterfactual stance where innovative and non-innovative firms are assumed to have varying responses to the intensity of innovation.

This paper contributes to the literature in three major ways. Firstly, the paper contributes to the thin empirical literature in SSA by assessing the impact of firm-level product innovations on

[29] Lagos Plan, Khartoum declaration, Addis Ababa declaration etc.

[30] *Another dataset on innovation is the World Banks supplementary innovations survey that is employed in this paper. This dataset is particularly useful as it can be easily merged with the Enterprise Surveys available in almost all SSA countries.*

employment growth using a newly available firm-level data. Scholarly evidence available in the literature is mainly from developed countries and Latin America. This may be partially due to the scarce firm-level innovation data in SSA. With the availability of some innovation data in recent years, this paper contributes to the literature by providing empirical evidence that helps to better understand product innovations and its labour market implications in SSA.

Secondly, this paper contributes to the literature by applying a novel approach to analyse the employment impacts of product innovation from a counterfactual stance where innovative and non-innovative firms have varying responses to the introduction of innovations and the intensity of innovations. In modern micro-econometrics, counterfactual causal analysis is becoming widespread in establishing causal relationships between economic variables. However, the application of causal analysis remains missing in the innovation-employment literature. This paper tries to go further by employing a counterfactual perspective and beyond the correlation analyses popular in the literature. In addition, we model the firms' choice to introduce innovation or otherwise and rigorously examine the 'impact' of firm-level product innovations on employment under heterogeneous responses with varying intensities. [31] This approach provides a deeper understanding of the causal relationship and to determine whether there is (are) innovation intensity (ies) where employment growth is maximized (or minimized). Thirdly, the creation (compensation) and destruction (displacement) impacts of product innovations may depend on the type and skill of workers (Harrison et al. 2014). This paper makes another important contribution to the literature by extending our analyses to understand the different impacts product innovation may have decent employment, specifically on the security and equity of workers.

In this paper, we adapt and apply the Dose Response Treatment Model under continuous treatment developed recently by Cerulli (2012) and used by Cerulli & Poti (2014). The Dose Response Treatment Model under continuous treatment is an econometric model for estimating continuous treatments under heterogeneous response where selection into treatment may be endogenous. This paper presents the first application of this perspective to analyze the employment impacts of innovation from a counterfactual stance where innovative and non-innovative firms have varying responses to the intensity of innovation. The data used in the paper comes from the World Banks Enterprise Survey (ES) and the Innovation Follow-Up Surveys for five (5) sub-Saharan African Countries. The study uses these comparable firm-level datasets for Congo Democratic Republic, Ghana, Tanzania, Uganda and Zambia. Results reveal compensation impacts of product innovations on employment growth. This conclusion is however found to be valid only within a sub-interval of firms' intensity of innovation. In extensions to decent employment, we found product innovations to be creating unsecured jobs as compared to secured jobs.

The rest of the paper is organized into the following sections. Section 2 presents a brief literature review on the relationship between product innovation and employment. In Section 3, the Dose Response Treatment Model and sources of data are presented. Section 4 presents the results and discussions in line with the objectives of the paper. We present our conclusion remarks and recommendations in Section 5.

[31] *According to Cerulli & Poti (2014), the empirical application of counterfactual causal analysis remains a future development. This paper presents the first application of this perspective.*

2. Related Literature

Development economics by tradition recognizes innovation as a major driver of economic growth and a source of employment generation (see Dosi, Freeman, Nelson, Silverberg & Soete 1988; Fagerberg *et a*l. 2005; Schumpeter 1934; Verspagen 1992 for a survey). Conceptually, the theoretical analyses of the effect of innovation on employment are done from either the micro or macro strand or both (see Pianta 2005; Vivarelli 2014). This review however concentrates on the micro strand due to the fact that, innovations are introduced at the firm-level where their employment effects are manifested directly (Pianta 2005).

The theoretical literature analyzing the employment effects of innovation essentially distinguishes between two main types of innovation as product and process innovations. This distinction is however not strict as complementarity is found to exist between the two types of innovation (Mohnen & Hall 2013; Mairesse & Mohnen 2010; Pianta & Antonucci 2002). The overall effect (direct and indirect) of both types of innovation on employment at the firm-level is still theoretically contrasting and ambiguous (Lachenmaier & Rottmann 2010; Hall et al. 2008; Pianta 2002). Product innovations are intended to make firms' more technologically competitive(Bogliacino & Pianta 2010; Pianta & Antonucci 2002).[32] The improved competiveness is expected to lead to the introduction of "new" products on the market through quality advantages thereby stimulating economic activity and market expansion and hence employment (Pianta & Antonucci 2002). This enables a direct positive relationship between innovation and employment. However, the market expansion that enables the positive direct effect could be as a result of displacement (crowding out effect) of other less competitive firms in the industry.[33] The effect of the product innovation is therefore theoretically unclear and inconclusive.

As noted earlier, complementarity is found to exist between process and product innovations (Mohnen & Hall 2013; Mairesse & Mohnen 2010; Pianta & Antonucci 2002). The theoretical effect of introducing both types of innovations on employment depends on the size of the compensation and displacement effects emanating from both types of innovation. If product innovation have a larger compensation (positive) effect as compared to the displacement (negative) effect from process innovation, joint introduction of both types of innovation will be expected to generally have compensation (positive) effects on employment growth and vice versa. The effect of innovation on employment also extends beyond the firm-level and may be found at the industry level and even beyond. These indirect effects may result from the competitive redistribution of output and demand due to changes in relative prices as well as input-output relations between firms in an industry. Firms may also adopt innovations generated in other industries leading to employment impacts (Pianta 2005; Verspagen 2004). This is however beyond the scope of this paper.

Despite the theoretical ambiguity in the theoretical literature, there exists some level of general consensus in the empirical literature about the relationship between product innovation and employment at the firm-level (see Vivarelli 2014; Pianta 2005 for recent survey of the literature). Copious empirical works in the literature find positive effect of product innovation on employment

[32] See OECD/Eurostat (2005: paragraph 156) for a broad definition of product innovation.
[33] The crowding-out effect is however captured at firm-level analyses if firms in the dataset are representative of the industry , 2014).

(see Harrison et al. 2014; Meriküll 2010; Hall et al. 2008; Peters 2008; Piva & Vivarelli 2005, 2003; Smolny 1998). Harrison et al. (2008, 2014) analyzed the stimulating effects of innovation on employment using innovation survey data on both manufacturing and service sector firms in France, Germany, Spain and the United Kingdom. The authors developed a simple theoretical framework that disentangled the effect of innovation (product and process) on output growth and employment growth from existing products. The authors assumed both process and product innovating firms to be product innovators as both innovations "correspond to the introduction of new products". The major finding emanating from the empirics is that, product innovation is a major source of employment and the compensation effects from it far outweigh the displacement effect from process innovation. Hall et al. (2008), Peters (2008), Crespi & Tacsir (2013) and Elejalde, Giuliodori & Stucchi (2015) using different adapted versions of the Harrison et al. (2008) model found similar results. Using a panel data from Italian manufacturing firms, Hall et al. (2008) found a crowding out effect associated with non-innovating firms resulting in a cancellation effect of the positive employment growth obtained from product innovation. Crespi & Tacsir (2013) and Elejalde et al. (2015) analysed the effect of product and process innovations on employment in Latin America using innovation survey data focusing on the manufacturing industry. The authors found product innovations to be skill-biased especially in high-tech manufacturing firms. Further analysis by Elejalde et al. (2015) indicates that, product innovation is skill biased but creates both skilled and unskilled jobs.

Empirical evidence analyzing the relationship between innovation and employment in SSA is scant. The idiosyncratic nature of innovation in SSA coupled with the structural features of innovation might lead to invalid extrapolation of results from other regions. The known empirical evidences available are Gebreeyesus (2011) and Konte & Ndong (2012). Using secondary survey data on informal micro-enterprises in Ethiopia, Gebreeyesus (2011) found innovative activities to contribute to employment growth. The authors also found no bi-directional causality from employment growth to innovation. In a rare descriptive study that collected primary data on informal Information and Communication Technology (ICT) firms in Senegal, Konte & Ndong (2012) found innovation as a contributor to job creation and economic growth.

3. Methodology

3.1 Data and Descriptive Analysis

The empirical investigation in this paper employs data from the Enterprise Survey (ES) and the Innovation Follow-Up Surveys of the World Bank.[34] The ES is a World Bank project, which collects enterprise data in 122 countries with a standard methodology allowing for cross-country comparisons. The ES methodology randomly stratifies firms by sector, size and location thus making the sample in each country representative. The Innovation Follow-Up Surveys are follow-up surveys to the ES that collect representative firm-level data on innovation and innovative activities of firms[35] between last fiscal year and three fiscal years ago. The Innovation Follow-Up

[34] *Both datasets cover manufacturing and service sector firms.*
[35] *See the Oslo Manual (OECD &Eurostat, 2005) for measurement definition of these concepts.*

Surveys follow the Oslo Manual (OECD/Eurostat 2005) and cover 19 countries over 2011-2014 out of which 15 of the countries covered are in Africa.

ES and the Innovation Follow-Up Surveys were merged at country level using a unique country identifier. It is important to point out that, we only considered countries that have ES in the same year as the Innovation survey.[36] All merged country datasets were then appended using a global unique identifier for larger sample size as all individual countries have large missing values for almost all variables of interest. For instance, only few firms in each country recorded information for a variable such as "percentage sales from all product innovations". Appending all the datasets across countries guarantees a larger sample size. In total, data from 5 SSA countries totaling 2,466 firms were obtained. Table 1 presents the list of countries, the year of the surveys and the number of firms from each country under study. A look on Table 1 indicates varying national samples.

Table 1: Description of data by country and year of data collection

Country	Year of ES (For)	Year of Innovation Survey (For)	Number of firms
Congo, D.R. (DRC)	2013(2012)	2013(2012-2010)	385
Ghana (GH)	2013(2012)	2013(2012-2010)	549
Tanzania (TZ)	2013(2013)	2013(2012-2010)	543
Uganda (UG)	2013(2013)	2013(2012-2010)	449
Zambia (ZAM)	2013(2012)	2013(2012-2010)	540
TOTAL			**2,466**

Source: Computed by author from ES and Innovation Follow-up surveys.

In order to standardize our dataset, we employed exchange rate data and implicit price deflators' data from the World Bank's World Development Indicators and the United Nations System of Accounts with base year 2005 respectively.

Due to the large number of cross missing values, there was a large drop in the total number of firms and in some cases all firms in some countries across regression specifications. As a result, the total number of countries and the total number of firms vary across innovation types and consequently across estimations. Despite the enormous drop in the number of firms, the representativeness of the population in terms of sector and size was relatively maintained.[37] Table 2 shows the basic descriptive statistics for two main variables employed in this paper. For each variable, we sub-divided the sample into innovators and non- innovators across all countries under consideration.[38]

From Table 2, a total number of 2,456 firms responded to the question on product innovations. 955 firms representing about 38.9% of firms introduced product innovations with a mean percentage sales from all product innovations (product intensity) of about 34.97%. Product innovators experienced a 9.77% growth in total employment while non-product innovators grew by 15.55%. The above descriptive statistics indicate that, in our sample, total employment growth tends to be lower for product innovators as compared to non-product innovators. A closer look across each country descriptive statistics however indicates a much-mixed employment growth across innovation. For example, product innovators in Uganda experienced negative growth in

[36] *Ethiopia, Rwanda, and Zimbabwe are also excluded as the sampling methodologies employed in the follow up survey differ from the ES global methodology.*
[37] *See appendix B.*
[38] *See appendix C for definitions of variables.*

employment during the period under consideration. Product innovators in Tanzania experienced lower employment growth as compared to non-product innovators.

Table 2: Descriptive statistics of innovation and employment growth variables

	ALL	DRC	GH	TZ	UGA	ZAM
No. of firms in data	2,466	385	549	543	449	540
Product innovation						
No. of respondents	2456	383	544	541	448	540
Innovators	955	147	154	89	238	327
Non-innovators	1501	236	390	452	210	213
Product Intensity (Mean % sales)	34.97	44.95	36.65	43.5	37.64	25.97
Total employment growth (Mean)						
Product Innovators	.098	.138	.112	.347	-.036	.118
Product Non-Innovators	.156	.112	.101	.409	.031	.068

Source: Computed by author from ES and Innovation Follow-up surveys

3.2 Model

The Dose Response Model employed in this paper is an econometric model for estimating continuous treatments under heterogeneous responses where selection into treatment may be endogenous (see Cerulli 2012). A firm's decision to innovate as well as engage in innovative activities may not be random and may be influenced by confounders and vice versa. Cerulli & Poti (2014) applied (the only known application) the methodology to analyze the impact of public support intensity and firm R&D performance. A variant model was also developed and used by Imbens & Hirano (2004) with Fryges & Wagner (2008) applying the Imbens & Hirano (2004) model to investigate the relationship between exports and productivity growth. The choice of the Dose Response Treatment Model under continuous treatment model is based on its non-requirement of full normality and its applicability to data where lots of the firms have not introduced any type of innovation and vice versa (see Cerulli & Poti 2014).

3.2.1 Model descrption

Assume there are two exclusive groups of firms: innovative firms (treated) and non-innovative firms (untreated). Let the innovation indicator,$W_i = \{0,1\}$ show whether a firm has introduced an innovation ($W_i = 1$) or not, $W_i = 0$. Firms are assumed to have different innovation intensities (t_i) with non-innovative firms having $t_i = 0$. Innovative firms are assumed to take values greater than zero ($t_i > 0$) as these firms have within the period under consideration, introduced at least one product innovation with different intensities from a vector of innovations $I_i = \{PR\}$ where I_i refers to the vector of product innovations introduced by firm i, PR refers to product innovation. t_i is therefore assumed to take values strictly within the continuous range of [0:100].

Let employment growth (outcome) from innovative firms (treated) be defined as Y_{1i} and employment outcomes of non-innovative firms (untreated) be Y_{0i}.[39] Employment outcomes are assumed to be exclusive to a firm. Assume further a vector of M confounders as $X_i = \{x_{1i} \dots x_{Mi}\}$

[39]*Temporary and permanent employment growths, ratio of male to female employment, growth of skilled and unskilled employments were used as outcome proxies for decent employment in the extended model.*

for all firms. Let N refer to the total number of firms, N_1 refer to the total number of innovative firms and N_0 be the total number of non-innovative firms with $N = N_1 + N_0$.

Following Cerulli (2012) and Cerulli & Poti (2014), let the population outcomes (suppressing subscripts for simplification) be written as:

$$w = 1: y_1 = a_1 + f_1(x) + g(t) + e_1$$

$$w = 0: y_0 = a_0 + f_0(x) + e_0 \qquad (1i)$$

where y_1 and y_0 are the employment outcomes of innovative and non-innovative firms respectively, a_1 and a_o are two scalars, $f_1(x)$ and $f_0(x)$ are firm's responses to the vector of confounding variables (x) to innovating and not-innovating, $g(t)$ is the response function to the intensity or the level of innovation (treatment) taking value 0 if $w = 0$ and $\neq 0$ if $w = 1$. Following Cerulli & Poti (2014), assume $f_1(x)$ and $f_0(x)$ have a linear parametric form as $f_1(x) = x\delta_1$ and $f_0(x) = x\delta_0$. The causal parameters conditional on x, t are defined as:

$$\mathrm{ATET}(x, t > 0) = E(y_1 - y_0|\mathrm{x}, \mathrm{t} > 0)$$

$$\mathrm{ATENT}(x, t = 0) = E(y_1 - y_0|\mathrm{x}, \mathrm{t} = 0) \qquad (1ii)$$

$$\mathrm{ATE}(x, t) = E(y_1 - y_0|\mathrm{x}, \mathrm{t}) = \{^{(a_1 - a_0) + x(\delta_1 - \delta_0) + g(t)\ if\ t>0}_{(a_1 - a_0) + x(\delta_1 - \delta_0)\ if\ t=0}\} = \{^{a + x\delta + g(t)\ if\ t>0}_{a + x\delta\ if\ t=0}$$

where ATET and ATENT refer to Average Treatment Effect on the Treated (innovative firms) and Average Treatment Effect on Non-Treated (non- innovative firms) respectively. ATE is the Average Treatment Effect.

Cerulli (2012) and Cerulli & Poti (2014) derived the Average Treatment Effect (ATE) conditional on x, t, w as:

$$ATE(x, t, w) = \{^{ATE(x,t>0)\ if\ w=1}_{ATE(x,t=0)\ if\ w=0} = w[a + x\delta + g(t)] + (1 - w)[a + x\delta] \qquad (2)$$

By averaging Equation (2) on x, t, w, the unconditional ATE is obtained as:

$$\mathrm{ATE} = E_{(x,t,w)}\,[ATE(x, t, w)] = E_{(x,t,w)}\,\{w[a + x\delta + g(t)] + (1 - w)[a + x\delta]\}$$

$$= E_{(x)}\left\{E_{(t)}\left\{E_{(w)}\,\{w[a + x\delta + g(t)] + (1 - w)[a + x\delta]|x, t\}|x\right\}\right\}$$

$$= p(w = 1)E_{(x)}\left\{E_{(t>0)}\ [a + x\delta + g(t)]|x\right\} + p(w = 0)E_{(x)}\left\{E_{(t=0)}\ [a + x\delta]|x\right\}$$

$$ATE = p(w = 1)(a + \bar{x}_{t>0}\delta + \bar{g}) + p(w = 0)(a + \bar{x}_{t=0}\delta) \qquad (3i)$$

where $\bar{g}$ is the average response function taken over $t > 0$.

Applying the Law of Iterated Expectations (LIE) where $ATE = p(w=1)(ATET) + p(w=0)(ATENT)$ and following Cerulli (2012) and Cerulli & Poti (2014), the remaining causal parameters can be rewritten from Equation 3i as:

$$ATET = (a + \bar{x}_{t>0}\delta + \bar{g}) \quad (3ii)$$

$$ATENT = (a + \bar{x}_{t=0}\delta) \quad (3iii)$$

Combining Equations (2), (3ii) and (3iii) by adding and subtracting (3ii) and (3iii) from (2) gives:

$$ATE\ (x,t,w) = w[a + x\delta + g(t) + (a + \bar{x}_{t>0}\delta + \bar{g}) - (a + \bar{x}_{t>0}\delta + \bar{g})] + (1-w)[a + x\delta + (a + \bar{x}_{t=0}\delta) - (a + \bar{x}_{t=0}\delta)] \quad (4i)$$

$$ATE\ (x,t,w) = w\big[\{(a + \bar{x}_{t>0}\delta + \bar{g}) + (x_{t>0} - \bar{x}_{t>0})\delta + (g(t) - \bar{g})\} + (1 - w)[(a + \bar{x}_{t=0}\delta) + ((x_{t=0} - \bar{x}_{t=0})\delta]\big] \quad (4ii)$$

Rewriting in terms of (3ii) and (3iii), Equation (4ii) becomes:

$$ATE\ (x,t,w) = w\big[\{ATET + (x_{t>0} - \bar{x}_{t>0})\delta + (g(t) - \bar{g})\} + (1-w)[ATENT + (x_{t=0} - \bar{x}_{t=0})\delta]\big] \quad (5i)$$

and

$$ATET(x,t) = ATE(x,t,w=1) = ATET + (x_{t>0} - \bar{x}_{t>0})\delta + (g(t) - \bar{g}) \quad (5ii)$$

$$ATENT(x,t) = ATE(x,t,w=0) = ATENT + (x_{t=0} - \bar{x}_{t=0})\delta \quad (5iii)$$

Following Cerulli (2012) and Cerulli & Poti (2014), the Dose Response Function is derived by simply averaging Equation (5i) over x as:

$$ATE(t,w) = E_x\{ATE(x,t,w)\} = w[ATET + (g(t) - \bar{g})] + (1-w)ATENT \quad (6)$$

Equation (6) can be re-written as:

$$ATE(t) = \begin{cases} ATET + (g(t) - \bar{g}) & if\ t > 0 \\ ATENT & if\ t = 0 \end{cases} \quad (7)$$

where $ATE(t)$ is the main causal parameter of interest and defined as the Average Treatment Effect dependent on the intensity or the level of innovation.

Using the Potential Outcome Model (POM) and assuming Conditional Mean Independence (CMI), Cerulli (2012) derived the estimation equation for the causal parameters by substituting equation $(1i)$ into the observable outcome $y = y_0 + w\ (y_1 - y_0)$ as:

$$E(y|x,w,t) = a_0 + x\delta_0 + wATE + w[x - \bar{x}]\delta + w[g(t) - \bar{g}] \quad (8)^{40}$$

[40] *See Cerulli (2012, pp. 8 & 9) for proof.*

Following Cerulli (2012) and Cerulli & Poti (2014), assume $g\ (t)$ is a three degree polynomial as $g(t) = bt + ct^2 + dt^3$, equation (8) can be rewritten as:[41]

$$y = a_0 + \ x\delta_0 + wATE + w[x - \bar{x}]\delta + b[t - E(t)]w + c[t^2 - E(t^2)]w + d[t^3 - E(t^3)]w + \varepsilon \quad (9)$$

Under Conditional Mean Independence (CMI), OLS estimation of equation (9) is argued to provide consistent estimates of the causal parameters of interest (Cerulli 2012; Cerulli & Poti 2014).

The Dose Response Function is estimated as:

$$\widehat{ATE(t_\iota)} = w\left[\widehat{ATET} + \hat{b}\left(t_i - \frac{1}{N}\sum_{i=1}^{N} t_i\right) + \hat{c}\left(t_i^2 - \frac{1}{N}\sum_{i=1}^{N} t_i^2\right) + \hat{d}\left(t_i^3 - \frac{1}{N}\sum_{i=1}^{N} t_i^3\right)\right] + (1 - w)\widehat{ATENT} \quad (10)$$

where $\widehat{ATE(t_\iota)}$ is a consistent Dose Response Function with $\widehat{ATE(t_\iota)} = ATE(t_i)_{t_i>0}$.

Empirical evidence from the innovation literature indicates that, the decision to innovate or not (w) and the intensity or the level of innovation (t) are likely to be endogenous.[42] The assumption of Conditional Mean Independence (CMI) therefore breaks down and estimation of equation (9) with OLS gives biased estimates (Cerulli, 2012). Following Cerulli (2012), equation (9) is re-written as:

$$y = a_0 + \ x\delta_0 + wATE + w[x - \bar{x}]\delta + b[t - E(t)]w + c[t^2 - E(t^2)]w + d[t^3 - E(t^3)]w + \varepsilon \quad (11.1)$$

$$w = \begin{Bmatrix} 1\ if\ w^* = \eta_1 x_1 + \varepsilon_w\ > 0 \\ 0\ if\ w^* = 0 \end{Bmatrix} \quad (11.2)$$

$$t = \begin{Bmatrix} t' = \eta_2 x_2 + \varepsilon_t\ \ if\ w^* > 0 \\ t^* = 0\ if\ w^* = 0 \end{Bmatrix} \quad (11.3)$$

where w^* is the latent unobservable counterfactual of innovative and non-innovative firms. The intensity of an innovation is only observed $(t = t^{'})$ when a firm introduces an innovation $(w = 1)$, otherwise it is assumed to be unobserved (see Amemiya, 1985 pp. 384 & 385). Equation 11.2 and 11.3 are specified as a Type II Tobit model (see Amemiya 1985) where 11.2 regresses a vector of covariates x_1 that influences the decision of a firm to innovate or not to innovate and Equation 11.3 defines the vector of covariates, $x_2\ that$ determines the intensity of innovation.

The outcome estimation equation can be rewritten from equation 11.1 simply as:

$$y = a_0 + \ x\delta_0 + wATE + w[x - \bar{x}]\delta + bwT_1 + cwT_2 + dwT_3 + \varepsilon_y \quad (12)$$

[41] *According to Cerulli (2012) and Cerulli & Poti (2014), g (t) can be assumed to have linear, partial linear or polynomial regression forms. We assume a polynomial regression form here to control for possible non-linearity of the intensity of innovations.*
[42] *See Harrison et al. (2014)*

where $T_1 = [t - E(t)]$, $T_2 = [t^2 - E(t^2)]$ and $T_3 = [t^3 - E(t^3)]$ are considered to be endogenous together with w. ε_y is an error term with zero mean and constant variance.

3.2.2 Estimation/Identification procedure

The estimation in this paper is performed in two stages. The first stage involves a probit Maximum Likelihood Estimation (MLE) of the Type II Tobit models of Equation 12.2 and 12.3. The choice of the probit MLE is based on its "strong consistency and asymptotic normality properties" (Amemiya, 1973). Given data on our variables, we obtained the fitted values from the probit MLE in Equations 12.2 and 12.3. The fitted values obtained from the first stage probit MLE are then used as instruments in Equation 12.1 for the second stage where we performed a two stage least squares (2SLS) estimation (see Wooldridge 2013, p. 529; Cerulli 2012).

The second stage estimation poses issues of parameter identification as Equation 12 is assumed to have the same covariates in the Type II Tobit models. To resolve the parameter identification problem, we extended the identification assumption by Cerulli (2012) to specify the vector of covariates in Equations 11.2 and 11.3 as:

$$x_1 = (x, q_1)$$

$$x_2 = (x, q_2) \tag{13}$$

where q_1, q_2 are a vector of instrumental variables that appear and explain the probability of a firm to innovate (Equation 11.2) and the intensity of innovation (Equation 11.2) respectively thereby satisfying the exclusion restriction (Wooldridge 2013).

The two stages of estimation are performed using the *ctreatreg* econometric package (see Cerulli, 2012) in *Stata SE/13.1* which performs both the probit MLE and the 2SLS estimations automatically rather than the estimation of the two stages explicitly as both procedures have been found to give similar results. However, econometric packages have been found to be particularly useful in obtaining valid standard errors and test statistics as compared to the invalid standard errors and test statistics obtained from the "manual" estimation of both stages (Wooldridge 2013).

3.2.3 Testing for endogeneity

In this section, we provide statistical evidence to test the robustness and consistency of our results. The problem of endogeneity if present as noted above, biases and yields inconsistent estimates if equation 9 is estimated. As a result, estimation of the system of equations in equation 12 provides consistent coefficients using instrumental variables (IV). One difficulty in using IV, as well established in econometric literature, is the identification of valid instruments. The theoretical and empirical literature on employment and innovation have however, suggested several instruments that have been found to provide solution to the problem of endogeneity (see among others Harrison et al. 2014; Crespi & Tacsir 2013; Elejalde et al. 2015; Hall et al. 2008 and Peters 2008). Some of the identified instruments include increased range, clients as source of information, continuous

external R&D engagement (see Harrison et al. 2014; Hall et al. 2008); R&D intensity, share of market, internal R&D, patent, science (see Peters 2008); public support for innovation activities (see Crespi & Tacsir 2013).

We proceeded by testing the validity of these instruments identified in the literature. Using the C statistic χ^2 (difference-in-Sargan) under the null hypothesis of exogeneity, we test for the exogeneity of our innovation variables. Under the null hypothesis of valid instruments, test of over-identifying restrictions were conducted using the Hansen's J statistic chi-squared test for joint validity of the instruments. Test results using different combinations of instruments for which data is available for are presented in Table 3.

Panel A in Table 3 presents IV regression for product innovation estimated using Generalized Method of Moments (GMM). The C statistic χ^2 (difference-in-Sargan) test rejected the null hypothesis, with a strong significance, the exogeneity of our innovation variables. We therefore proceeded to test the validity of various combinations of instruments identified in the literature. . The Hansen's J χ^2 test failed to reject different combinations of license, patent and continuous external RD as valid instruments for product innovation.[43] The first-stage regressions of our innovation variables on the set of instruments are strongly significant supporting the validity of our instruments.[44]

Following Harrison et al. (2014), we conducted further, a test of the 'discriminatory power' of the Hansen's J χ^2 tests by introducing 'questionable' instruments. We introduced in addition to the valid instruments identified above, product-quality improvement variables such as the importance of innovation to- offer products already offered by competitors; deal with decrease in demand; decrease cost of production and ;open or increase market share- as instruments. Since these product-quality variables are directly related to price, we expect these sets of additional instruments to be rejected as valid instruments (see Harrison et al., 2014). Results from the Hansen's J χ^2 tests shown in the bottom two columns of Panel A as *e* and it shows the rejection of the validity of these additional instruments at 1% significance level. This is additional evidence that, our estimates are unbiased and consistent.

Table 3: Testing for endogeneity

Dependent variable: Employment growth	**A[b] Product innovation**
Constant	0.101
	(0.0503)
Introduced product innovation	-0.437
	(0.253)
Intensity of product innovation	0.0140
	(0.00546)
Number of firms	1815
C statistic χ^2 (difference in Sargan)	13.6646
Prob. value	0.0011
Hansen's J χ^2	2.49109

[43] *We also tested the exogeneity of our innovation variables and the validity of our instruments using the Durbin and Wu-Hausman statistics and the Sargan's and Basmann's chi-squared tests respectively. Test results confirm the problem of endogeneity and the validity of our instruments.*

[44] *See Appendix D.*

Prob. Value	0.1145
Hansen's J χ^2	16.9193[e]
Prob. value	0.0047[e]

Standard errors in parentheses. Coefficients and standard errors are robust to heterokesdasticity.
[b] Instruments used are license, patent, continuous external RD.
[e] Instruments used are license, patent, continuous external RD, clients as source of information, competitors' product, demand product, cost product.

4. Empirical Results and Discussion

Table 4 below presents the standardized results showing the impact of product innovation on employment growth in five countries namely Democratic Republic of Congo, Ghana, Tanzania, Uganda and Zambia. Panels A and B show the OLS and IV estimate respectively. We estimated different model specifications where we sequentially added different sets of control variables to extend both the basic OLS and IV specifications for robustness check. We included in all extended regressions size, sector, year and location dummies. It is useful to mention that, the estimated coefficient of product innovation is an estimate of the Average Treatment Effect as indicated in estimation equation. In other words, the estimated coefficient of product innovation for example indicates, ceteris paribus the average effect of the firm's innovative products on employment growth.

Table 4: Employment growth impacts of firm-level product innovation

	A-OLS				B-IV
	(1)	(2)	(3)	(4)	(5)
	Growth of total employment				
Product innovation	0.173***	0.065**	0.088***	0.096***	0.955**
	(0.028)	(0.032)	(0.027)	(0.027)	(0.394)
Log of experience			0.005	0.006	0.013
			(0.015)	(0.016)	(0.024)
Log of total employment (-3)			-0.087***	-0.083***	-0.067**
			(0.023)	(0.023)	(0.031)
Real growth of sales per worker			-0.172***	-0.177***	-0.180***
			(0.017)	(0.018)	(0.014)
R&D			0.040*	0.039*	0.021
			(0.022)	(0.021)	(0.042)
Log of labour cost per worker (USD)			0.007**	0.006	0.001
			(0.003)	(0.005)	(0.008)
Age			-0.004***	-0.004**	-0.007**
			(0.001)	(0.002)	(0.003)
Age Square			0.000**	0.000**	0.000**
			(0.000)	(0.000)	(0.000)
Size of firm[&]					
Medium			0.120***	0.126***	0.122***
			(0.032)	(0.031)	(0.037)
Large			0.255***	0.265***	0.258***
			(0.076)	(0.072)	(0.091)
Countries[$]					
Ghana		0.092***		-0.017	-0.042

		(0.018)		(0.024)	(0.045)
Tanzania		0.381***		-0.196***	-0.256***
		(0.050)		(0.043)	(0.076)
Uganda		-0.009		-0.165***	-0.185***
		(0.022)		(0.036)	(0.069)
Zambia		0.092***		-0.059	-0.101
		(0.017)		(0.043)	(0.090)
N	**1970**	**1970**	**1111**	**1111**	**1089**
R^2	0.031	0.132	0.522	0.543	.
adj. R^2	0.023	0.123	0.507	0.526	.

*Standard errors in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01*
All regressions include country, size, year, sector and location fixed effects.
All coefficients and standard errors are robust to heteroskedasticity.
$ Congo, Democratic Republic as the base country.
& Firms with small employees, >=5 and <=19, were used as the baseline.
£ All IV estimations used license as instrument for intensity of product innovation; Patent and external RD as instruments for introduction of product innovation.

The coefficients of product innovation have a significantly positive impact on employment growth across all OLS specifications. In panel B, we report IV estimates where we considered the percentage of sales from all innovative products (intensity of product innovation) and the introduction of product innovation as endogenous. Employing license, patent and external RD as instruments, results indicate a significantly positive impact of product innovations on employment growth. There is a noticeable increase in the coefficient of product innovation from the OLS estimate indicating the downward biasedness of the OLS results. This result implies that, product innovations stimulate economic activity and market expansion leading to compensation impacts on employment growth. This result is in line with existing empirical findings by Harrison et al. (2014, 2010), Meriküll (2010), Hall et al. (2008), Peters (2008), Smolny (1998), Piva & Vivarelli (2005, 2003). These studies find product innovations to generally have positive job creation effects.

The theory of economies of scope indicates that the joint introduction of both process and product innovations (JPP) by firms' is expected to imply a strictly higher positive impact on a firm's employment growth than the separate introduction of each type of innovation (Harrison et al., 2014)**.** In other words, the causal returns of JPP innovation on employment growth is expected to be strictly higher than the returns on employment growth of the separate introduction of product or process innovations on employment growth. We sought to test this complementarity hypothesis by combining firms that have introduced jointly, product and process (JPP) innovations to analyze whether firms that have introduced both innovations have a higher total employment growth or otherwise for Democratic Republic of Congo, Ghana, Tanzania, Uganda and Zambia. The main result presented in Table 5 below is robust across all specifications and indicates that, the joint introduction of both process and product innovations by firms' have a significantly positive employment growth impacts.

While coefficients are not statistically comparable between product and JPP specifications, our results from Column 4 shows a positive ATET of 0.189. This result indicates that, the compensation impact from product innovation outweighs the displacement effects from process innovation thereby reinforcing the positive employment growth impacts of JPP innovations. This suggest

cautiously that we do not have evidence of economies of scope in JPP innovations as a result of the crowding out effect from process innovations resulting in the partial cancellation of the positive impact obtained from product innovation. The stability of this result however indicates SSA firms' during the period under consideration favored and adopted technological competitive strategies with product quality advantages leading to market expansion rather than cost competitive strategies found by Pianta & Antonucci (2002) in European firms'. This may be due to the increasing middle class with incessant demand for new products coupled with relatively cheaper labour in SSA.

Other significant predictors from the extended specifications across all innovation types are: log of total employment three (3) years ago, real growth of total sales per worker, age, age squared and size of firm. The study also found foreign owned businesses have a significantly positive impact on employment growth and tend to grow more than locally owned firms' for JPP innovations. Log of age (age in the product innovation specifications) of the firm has an inverted U-shaped relationship with the employment growth of the firm with a significantly positive sign, however at decreasing rate (negative sign of significant squared value of log age). This implies that, the employment growth of firms fall, as firms' grow older. The total employment of the firm at the beginning of the period (3 years ago) has also been found to have a negative impact on the employment growth of firms across all specifications and innovation types. Firms' with larger total employment at the beginning of the period are found to grow much less than smaller firms in terms of employment. In addition, real growth of total sales per worker shows a negative impact on employment growth across all innovation specifications indicating a consistent inverse relationship suggesting that gains from sales (the evolution of demand for firms' products) occur through labour saving. Analyses of the possible indirect mechanisms through which innovation may impact employment growth however show that, firms' that have jointly introduced product and process innovations tend to create significantly more new jobs (positive employment growth) with gains in real growth of sales per worker as compared to non-JPP innovators. We however failed to find any evidence of similar indirect impacts of product innovations.

Table 5: Employment impacts of joint process and product innovations (JPP)

	A-OLS			B-IV	
	(1)	(2)	(3)	(4)	(5)
	Growth of total employment				
JPP innovation	0.122***	0.071***	0.084***	0.189**	0.275***
	(0.019)	(0.019)	(0.020)	(0.085)	(0.076)
Real growth of sales per worker (RGSPW)		-0.174***	-0.193***	-0.159***	-0.184***
		(0.016)	(0.021)	(0.007)	(0.008)
JPP*RGSPW			0.048		0.067***
			(0.031)		(0.014)
Log of labour cost per worker (USD)		-0.002	-0.0022	-0.002	-0.002
		(0.003)	(0.003)	(0.003)	(0.003)
R&D		-0.005	-0.007	-0.014	-0.030
		(0.020)	(0.020)	(0.027)	(0.024)
Ownership		0.076***	0.072***	0.073***	0.075***
		(0.024)	(0.023)	(0.026)	(0.024)
Log of total employment (-3)		-0.055***	-0.049***	-0.114***	-0.116***
		(0.014)	(0.014)	(0.016)	(0.014)
Log of age		0.187***	0.182***	0.090*	0.091*

		(0.033)	(0.033)	(0.054)	(0.049)
Log of age squared		-0.040***	-0.038***	-0.023**	-0.022**
		(0.008)	(0.008)	(0.011)	(0.010)
Size of firm[&]					
Medium		0.069*	0.0634*	0.151***	0.139***
		(0.037)	(0.037)	(0.026)	(0.024)
Large		0.277***	0.267***	0.404***	0.387***
		(0.070)	(0.071)	(0.053)	(0.048)
Country[$]					
Ghana		-0.035	-0.036	-0.024	-0.017
		(0.024)	(0.024)	(0.035)	(0.031)
Tanzania		-0.047	-0.0667*	-0.206***	-0.188***
		(0.041)	(0.039)	(0.065)	(0.057)
Uganda		-0.136***	-0.140***	-0.189***	-0.179***
		(0.032)	(0.031)	(0.040)	(0.036)
Zambia		-0.039	-0.039	-0.016	-0.042
		(0.027)	(0.027)	(0.059)	(0.052)
N	**1548**	**1262**	**1262**	**1242**	**1242**
R^2	0.022	0.534	0.540	.	.
adj. R^2	0.019	0.513	0.520	.	.

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include sector, year, location and 26 industry dummies. All coefficients and standard errors are robust to heteroskedasticity.
[$] Congo, Democratic Republic as the base country.
[&] Firms with small employees, >=5 and <=19, were used as the baseline.
[£] All IV estimations used license as instrument for intensity of product innovation; Patent and external RD as instruments for introduction of product and process innovations.

4.1 Dose Response Functions

As noted earlier, innovative firms have different intensities of innovations that may have different impacts on employment growth. We therefore aim to estimate the dose response functions in this section to analyse the impacts of different levels of product innovation intensities on employment growth of the firm. Based on the regression results in Tables 4 and 5, we determined the average expected conditional employment growth rates between periods t and $t-3$ given the innovation intensity in period t and the other covariates. The kernel density estimate distributions of $ATE(x)$, $ATET(x)$ and $ATENT(x)$ and Dose Response Functions plotted at 5% significance level for product and joint product and process (JPP) innovations derived from our IV estimation are shown in Figure 1 below[45]

The kernel density estimate is a non-parametric estimation that enables vivid visualization of the distributions of the $ATE(x)$, $ATET(x)$ and $ATENT(x)$. A look at the distributions of the kernel density estimates in Panels $A.i$ and $B.i$ of Figure 1 reveal less dispersion of our causal parameters across all innovations. The kernel density estimates of JPP innovations reveal differences in the employment growth of JPP innovators and non-innovators with non-JPP innovation generating much employment growth. The difference is less pronounced between product innovators and non-product innovators but the distribution indicates a lower employment growth due to product

[45] See Appendix E for the density and Dose Response Functions from the OLS estimations.

innovations. In summary, the kernel density estimations reveal less employment growth impact of both product and JPP innovations compared to non-innovators.

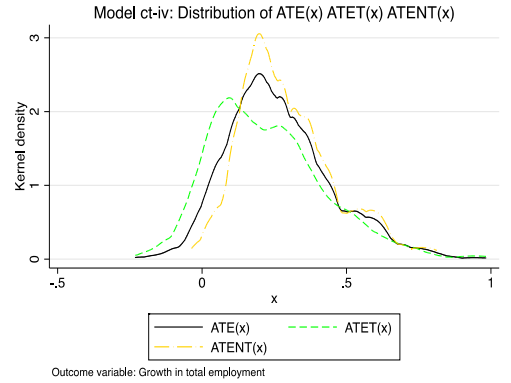
Figures $1.A.ii$ and $1.B.ii$ show the dose response functions where we assess the impact of different innovation intensities on employment growth. The dose response function showing the impact of a firm's percentage sales from all product innovations on employment growth plotted at 5% significance level is shown in Figure $1.A.ii$. The relationship is found to have a cubic hyperbola shape with firm employment growth falling from a positive point, reaching a minimum, rising to a maximum and declining thereof as percentage sales from all innovative products increase.

The implication of this shape is that, within specific intervals of percentage sales from all product innovations, employment is decreasing while we experience increasing growth only within a specific interval of firms' percentage sales from all product innovations. Pairwise treatment effects indicate strong significant differences between product intensities. This implies that, within certain intervals of percentage sales, product innovations have compensation effects on employment growth whiles other intervals have displacement effects on employment growth. An explanation to this result may be, relatively younger innovating firms or less established innovating firms in product markets have few products in the market and sales from these products make -up most of their total sales. As a result, these firms may not be growing as much due to competitive pressure from already established firms in the product market. A major finding by Harrison et al. (2014), Peters (2008) and others is that, firm level employment grows more the higher the sales growth due to new innovative product. Our evidence reveals a contrary conclusion with product innovations contributing to employment growth only within a sub-interval of percentage sales from all new product innovations.

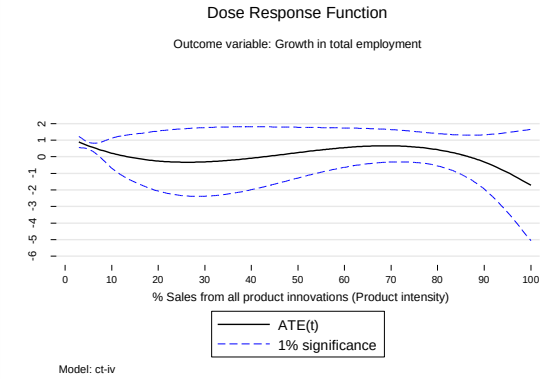
Figure 1: IV Kernel density estimations and Dose Response Functions

A: Product innovation

i.

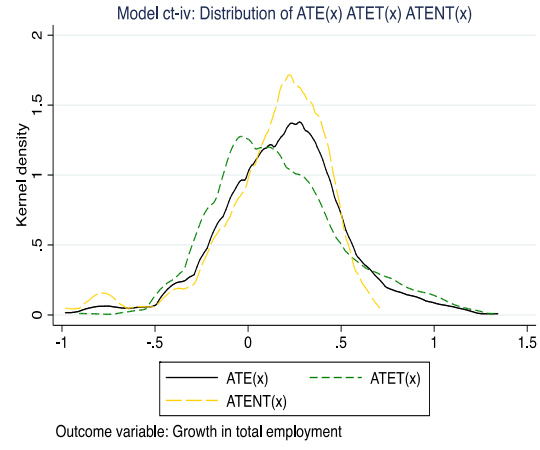


ii.



B: JPP innovation

i.



ii.

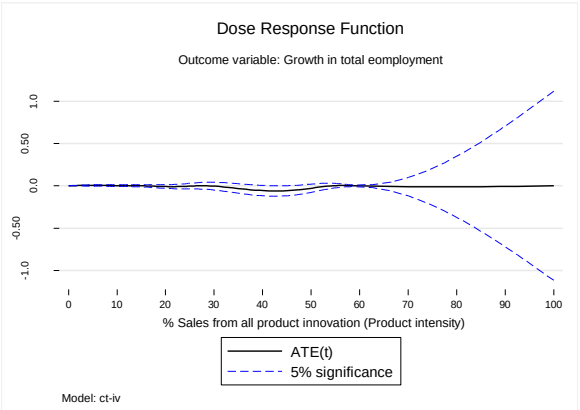


Figure. 1. $B. ii$ shows the dose response function for JPP innovation plotted at 5% significance level. JPP innovations generally tend to exhibit positive employment growth response across all intensities except between 30%-50% range where employment growth tends to be negative. Pairwise treatment effect confirms a significant employment growth rate with the implication that, if a JPP non- innovator introduces JPP innovation, the firm generally grows positively except the intensity is within the sub interval of 30%-50% where employment growth is negative.

4.2 Extensions to Decent Employment

The role of productive and decent employment[46] as a critical mechanism through which the benefits of growth are distributed is widely recognized in the growth-poverty nexus (See Islam 2004, 2013; Osmani 2005; Martins & Takeuchi 2013; ILO, 1972, 2008, 2011, 2012a, 2013; Holmes, McCord, Hagen-Zanker, Bergh, Zanker 2013). Decent jobs and productive employment have also been

[46] The ILO (2012a) defines productive employment as employment yielding sufficient returns to labour to permit the worker and her/his dependents a level of consumption above the poverty line. Decent employment/work refers to work that is productive and secured.

found to be important in achieving the newly adopted Sustainable Development Goals (SDG's) such as hunger, universal primary education, reducing child and maternal mortality mainly through the provision of income both at the wage sector or in self-employed activities. As a result, a renewed focus in international development policy is how to nurture and generate new sources of productive and decent employment. Using growth of permanent versus temporary employment as proxy for security of job; and the ratio of male to female workers in last fiscal year as proxy for equity of jobs, we seek to extend our analyses in this section to examine the innovation impacts of employment differentiated by security and equity in SSA. According to Harrison et al. (2014), these separate analyses are major contributions to the literature.

The empirical results showing the impact of product innovations on each proxy of decent employment are reported below in Tables 6 and 7. The standardized results of our basic and extended specifications presented in Tables 6 and 7 show the impact of product innovations on the security and equity of employment proxies of decent employment in the Democratic Republic of Congo, Ghana, Tanzania, Uganda and Zambia. Table 6 presents both the OLS and IV estimates for permanent and temporary employment used as proxies for employment security. Results indicate the displacement impact of product innovation on permanent employment growth while we find product innovation to have compensation impacts on temporary employment.[47] This result is robust across all specifications. This result implies that, product innovators prefer to hire on temporary basis rather than on permanent basis.

One explanation for this may be the labour cost differences. Firms that employ temporary workers are not required by law to pay social security and income tax for their temporary employees. Another explanation may be firms' preference to hire workers on temporary basis due to the uncertainty about the performance of product innovations. The results do not change after controlling for the skill differences. Using the ratio of male to female employees in a firm as a proxy for employment equity, our OLS results indicate that product innovations are gender biased towards male employment at 5% significance. However, after controlling for possible endogeneity, the significance varnishes but the sign of the coefficient remains the same (see Table 7).

Table 6: Permanent vs. temporary employment impacts of product innovation

	A-OLS		A-IV£	B-OLS		B-IV£
	(1)	(2)	(3)	(5)	(6)	(7)
	Growth of permanent employment			Growth of temporary employment		
Product innovation	-0.162***	-0.087***	-0.930**	0.067***	0.036*	0.531*
	(0.028)	(0.027)	(0.382)	(0.018)	(0.021)	(0.289)
Log of experience		-0.004	-0.013		-0.014	-0.014
		(0.015)	(0.023)		(0.013)	(0.017)
Log of total employment (-3)		0.082***	0.062**		-0.037*	-0.031
		(0.019)	(0.030)		(0.020)	(0.023)
Real growth of sales per worker		0.174***	0.178***		-0.048***	-0.047***
		(0.017)	(0.013)		(0.010)	(0.010)
R&D		-0.037*	-0.023		0.025	0.007
		(0.021)	(0.041)		(0.016)	(0.031)

[47] *We also found similar effects for introducing joint product and process innovations (See Appendix F)*

Log of labour cost per worker (USD)		-0.005	-0.001		0.009**	0.005
		(0.005)	(0.008)		(0.004)	(0.006)
Age		0.004***	0.007**		-0.001	-0.003
		(0.001)	(0.003)		(0.001)	(0.002)
Age Square		-0.000**	-0.000**		0.000	0.000
		(0.000)	(0.000)		(0.000)	(0.000)
Size of firm						
Medium		-0.126***	-0.119***		0.069**	0.059**
		(0.029)	(0.036)		(0.028)	(0.027)
Large		-0.265***	-0.243***		0.092	0.108
		(0.067)	(0.088)		(0.066)	(0.067)
Countries$						
Ghana		0.018	0.043		0.003	-0.01
		(0.023)	(0.043)		(0.021)	(0.033)
Tanzania		0.185***	0.249***		-0.103**	-0.157***
		(0.040)	(0.073)		(0.042)	(0.055)
Uganda		0.148***	0.176***		-0.086**	-0.103**
		(0.032)	(0.067)		(0.036)	(0.051)
Zambia		0.048	0.095		-0.074**	-0.096
		(0.044)	(0.088)		(0.033)	(0.066)
N	**2113**	**1111**	**1089**	**2065**	**1111**	**1089**
R^2	0.035	0.566	.	0.018	0.163	.
adj. R^2	0.016	0.540	.	-0.001	0.132	.

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include country, size, year, sector and location.
All coefficients and standard errors are robust to heteroskedasticity.
$ Congo, Democratic Republic as the base country.
£ All IV estimations used license as instrument for intensity of product innovation; patent and external RD as instruments for introduction of product innovation.

Table 7: Impact of product innovation on the ratio of male to female employment in last year

	A-OLS			B-IV	
	(1)	(2)	(3)	(4)	(5)
	Ratio of male to female employment in last year (R_M_F)				**Log(R_M_F)R**
Product innovation	6.406***	3.913*	3.419**	3.051	2.175
	(2.056)	(2.044)	(1.613)	(22.50)	(1.883)
Log of total employment (-3)			4.638***	8.146***	0.490*
			(1.096)	(2.309)	(0.193)
Real growth of sales per worker			-1.089***	-2.365	-0.183
			(0.350)	(1.707)	(0.143)
R&D			-0.507	-0.794	0.0491
			(1.368)	(5.285)	(0.442)
Log of labour cost per worker (USD)			-0.152	1.177	0.090
			(0.325)	(1.404)	(0.117)
Age			-0.073	-0.216	-0.035
			(0.086)	(0.358)	(0.030)
Age Square			0.000	0.001	0.000
			(0.001)	(0.002)	(0.000)
Size of firm					
Medium			-1.751	-7.656	-0.348
			(1.691)	(5.206)	(0.436)
Large			-8.583**	-7.295	-0.929

			(3.892)	(12.18)	(1.019)
Countries[$]					
Ghana		5.412***	0.967	13.33	0.573
		(0.731)	(1.853)	(9.599)	(0.803)
Tanzania		2.697***	-0.991	-9.293	-0.512
		(0.553)	(2.413)	(14.38)	(1.203)
Uganda		1.711**	-3.600*	-1.461	-0.629
		(0.725)	(1.838)	(6.779)	(0.567)
Zambia		2.160***	-1.838	-12.40	-1.923
		(0.732)	(3.141)	(15.90)	(1.330)
N	**815**	**815**	**411**	**176**	**176**
R^2	0.122	0.178	0.486	.	.
adj. R^2	0.118	0.170	0.440	.	.

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include country, size, year, sector and location.
All coefficients and standard errors are robust to heteroskedasticity.
[$] Congo, Democratic Republic as the base country.
[£]All IV estimations used license as instrument for intensity of product innovation; patent and external RD as instruments for introduction of product innovation.
[R] Employs the log of the ratio of male to female employment in last year as the dependent variable.

5. Concluding Remarks

The relationship between innovation and employment remains central especially in sub-Saharan African economies where 'innovation-led' development thinking is emerging. In this paper, we sought to contribute to the deeper understanding of the causal relationship between product innovations and employment growth by in sub-Saharan Africa by employing a counterfactual perspective where we considered varying innovation intensities.

The paper adapted the Dose Response model under continuous treatment and used the World Bank's Enterprise Survey (ES) merged with the newly available Innovation Follow-Up Surveys data for five (5) sub- Saharan African countries namely Congo Democratic Republic, Ghana, Tanzania, Uganda and Zambia. Our results highlight the critical importance of innovation activities in stimulating employment growth in sub-Saharan Africa within sub-intervals of innovation intensity. Specifically, results from the paper reveal the relevance of product and joint product and process innovations as important sources of firm-level employment growth. We have shown that these conclusions only hold within specific sub-intervals of firms' intensity of innovation. In other words, the impact of firms' innovation activities on employment growth varies and depends on the firms' innovation intensity. In extensions to decent employment, we employed proxies for security of job and equity of jobs and found product innovations lead to the creation of unsecured jobs.

The policy implications of these results cannot be overemphasized. In a continent where policy is being directed towards enhancing innovations at the firm-level, our results reveal that policy makers need to be wary if the primary motive of the innovation policies is to generate decent employment in the short term. This is because, the intensity of innovations are not homogeneous but heterogeneous across firms with different compensating and displacement impacts on employment growth. We see a trade-off between unsecured jobs and unemployment. The paper therefore recommends policy efforts that will extend social security to all type of workers, be it temporary or permanent, in line with national, regional and continental innovation policies and the

ILO-WHO Social Protection Floor Initiative by ensuring minimum income security to all workers. The role of firms' in developing and extending in-house social protection programmes to all manner of workers is critical in this process. We also recommend labour market regulations and restructuring at the national and continental levels of governance to promote innovations that create secured and equitable employment in sub -Saharan Africa in the long term.

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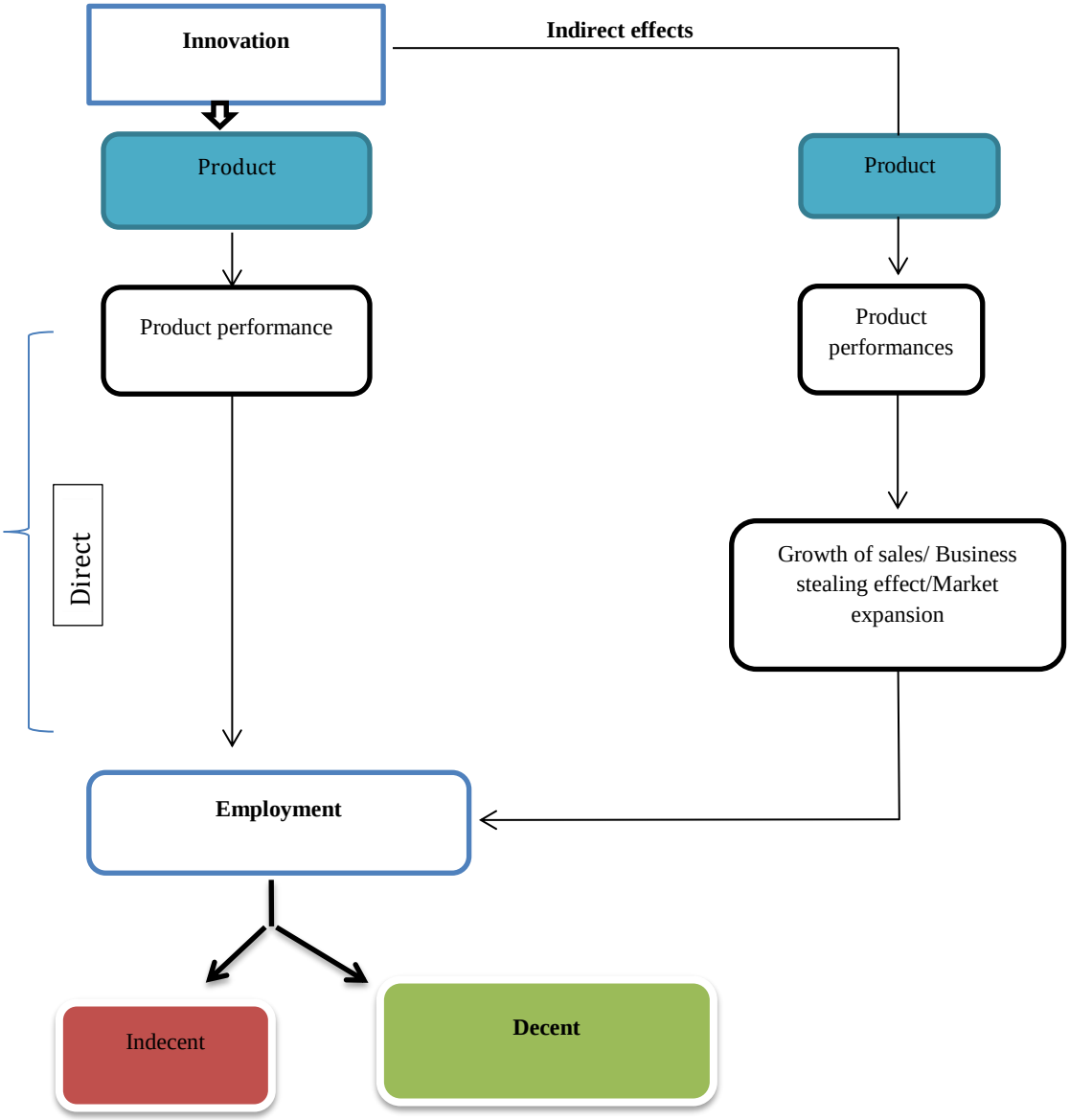
Annex I

Figure 2: Simple theoretical relationship between product innovation and employment at the firm- level.



Sources: Adapted from Evangelista &Vezzani (2010) and Gallouj & Djellal (2010)

Annex II

Table 8: Population and sample representation of data by sector and size of firm

	Total data population	Product	In sample Process	JPP
No. of firms	4,955	1089	2057	1242
Sector				
Manufacturing (%)	40.59	51.97	42.68	53.06
Retail (%)	25.37	17.355	24.16	17.71
Services (%)	34.05	30.67	33.16	29.23
Size of firm				
Micro (%)	2.16		2.38	
Small (%)	62.72	65.66	63.98	65.14
Medium (%)	26.68	27.54	25.96	27.77
Large (%)	8.44	6.80	7.68	7.09

Annex III

VARIABLE DEFINITION

Growth of total employment: the percentage change in firm's total employment (permanent+ temporary) between last fiscal year and 3 fiscal years ago.

Growth of permanent employment: the percentage change in firm's total permanent full time employment between last fiscal year and 3 fiscal years ago.

Growth of temporary employment: the percentage change in firm's total full-time temporary employment between last fiscal year and 3 fiscal years ago. Full-time temporary employment 3 fiscal years ago is constructed assuming that the ratio of permanent and temporary employment in last fiscal year is the same 3 fiscal years ago.

Product innovation: a binary variable taking the value of 1 if the firm has introduced product innovation over the last 3 fiscal years and 0 if otherwise.

JPP innovations: a binary variable taking the value of 1 if the firm has introduced both product and process innovations over the last 3 fiscal years and 0 if otherwise.

Product innovation intensity: a continuous variable indicating the percentage of total sales represented by sales from all innovative products or services. It assumes strict value between 0-100. Zero implies the firm has not introduced product innovation.

Growth of skilled (unskilled) employment: the percentage change in the firm's total full-time skilled (unskilled) workers between last fiscal year and 3 fiscal years ago. Full-time unskilled workers in last fiscal year and 3 fiscal years ago are constructed by dividing the total employment

in each period by the ratio of unskilled employment to skilled employment plus 1. We assume the ratio of unskilled employment to skilled employment last fiscal year is approximately similar to ratio of unskilled employment to skilled employment 3 fiscal years ago.

Ratio of male to female employment: constructed as the total number of full-time male workers divided by the total number of full-time female workers at the end of last fiscal year.

Log of experience: the logarithm of the number of working years of the top manager.

Ownership: a dummy variable that takes value 1 if the firm is foreign owned and 0 if the firm is owned domestically.

Log of total employment (-3): the logarithm of total number of employees at end of 3 fiscal years ago.

Real growth of sales per worker: constructed as the difference in the logarithm of deflated total sales of output per worker in last fiscal year converted to United States Dollars using exchange rate in corresponding fiscal year minus the logarithm of deflated total sales of output per worker in last 3 fiscal years converted to United States Dollars using exchange rate in the corresponding fiscal year. Sales are deflated using implicit deflators from United Nations System of Accounts with base year 2005.

R&D: a binary variable taking the value of 1 if the firm has spent on formal R&D activities during the last three years and 0 if otherwise.

Log of labour cost per worker (USD) the logarithm of labour cost per worker in United States Dollars constructed as total cost of labour/total permanent employees+0.5(temporary employees) converted using exchange rate in last fiscal year.

License: a dummy variable that takes value 1 if the firm purchased/licensed any patented or non-patented inventions over the last 3 fiscal years and 0 if otherwise.

Patent: a dummy variable that takes value 1 if the firm applied for a patent concerning a product innovation or concerning process innovation or both over the last 3 fiscal years and 0 if otherwise.

External R&D: a dummy variable that takes value 1 if the firm conducted extramural R&D over the last 3 fiscal years and 0 if otherwise.

Internal R&D: a dummy variable that takes value 1 if the firm conducted intramural R&D over the last 3 fiscal years and 0 if otherwise.

Increased range: a dummy variable that takes value 1 if the firm introduced product innovations to extend the range of products or service offered by firm over the last 3 fiscal years and 0 if otherwise.

Age: the number of years the firm has being operating.

Age square: the square of the number of years the firm has being operating.

Industry: sectors according to the group classification of ISIC Revision 3.1: group D, construction sector (group F), services sector (groups G and H), and transport, storage communications sector (group I) and IT (group K sub-sector 72).

Sector: a categorical variable that takes value 0 if the firm is engaged in manufacturing, 1 if firm is engaged in retail and 2 if firm is engaged in services.

Size of firm: a categorical variable that takes value 0 if the firm is micro (<5), 1 if the firm small (>=5 and <=19), 2 if the firm is medium (>=20 and <=99) and 3 if large (100 and over).

Support: a dummy variable that takes value 1 if the firm receives government support and 0 if otherwise.

Year: year of data collection.

Annex IV

Table 9: First stage estimations for product innovations

% sales from all innovation	Coef.	Std. Err.	P>z	Introduce product innovations	Coef.	Std. Err.	P>z
Log of experience	-1.719	2.098	0.413	Log of experience	0.004	0.083	0.963
Log, total emp. (-3)	-0.727	1.484	0.624	Log, total emp. (-3)	0.189	0.065	0.004
Real growth of sales per worker	0.651	0.854	0.446	Real growth of sales per worker	-0.063	0.036	0.077
R&D	1.403	2.641	0.595	R&D	0.386	0.102	0.000
Log of labour cost per worker (USD)	-1.414	0.711	0.047	Log of labour cost per worker (USD)	0.004	0.028	0.880
Ghana	-4.630	4.015	0.249	Ghana	-0.262	0.129	0.042
Tanzania	-1.963	6.228	0.753	Tanzania	-0.525	0.191	0.006
Uganda	-7.580	4.020	0.059	Uganda	0.519	0.159	0.001
Zambia	-14.99	6.481	0.021	Zambia	0.381	0.248	0.124
Age	-0.292	0.205	0.155	Age	0.009	0.009	0.289
Age Square	0.001	0.002	0.622	Age Square	0.000	0.000	0.322
License	**6.806**	**3.87**	**0.01**	**Patents**	**0.609**	**0.11**	**0.00**
Constant	62.11	10.76	0.000	**External R&D**	**0.403**	**0.16**	**0.01**
				Constant	-0.870	0.395	0.028
/athrho	-0.104	0.206	0.615				
/lnsigma	3.100	0.036	0.000				
rho	-0.103	0.204					
sigma	22.19	0.789					
lambda	-2.289	4.553					

All regressions include country, size, year, sector and location fixed effect.

Heckman selection
(regression model with sample selection)

Log likelihood = -2686.801

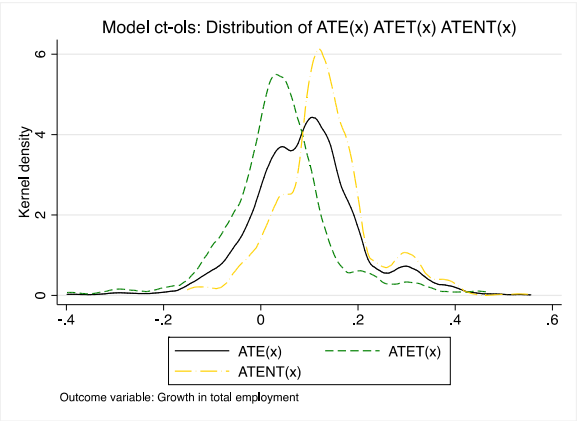
Number of observations=1091
Censored obs = 637
Uncensored obs = 454
Wald chi2 (31) = **131.69**
Prob > chi2 = 0.000

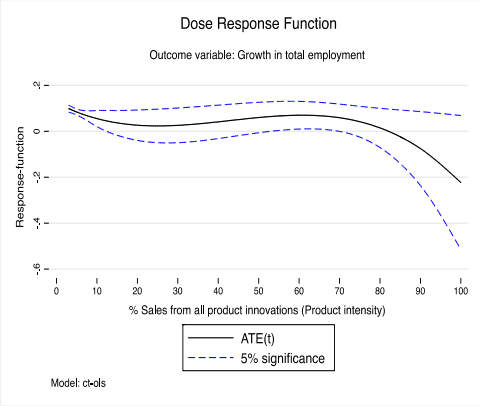
Annex V

Figure 3: OLS Kernel density estimations and Dose Response Functions

A: Product innovation

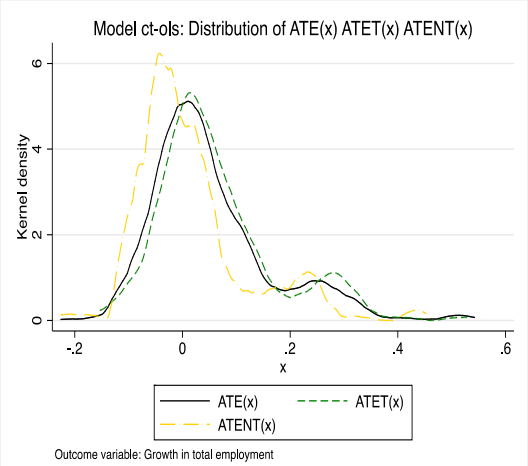
i. ii.

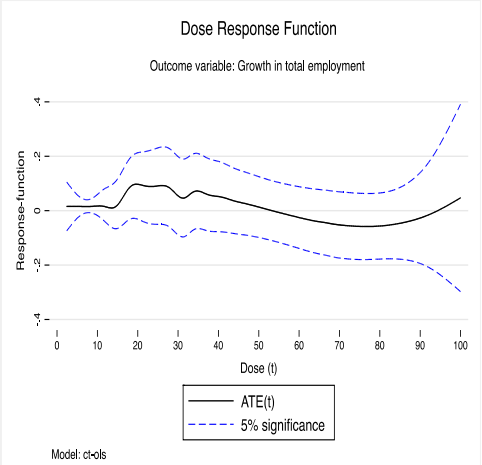




B: JPP innovation

i. ii.





Annex VI

Table 10: Growth of permanent vs. temporary employment impacts of JPP innovations

	A-OLS		A-IV[£]	B-OLS		A-IV[£]
	(1)	(2)	(3)	(4)	(5)	(6)
	Growth of permanent employment			**Growth of temporary employment**		
JPP	-0.061***	-0.07***	-0.175**	0.0152	0.0274**	0.128*
	(0.022)	(0.019)	(0.084)	(0.013)	(0.013)	(0.068)
Log of labour cost per worker (USD)		0.002	0.002		-0.004*	-0.004
		(0.003)	(0.003)		(0.002)	(0.002)
R&D		0.009	0.011		-0.01	-0.025
		(0.019)	(0.026)		(0.017)	(0.021)
Ownership		-0.08***	-0.07***		0.052***	0.058***
		(0.023)	(0.026)		(0.02)	(0.021)
Log of total emp'ment (-3)		0.048***	0.107***		-0.026**	-0.065***
		(0.013)	(0.015)		(0.012)	(0.012)
Real growth of sales per worker		0.171***	0.157***		-0.042***	-0.033***
		(0.015)	(0.007)		(0.012)	(0.0057)
Log of age		-0.18***	-0.088*		0.100***	0.064
		(0.032)	(0.053)		(0.026)	(0.043)
Log of age squared		0.039***	0.023**		-0.022***	-0.015*
		(0.007)	(0.011)		(0.006)	(0.009)
Size of firm[&]						
Medium		-0.071**	-0.15***		0.013	0.061***
		(0.035)	(0.026)		(0.032)	(0.021)
Large		-0.27***	-0.39***		0.127***	0.198***
		(0.069)	(0.053)		(0.048)	(0.042)
Country[$]						
Ghana	-0.070***	0.034	0.024	0.032***	-0.014	0.002
	(0.017)	(0.023)	(0.034)	(0.010)	(0.02)	(0.028)
Tanzania	-0.323***	0.049	0.201***	0.139***	-0.004	-0.107**
	(0.045)	(0.039)	(0.064)	(0.036)	(0.034)	(0.052)
Uganda	0.031	0.129***	0.183***	-0.019	-0.061**	-0.062*
	(0.023)	(0.030)	(0.040)	(0.019)	(0.028)	(0.032)
Zambia	-0.071***	0.038	0.011	0.019*	-0.010	-0.035
	(0.018)	(0.027)	(0.059)	(0.01)	(0.021)	(0.047)
N	**1648**	**1262**	**1242**	**1613**	**1262**	**1242**
R^2	0.116	0.544	.	0.042	0.146	.
adj. R^2	0.112	0.524	.	0.037	0.108	.

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All regressions include sector, year, location and 26 industry dummies.

All coefficients and standard errors are robust to heteroskedasticity.

[$] Congo, Democratic Republic as the base country.

[&] Firms with small employees, >=5 and <=19, were used as the baseline.

[£] All IV estimations used license and patents as instruments.

The Impact of Foreign Direct investment on Domestic Investment in Sudan: Giving Hope Hypothesis

Mohammed Elhaj Mustafa Ali[48]

Abstract

Previous empirical studies on the relationship between foreign direct investment (FDI) and domestic investment generate mixed results. To interpret the positive role that FDI plays in promoting domestic investment, this paper proposes and provides an empirical test for giving hope hypothesis. The postulated hypothesis states that, along with its potential contributions in augmenting domestic investment in recipient countries, the presence of FDI could also increase growth in domestic investment by giving hope to domestic firms to grow by raising their confidence in domestic business environment. To validate this hypothesis, the paper utilizes time series data on Sudan covering the period from 1980 to 2013. The empirical analysis is performed using co-integration and Vector Error Correction Model (VECM) techniques. The findings indicate the existence of a complementary relationship between FDI and domestic investment in Sudan. Moreover, as expected, the rest of the variables included in the model have displayed the anticipated signs. Based on these findings, policymakers might find it beneficial to encourage integration between domestic and foreign investments. This goal can be accomplished by taking up two policy actions. First, the interdependence between foreign and domestic investments can be preserved by stimulating MNCs that supplement domestic firms with raw materials, sophisticated technologies and furnish them with access to foreign markets. Second, this desirable complementary relationship can be also reinforced by promoting the types of domestic investment that have a wide range of forward and backward linkages with FDI.

Key words: *Sudan, Co-integration, Domestic Investment, FDI*

1. Introduction

The relationship between foreign direct investment (FDI) and domestic investment is often represents a focal point for huge number of scholarly research. In particular, this interest has been revived in recent years, mainly due to the strong integration between world's economies and the recognition that FDI by multinational corporations (MNCs) plays a significant role in boosting capital accumulation in developing economies. FDI has a potential to promote domestic investment through several channels including strengthening backward and forward linkages between MNCs and domestic sectors, diffusing contemporary technologies in underdeveloped sectors, equipping workers with managerial skills as well as connecting domestic industries with foreign markets. However, there is a line of theorization believe that the expansion in receiving FDI could impede

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domestic investments instead of promoting them. According to this argument, FDI can seize the domestic markets in which infant industries in developing countries sell their immature products and, therefore, stopping them from acquiring the benefits resulting from economies of scales. Moreover, since FDI is expected to pay much higher prices for local inputs, transplanting new FDI projects in a certain economy may raise local firms' costs of production. Such increases in costs diminish the competitiveness of these firms in international markets and, as a consequence, limit their ability to expand.

This controversy upon the relationships between foreign and domestic investments has been professed in what is known in the literature on FDI by "the crowding-out" and "crowding-in" hypotheses. Compatible with these conflicting hypotheses, the available empirical literature provides contrasting outcomes. Some studies supported the existence of a complementary relationship between FDI and domestic investment while others do not. Due to these conflicting evidences, the recipient countries' attitudes towards hosting FDIs have also largely varied according to policymakers' recognition to the impact that FDI could have on domestic firms.

Sudan, like other developing countries, is considered extremely undercapitalized and lack adequate sources of capital. The country's domestic savings are far less than to cover the capital needed to put the economy on the track of sustainable economic growth and development. The heavy reliance on agriculture, failure to channel domestic savings into domestic financial institutions and the prevalence of customs encouraging luxurious consumption have contributed greatly in widening the gap between capital needed to initiate real development process and domestic savings. Therefore, if the country seeks to overcome its economic dilemma, new sources of capital must come up to supplement its inadequate domestic savings. However, in light of unfeasibility of all sources of capital such as borrowing, aids and portfolio investments, the only feasible alternative for the country to fill its capital gap is by hosting FDI. Recently, after exploiting oil in commercial quantities, many MNCs competed to invest in the country. As a result all inward FDI measurements have seen significant increases. These improvements in FDI performance are anticipated to boost domestic investment. However, the current stylized facts reveal that domestic investment is, to a large extent, stagnant and don't grow at the same speed of that of FDI. Accordingly, it appears as if the two types of investments don't show any signal for a complementary relationship.

This unsatisfactory outcome, combined with controversies in the theoretical and empirical literature, makes the question about FDI's impact on domestic investment in Sudan as one of most pressing puzzles. With this in mind, this paper endeavors to analyze the probable influence of FDI on domestic investment in the country by utilizing co-integration and vector error correction model (VECM) techniques. Specifically, the study follows the lead of Feldstein (1994), Sun (1998), Lipsey (2001), and Agosin & Mayer (2000) to construct an empirical model in which FDI has been introduced as one of the predictors for domestic investment. The study is driven by the concern that the findings from cross-countries studies are powerless in detecting the nature of the relationship between these types of investment in each single country. This is the case because the anticipated impact on domestic firms may diverge from country to another depending on a variety of factors such as business environment as well as the nature of domestic investments themselves. Furthermore, the paper argues that, other than its well-recognized contributions in boosting growth

in domestic firms, FDI's presence has a potential to contribute positively to domestic investment by tracking hope to domestic businesses in Sudan.

The paper makes key contributions to the existing literature on FDI in general, and to a limited body of evidence on the impact of FDI on domestic investment in Sudan in particular. First, Sudan has a long history in hosting FDI. However, to the best of the author's knowledge there is no evidence has been brought by empirical study to provide policymakers with accurate information about the relationship between FDI and domestic investment. Second, in a country like Sudan, realizing a higher level of domestic investment is of a great importance in achieving the desired economic transformation. This is because the country is well endowed with natural and human resources that their exploitation is largely depends on the availability of capital. Finally, this study is unique with respect to the FDI's presence in a developing country like Sudan. The country is similar in terms of economic and social characteristics, to many African countries. Thus, this study would serve as a mirror to reflect the true impact of FDI on domestic investment in these countries.

The rest of this paper proceeds as follows: Section 2 gives a brief overview for FDI in Sudan by emphasizing its relationship with domestic investment. Section 3 reviews the related literature. Section 4 constructs the empirical model, while Section 5 discusses methodology, variables and data used. Section 6 introduces the empirical results and finally, the conclusion and policy implications are presented in Section 7.

2. The Patterns of Domestic and Foreign Investments in Sudan

Having a look at the stylized facts on FDI and its interactions with domestic investment in Sudan would help a lot in painting part of the picture on the relationship between these two types of investments. Table 1.2 sketches the relationships between gross capital formation[49] (GKF) and gross fixed capital formation[50] (GFKF), gross domestic saving (GDS) and FDI as percentages of GDP in Sudan during 1976-2012. As can be seen from the table, GFKF, GKF and GDS (% GDP) were almost stagnant over the period from1976 to 1980. Specifically, GKF (% GDP) and GFKF (% GDP) have grown at slower rates. They recorded an annual average of 21.16% and 22.04% for GFKF and 27.01% and 25.74% for GKF in the periods of 2001-2005 and 2006-2010, respectively (World Bank, 2014). Putting things together, during that period, the patterns of FDI inflows (% of GDP) did not diverge from that of domestic capital indicators. Specifically, FDI flow (% GDP) decreased from an annual average of 0.19% during 1981-1985 to -0.08% during 1986-1990. These facts indicate that over the 1980s and the 1990s, Sudan was not fitted to attract significant amounts of FDI compared to its economic size. Undoubtedly, this image has been corrected after the country

[49] *Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and "work in progress." According to the 1993 SNA, net acquisitions of valuables are also considered capital formation. Data are in current local currency (World Bank, 2014).*

50 The model also takes into consideration the major event that has influenced domestic investment in Sudan: the implementation of privatization policy which has been anticipated to contribute positively towards capital formation and thus investment.

adopted the privatization policies in the 1990's. By the advent of this policy, FDI (% GDP) increased to %0.18 during the first half of the nineties and climbed further to its peak at 5.19% during 2001-2005. These increases were roughly more 45 times than what was realized during 1976-1980. In the same way, the ratio of domestic savings (GDS) to GDP was also negligible in the 1970s and 1980s. As reported in Table 1.2, GDS (% GDP) registered an annual average of 6.71 and 3.53 during 1976 -1980 and 1981-1985, respectively. It increased from an annual average of 11.55 during 1991-1995 to 23.28 during 2001-2005, to an annual average of 24.66 in 2006-2010. Also as can be observed, Table 1.2 also displays both GKF and GFKF as ratios to domestic savings (GDS) as well as FDI as a ratio to GFKF. From the figures displayed, it can be seen that during 1976-1980, GDS were far less than to provide fund for domestic investment. They covered only 42% from fund needed by investment sector (GDS/GKF = 42%). The ratios of GDS to both GFKF and GKF contracted from 42% and 53% to only 24% (see columns 6 and 7) as GDP grew by -5% and 6% during the years 1984 and 1985, respectively. In other words, this indicates that gaps between domestic savings and both measures of capital formation have widened from -48 % (42-100) and -47% (53-100) during 1976-1980 to -76% (24-100) during 1981-1985. Interestingly, these figures indicate FDI responded positively by filling the drop in domestic savings during that tough period. Its portions to GFKF increased, on average, from 0.80% in 1976-1980 to 1.12% in 1981-1985.

Table 1.2: Domestic capital formation, gross domestic saving and FDI in Sudan (1976-2012)

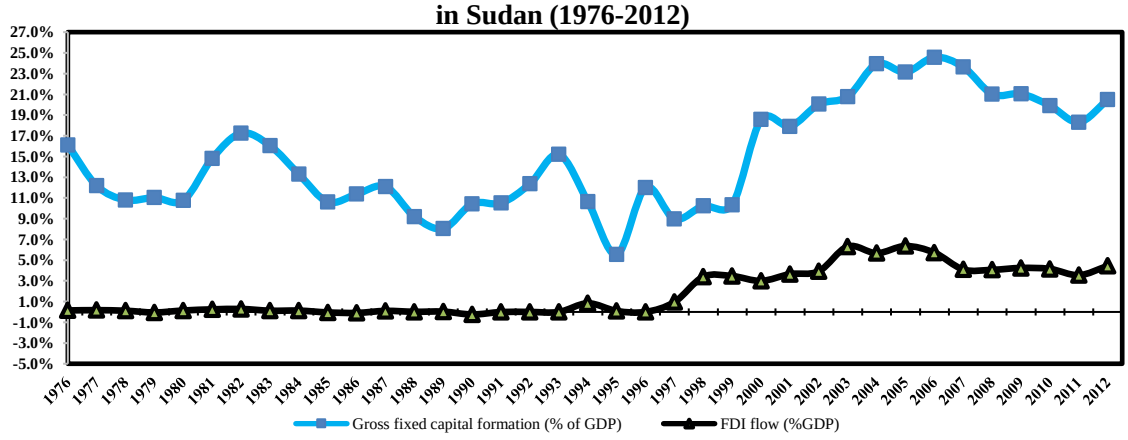
(1) Year	(2) GFKF/ (GDP) (%)	(3) GKF/ (GDP) (%)	(4) GDS/ (GDP) (%)	(5) FDI/ (GDP) (%)	(6) GDS/ (GKF) (%)	(7) GDS/ (GFKF) (%)	(8) FDI/ (GFKF) (%)
1976-1980	12.17	15.60	6.71	0.11	42	53	0.80
1981-1985	14.41	14.19	3.53	0.19	24	24	1.12
1986-1990	10.23	10.03	6.03	-0.08	49	54	-0.21
1991-1995	10.86	17.68	11.55	0.18	64	112	1.89
1996-2000	12.02	17.58	11.47	2.16	59	89	15.6
2001-2005	21.16	27.01	23.28	5.19	86	111	32.9
2006-2010	22.04	25.74	24.66	4.46	97	113	23.4
2011-2012	19.40	21.64	17.26	4.00	81	90	20.2
1976-2012	14.95	18.44	12.72	1.87	61	80	11.1

Sources: World Bank, World Bank Indicators (2014) & UNCTAD (2014)

However, after the 1990s period, the gap between capital formation (gross and fixed) has been ~c^&_ narrowed. It decreased from an annual average of -41% (59-100) and -11% (89-100) during 1996-2000 to an annual average of -14% (86-100) and + 11% during 2001-2005 for GKF and GFKF, respectively. Also, the picture becomes more dramatic if FDI inflows viewed in comparison to domestic capital formation. As can be professed from Table 1.2, the shares of FDI as a portion of GFKF were small during the period from 1976 to 1990. FDI ratios to domestic investment were insignificant during 1970s and 1980s. It counted for an average of 0.80, 1.12 and -0.21 during 1976-1980, 1981-1985 and 1986-1990, respectively. However, the ratios of FDI to GFKF has improved sharply after the mid of the 1990s and onwards. It accounted to an annual average of 1.89% during 1991-1995. These impressive increases were even more remarkable, reaching 15.6%, 32.9% and 23.4% during 1996-2000, 2001-2005 and 2006-2010, respectively

To make the picture clearer, Figure 1 illustrates the pathway of FDI and domestic capital formation (% GDP) in Sudan throughout 1972 - 2013. As one can observe, the fixed capital formation (% GDP) was relatively stagnant over the 1970s and the 1980s. This masks the volatility of domestic investment in response to the fluctuations in GDP growth. In the second half of 1990s, however, FDI inflows (% GDP) rose dramatically compared to 1970s and 1990s establishing its mark as one of the major contributor to promote domestic investments. In general it can be inferred that both gross domestic capital and gross fixed capital formation were, to some extent, positively influenced by FDI's presence. However, concluding that FDI has a complementary relationship with domestic investment based on the above descriptive facts provides uncertain conclusion. Therefore, the modern econometric techniques can be utilized to ascertain this relationship.

Figure 1: Gross fixed capital formation (% of GDP) and FDI flow (%GDP) in Sudan (1976-2012)



Source: UNCTAD Statistics on FDI (2014)

3. Literature Review

Researchers have paid a great attention to the impact of FDI on domestic investment. However, those researchers did not come to a solid agreement regarding the nature and magnitudes of this impact. A large body of literature confirms the role of FDI in stimulating growth in domestic firms (Keller 2001; Li et al. 2001; Ruane & Ugur 2002 and Keller & Yeaple 2003). In contrast, there is countless empirical evidence of the view that the opposite is true. That is hosting FDI impedes growth in domestic firms instead of promoting them (Djankov & Hoekman 2000; Zukowska-Gagelmann 2002; Konings 2001).

Regardless of optimistic or pessimistic expectations concerning this impact, the prevailing literature proposes several channels through which FDI influences domestic firms. First, FDI are anticipated to create backward and forward linkages with domestic sectors and, thus, boosts domestic investment beyond the levels maintained before its entry (Van Loo 1977; Lall 1980; Feldstein 1995; Chen et al. 1995; Rodriguez 1996; Markusen & Venables 1999; Aitken & Harrison 1999; Blomstrom et al. 1999; Agosin & Mayer 2000 (cited by Quader 2009); Lin & Saggi 2004; Isabel Faeth 2006). The second possible channel through which FDI's knowledge spillovers effect can be conveyed to domestic firms is embodied in the so-called the horizontal (intra-firms) and

vertical (inter-industries) spillovers (Borensztein et al. 1998; Hejazi & Safarian, 1999; Djankov & Hoekman; 2000; Lin & Zhang 2009). Narrowing down, these potential spillovers effects could take place via several ways including imitation (Das 1987; Wang & Blomstrom 1992; Glass & Saggi 1999; Saggi 2002 and Gorg & Strobl 2002), workers' mobility (Hoekman 2000; Fosfuri et al. 2001 and Gorg & Strobl 2005) and export spillovers (Aitken et al. 1997; Banga 2003 and Greenaway et al. 2004). Third, the impact of FDI on domestic investments can be viewed from market structure's perspective as the presence of foreign firms causes changes in the levels of competition in domestic markets. This argument is manifested in the market stealing hypothesis. According to this strand of literature, the crowding-in effects occur if and only if FDI by MNCs constructs new investments in downstream or upstream production that would not take place in their absence (Caves,1971; Jansen, 1995; De Mello, 1999; Apergis et al., 2006 and Sala & Trivin, 2014).

Summing up, the literature suggests several channels through which FDI's crowding-in impact can be transmitted into domestic sector and, thus, stimulating growth in domestic investment. The literature agreed that this impact (positive or negative) can be occurred only through physical contributions including backward and forward linkages, competition, horizontal and vertical spillover effects. However, this literature did not show any concern towards the role of FDI psychological impact in encouraging domestic investors to conduct new businesses. This study proposes that the positive impact of FDI on domestic investments can be also channeled through non-conventional contributions. This can be assembled in the hope, inspiration and enthusiasm that FDI's presence brought to domestic investors by assuring that the national economy is promising and deserve establishing new ventures. This inspiration and motivation to conduct new businesses can be stated in the giving hope hypothesis.

3.1 Giving Hope Hypothesis

As noted above, the previous studies have made significant contributions in analyzing the hypothesized relationship between FDI and domestic investment. However, there exist a wide range of disagreements in the empirical evidence to the extent that it became difficult to indicate whether this relationship is a complementary or a substitutive. Against these questionable outcomes, this paper seeks to investigate this debatable issue in the light of Sudanese business environment. The paper argues that in a country like Sudan, it is reasonable to think about the relationship between FDI and domestic investment in a manner and context that differ from that of other countries. It proposes that the ambiguous results generated by previous studies on this relationship might be caused by ignoring the subjective aspects of investment decision. In this regard, the study suggests that the presence of FDI in Sudan elevates the confidence of native investors in domestic business environment and, therefore, triggers expansions in domestic investments. It is well known that Sudan is characterized by instability, war, ethnic tension and vulnerability in international relations.

Moreover, for a long period of time, the country economic profile masks continuous economic downturns and backwardness in all sectors. These impediments work jointly to block FDI entry as well as discouraging domestic investments by national investors. This is what can be normally expected in the presence of such unfriendly environment for potential domestic investment in general and FDI in particular. In this regard, it is generally understood that MNCs are rational

economic agents, endeavoring to maximize profits. Therefore, when they decide to run businesses in other region, they always assure that their new destination areas enjoy conditions that contribute in securing future profits (Kobrin 1978; 1982; Fry 1983; Nigh 1985; Jansen 2006). However, as discussed before, the stylized facts on Sudan reveal that both domestic and foreign investments have seen significant increases in spite of all these obstacles. Therefore, the questions may raise here are as follows: why does domestic investment expand in such unfriendly business environment? Does FDI's presence have a role in stimulating native investors to increase investment spending? Providing accurate answers for these two questions is not an easy task in light of deficiency of data needed to conduct a reliable empirical investigation. However, a precise motivation for the occurrence of a complementary relationship between FDI and domestic investment in Sudan can be presented. This study argues that, along with its already well recognized positive impact on domestic investment, FDI could induce more domestic investments through what can be called "giving hope hypothesis".

The proposed hypothesis states that the presence of FDI, especially in a violent business environment such as that prevailing in Sudan, would give hope to, and motivate, the disappointed domestic investors to run businesses in their own country. In other words, seeing foreigners who cross political, social and economic borders to carry out businesses with a full hope in acquiring profits in the future will motivate native business actors to compete for acquiring share in national economic pie. The argument can be furthered by stating that, owing to the FDIs' presence, the capital flight exercised by native investors will be stopped. Instead, a wide range of domestic investments would emerge giving way to intensified agglomeration effects and, thus, more domestic investments.

4. The Model

To predict the level of domestic investment in Sudan, the paper pursues the lead of Lipsey (2001), Sun (1998) and Agosin & Mayar (2005) to build a general model in which the variables included are vindicated by economic theory. According to those scholars, the domestic investment function in which FDI is included as additional explanatory variable can be depicted in the following identity:

$$I_t = I_{d,t} + I_{f,t} \qquad 4.1$$

$$I_{f,t} = FDI \qquad 4.2$$

Where I_t represents total investment in economy at time t, $I_{d,t}$ is the domestic investment at time t, and $I_{f,t}$ is investment conducted by foreign investors at time t. According to Agosin & Mayar (2005a), domestic investment is represented by the stock adjustment variable that acts in response to the difference between the anticipated (desired) capital stock ($K^*_{d,t}$) and the actual capital stock ($K_{d,t}$). Hence, the basic investment model takes the following form:

$$I_{d,t} = \lambda(K^*_{d,t} - K_{d,t}) \qquad 4.3$$

Where λ represents the coefficient of adjustment to the difference between the two types of investments. In the model tackled by this study, the stock of capital depends on GDP growth($GDPG$), the availability of domestic credit(CRD), real exchange rate ($REXR$), inflation rate (INF), and trade openness ($OPEN$). These variables enter investment function as follows:

$$K^*_{d,t} = \psi_0 + \psi_1 GDPG + \psi_2 CRD + \psi_3 REXR + \psi_4 OPEN + \psi_5 INF \qquad 4.4$$

Now let us consider the law of motion of the capital stock:

$$K_{d,t} = (1-\delta)K_{d,t-1} + I_{d,t-1} \qquad 4.5$$

Where δ denotes the annual depreciation rate in domestic capital. By plugging 4.4 and 4.5 into 4.3 yields:

$$I_{d,t} = \lambda(\psi_0 + \psi_1 GDPG + \psi_2 CRD + \psi_3 REXR + \psi_4 OPEN + \psi_5 INF - ((1-\delta)K_{d,t-1} + I_{d,t-1}) \qquad 4.6$$

$$I_{d,t} = \lambda\psi_0 + \lambda\psi_1 GDPG + \lambda\psi_2 CRD + \lambda\psi_3 REXR + \lambda\psi_4 OPEN + \lambda\psi_5 INF - \lambda((1-\delta)K_{d,t-1} + I_{d,t-1}) \qquad 4.7$$

$$I_{d,t} = \beta_0 + \beta_1 GDPG + \beta_2 CRD + \beta_3 REXR + \beta_4 OPEN + \beta_5 INF + I_{d,t-1} \qquad 4.8$$

Where $\beta_0 = \lambda(1-\delta)K_{d,t-1}$, $\beta_2 = \lambda\psi_2$, $\beta_3 = \lambda\psi_3$, $\beta_4 = \lambda\psi_4$, $\beta_5 = \lambda\psi_5$

By substituting 4.2 and 4.8 into 4.1 (adding real FDI to domestic investment model it will be transformed into total investment model) and taking the log will produce the following:

$$logDI_t = \beta_0 + \beta_1 GDPG_t + \beta_2 CRD_t + \beta_3 logRFDI_t + \beta_4 REXR_t + \beta_5 OPEN_t + \beta_6 INFL_t + \beta_7 PRIV_t + \varepsilon_t \qquad 4.9$$

Where $logDI_t$ is natural logarithm of domestic investment; the constant or intercept value β_0 represents the expected value of domestic investment when each predictor is zero and $PRIV_t$ is a dummy variable employed to deliver the impact of adopting privatization policy on domestic investment. It takes a value of 1 from the year 1992 and onward and 0 otherwise. The error term, which is supposed to be normally distributed, is denoted by ε_{8t}. The rest of the variables remained as defined before. The β is $1 \times K$ vector of unknown parameters ($\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 and\ \beta_7$) are the coefficients to be estimated. The log-log measurement has been applied for variables in level ($DI_t and\ RFDI$) in order to reveal the elasticity of the dependent variable with respect to each variable in question[51]. The rationale for the inclusion of the right hand side variables is explained below.

[51] *Each coefficient measures the percentage changes in domestic investment in reaction to a 1 percentage change in each of the dependent variables. However, the variables stated in ratios (i.e. non-log form) are interpreted as semi-elasticity implying that their generated coefficients are multiplied by 100 to give the percentage change in the predicted variable.*

Real GDP growth has been included in the model to account for the so called accelerator effect. According to this principle, changes in GDP are expected to induce changes in investment, but at more rapid rate than the rates of increases in GDP. Thus, the coefficient which conveys the effect of GDP growth on domestic investment ($GDPG_t$) is expected to carry a positive sign ($\beta_1 > 0$). Also, the model incorporates the effect of domestic credit availability on domestic investment. A financial system that supplies credit at lower interest rates is predicted to promote domestic capital since a high accessibility to banking credit stimulates domestic firms to expand and grow. However, because the observable interest rate does not mirror the scarcity of capital in Sudan, this study takes into account the quantity rather the price of credit[52]. Accordingly, the sign of domestic credit variable (CRD_t) is anticipated to be positive ($\beta_2 > 0$).

Turning to the variable of interest, the FDI, the empirical literature did not come to a complete consensus about the relationship between domestic investment and FDI. So far, the impacts of FDI on domestic investment remain unrecognized ($\beta_3 =?$). However, as discussed before, FDI may influence domestic investment in a different manner than that described in previous literature. Specifically, FDI's presence may stimulate native investors who were previously hesitated, due to unfavorable business environment, to run new businesses. This would occur through the so called "Giving hope hypothesis". According to the proposed hypothesis, the presence of FDI in a certain country, in particular the most disturbed and politically unstable like Sudan, would trigger growth in domestic investments in that country. The hypothesis argues that FDI's positive effect on domestic investment may occurs due to several reason including the psychological assurance imposed by the presence of foreign firms, agglomeration effects and freeing capital hoarded by public to participate in economic activities. Therefore, instead of suggesting an ambiguous sign for the coefficient associated with FDI, a positive sign is anticipated ($\beta_3 > 0$).

In the same vein, since the level of domestic investment is highly affected by price of intermediate imports through its effect on firms' profitability, real exchange rate is included as a proxy for the price of non-tradable goods in relation to imports (Fry 1993). Therefore, considering the volatility of exchange rate in Sudan, any depreciation in real exchange rate will be negatively correlated with domestic investment. Therefore, the sign of the coefficient is projected to be negative ($\beta_4 <0$). Additionally, this paper extends previous empirical models by including trade openness, and inflation rate in investigating FDI's impact on domestic investment. For a variety of reasons, the connection between these two variables and domestic investment is quite evident. Based on the argument of free trade proponents, increases in exports represent a key factor in deciding economic growth in a certain country. Therefore, domestic investment is expected to be increasing function in trade openness ($\beta_5 > 0$). Likewise, a high inflation rate affects the cost of finance in the economy. In sequence, a high and unpredictable inflation rate is expected to have a strong

[52] *It has to be noted that from theoretical point of view, the real interest rate could be included in the investment function. However, due to less developed financial and banking system in Sudan, investors would have less opportunity to smooth their investment path through borrowing from banking and financial sector. Moreover, the dominance of banking Islamic credit modes (such as Murabaha, Mudarba , Musharka, …., etc) make it difficult to observe the impact of the official interest rate on the investment performed by private sector. Therefore, in the above model the potential consequences of the interest rate on gross domestic investment have been excluded and instead we use the banking credit available to private sector.*

disincentive effect on domestic investment. In contrast, the high inflation rates may stand as an indication that government spends more on infrastructure and, thus, contributes in intensifying investments. Accordingly, the aggregate effect of inflation rate remains undecided ($\beta_6 =?$)

The privatization which indicates the increase of private sector share in GDP is also considered a crucial factor in shaping the path of domestic investment. The initiation of such policy is expected to enhance the levels of accountability and transparency in business environment by decreasing the role of public sector and, thus, increasing domestic investments. In addition, the successful private sector helps in diffusing sophisticated technologies and managerial skills among privately owned businesses and, thereby, expands domestic investments. Moreover, being a transfer of public capital to private sector, privatization is an obvious signal for both domestic and foreign investors that the country is committed to the private ownership nurturing domestic firm to expand. In view of that, the anticipated sign of the dummy variable conveying the privatization effect is supposed to be positive ($\beta_7 > 0$).

5. Econometric Procedures

To make the objective of this study achievable, the empirical analysis is executed by using co-integration and VECM techniques. The procedures to perform the intended analysis begin with testing for the unit roots in the data used. Two popular and asymptotically equivalent tests for the unit roots can be applied to the variables: Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) tests. Accordingly, if the variables included are found to be integrated of order one I(1), then the next step is to make sure whether they are co-integrated or not. This step will be carried out by using Johansen' procedure (Johansen, 1988 and Johansen & Jueslius, 1992). Following this step, if co-integration relationships are detected among the variables, the study goes forward to estimate the long run relationship in VECM framework after adding an error correction term to correct for the short run deviations from the long run relationships.

Based on this methodological argument, the VECM that is appropriate to the variables incorporated in the model illustrated by equation 4.9 can be written as follows:

$$\begin{aligned}\Delta\log DI_t = \psi_{0i} &+ \sum_{i=1}^{n} \psi_{11}\,\Delta\mathrm{GDPG}_{t-1} + \sum_{i=1}^{n} \psi_{12}\,\Delta\,\mathrm{CRD}_{t-1} + \sum_{i=0}^{n} \psi_{13}\,\Delta\log\mathrm{RFDI}_{t-1} \\ &+ \sum_{i=0}^{n} \psi_{14}\,\Delta\mathrm{REXR}_{t-1} + \sum_{i=0}^{n} \psi_{15}\,\Delta OPEN_{t-1} + \sum_{i=0}^{n} \psi_{16}\,\Delta INF_{t-1} + \psi_{17}\,\mathrm{PRIV} \\ &+ \delta_{11}\,ECT_{t-1} + \mu_{1\,t} \qquad (5.1)\end{aligned}$$

Where ψ_{0i} represents the constant growth in each independent variable, μ_{1t} are the white noise disturbance terms with mean zero and finite covariance, t denotes years, n is the lag order, Δ represent first differences operator required to induce stationarity for corresponding variables in the system, and the estimated coefficients of ψ_{11} represent the short-run causality between the variables under consideration. ECT_{t-1} is the error correction terms lagged one period whereas the coefficients δ_{11}, measure the long run causality relationships in the cointegration framework ($-1 < \delta < 0$). The error correction coefficient is very decisive in the error correction model estimation as

a greater coefficient represents higher speed of adjustment towards the long-run equilibrium. Additionally, if, for example, (δ_{11}) is statistically significant in equation (5.1) but not significant in the other equations of the system, it means that $GDPG_t, RFDI_t, CRD_t, EXR_t, OPEN_t, INF_t, and\ PRIV_t$ granger cause domestic investment in Sudan (DI_t). If the opposite takes place for any of the predictors variables, it means that the predictor variables, among them are DI_t, Granger cause that variable. However, since the main purpose of this study is to identify whether FDI have a positive impact on domestic investment or not, the concern is directed to unidirectional relationship that run from FDI to domestic investment. This choice is driven by the aim of testing the existence of giving hope hypothesis proposed by this paper.

5.1 *The Data*

Annual data spanning from 1980 to 2013 has been used to estimate the model specified. Part of this data is sourced from world development indicators (WDI) released by World Bank (2014). In addition, the basic source of data on FDI is the statistics published by United Nation Conference on Trade and development (UNCTAD). All monetary variables have been converted to constant prices by using GDP deflator provided by World Bank. The description of the variables and data sources is summarized in Table 5.1.

Table 5.1: Summary of variables' description and data sources

Variable	Description	Period	Source
DI	Real gross fixed capital formation	1980-2013	World Bank (Release -2014)
GDPG	Annual percentage growth rate of GDP	1980-2013	World Bank (Release -2014)
CRD	Domestic credit provided by banks	1980-2013	World Bank (Release -2014)
REXR	Real exchange rate	1980-2013	World Bank (Release-2014)
INFL	Inflation rate	1980-2013	World Bank (Release -2014)
OPEN	The sum of exports and imports (% of GDP)	1980-2013	World Bank (Release -2014)
RFDI	Real total foreign direct investment stock	1980-2013	UNCTAD (Release -2014)

5. EMPIRICAL RESULTS

5.1. *Testing the Order of Integration*

The results reported in Table 6.1 are based on the Augmented Dickey-Fuller (ADF) and Phillip and Perron (PP) unit roots tests for all variables included in the model under investigation. On the whole, the tests indicate that the null hypothesis, the series in their levels contain unit roots, with intercept but without trend, cannot be rejected with exception of growth in real GDP (GDPG) and real exchange rate (REXR) series. Similarly, apart from those two series, the test results for stationarity with intercept and trend fail to reject the null hypothesis. This outcome implies that the rest of the series are all nonstationary. However, after differencing the data once, the tests statistics reject the null hypothsis for all series. Specifically, the results of the ADF and PP tests

suggest that all varaibles are I(1) at level and log level but I(0) at first difference. The existence of unit roots emphasizes the presence of non-stationarity in the varaibles and, consequently, ligitimates the use of varaibles' first differnces in estimating the empirical model. However, the series that integrated in the same order may cointegrate and move concurrently in the long run. Thus, the Johansen-Juselius procedure of multivariate cointegration has been justifiably required to determine the existence of long run relationships between these series.

Table 6.1: Summary of ADF and PP unit roots tests for variables at both levels and first differences

ADF test			PP test		
Variables	Test-Statistic		Variables	Test-Statistic	
	With intercept but without trend	With intercept and trend		With intercept but without trend	With intercept and trend
Log(DI)	-0.542	-2.629	Log(DI)	-0.299	-2.613
GDPG	-4.331***	-4.277***	GDPG	-4.345***	-4.281***
CRED	-1.634	-0.605	CRED	-1.465	-1.012
Log(RFDI)	-2.939	-2.525	Log(RFDI)	-1.586	-0.961
REXR	-2.984**	-2.917	REXR	-3.004**	-2.934
OPEN	-1.471	-1.609	OPEN	-1.666	-1.817
INFL	-2.199	-2.298	INFL	-2.253	-2.313
First difference			**First difference**		
ΔLog(DI)	-6.629***	-6.596***	ΔLog(DI)	-6.897***	-7.192***
ΔGDPG	-7.537***	-7.438***	ΔGDPG	-10.90***	-11.14***
ΔCRED	-8.245***	-8.521***	ΔCRED	-8.225***	-8.521***
ΔLog(RFDI)	-2.599	-3.066	Δ Log(RFDI)	-2.601*	-3.016*
ΔREXR	-6.975***	-6.923***	Δ REXR	-8.090***	-9.258***
ΔOPEN	-5.506***	-5.370***	ΔOPEN	-5.600***	-5.481***
ΔINFL	-8.133***	-8.047***	ΔINFL	-7.968***	-7.905***

Note: Δ denotes first difference operator. ⋆⋆⋆, ⋆⋆, ⋆ denotes the rejection of null hypothesis of unit root at the 1%, 5% and 10% significance levels, respectively.

5.2 Co-integration Test Results

After verifying that all variables are integrated of order one, the data series are further examined by using the Johansen and Juselius (1990) co-integration test. Both the trace (λ_{trace}) and maximum eigenvlaue (λ_{max}) tests statistics are used to determine the presence as well as the number of co integration relationships among the variables concerned. However, before conducting co integration test, it is necessary to determine the appropriate lag length to be used. Table 6.2 displays the results of the lags each criterion suggests. As can be seen, the five criteria suggest setting a lag length at 1. This confirms that there is considerable uniformity in the lag length selections resulting from the five criteria used since all of them have chosen one lag. Accordingly, in the next step, the multivariate co integration techniques developed by Johansen and Juselius (1990) is applied to detect the number of co integrating vectors which bind the variables together.

The results for co integration tests are reported in Table 6.3. The reported results suggest that the trace (λ_{trace}) test statistics reject the null hypothesis for $r = 0$ at five percent level of significance. In particular, the hypothesis $r = 0$ is rejected as the computed value of the trace test statistic (298.2187) is greater than the critical value (125.6154). In the same way, the null hypotheses that $r = 1, r = 2, r = 3, r = 4, r = 5, r = 5, r = 6, r = 7$ are also rejected. Similarly, the null

hypotheses that $r = 0, r = 1, r = 2, r = 3, r = 4$ are also rejected by the maximum eigenvlaue (λ_{max}) test as the computed values of the test statistic are greater than the critical values for the number of vectors suggested.

Table 6.2: Lag Selection Criterion Tests

Lag length test	LogL	LR	FBE	AIC	SC	HQ
0	-486.76	NA	92416.0	31.298	31.93	31.510
1	-354.95	189.48*	581.63*	26.121*	29.007*	27.078*

*Note: * indicates lag order selected by the criterion, (each test at 5% level).* Legend: *LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, and HQ: Hannan-Quinn information criterion*

Table 6.3: Johansen tests for the number of co integrating (1980-2013)

Results of Trace co integration test				Results of the Maximum Eigenvalue test			
H_0	H_1	Test Stat.	5%	H_0	H_1	Test Stat.	5%
r = 0	r = 1*	298.21	125.61	r = 0	r = 1*	104.53	46.231
r <= 1	r = 2*	193.67	95.753	r <= 1	r = 2*	79.283	40.077
r <= 2	r = 3*	114.39	69.818	r <= 2	r = 3*	43.802	33.876
r <= 3	r = 4*	70.592	47.856	r <= 3	r = 4*	34.793	27.584
r <= 4	r = 5*	35.798	29.797	r <= 4	r = 5*	16.914	21.131
r <= 5	r = 6*	18.884	15.494	r <= 5	r = 6	10.688	14.264
r <= 6	r = 7*	8.1963	3.8414	r <= 6	r = 7	8.1963	3.8414

*Note: * denotes rejection of the hypothesis at the 0.05 level, Trace test and Max-eigenvalue test indicate 7 and 4 co integrating equations at the 0.05 level, respectively.*

Going over the main points, as indicated by trace test's (λ_{trace}) results, it can be concluded that there is an evidence of seven co integrating vectors in the system in which privatization is treated as an exogenous variable. In contrast, the maximum eigenvalue test (λ_{max}), the more influential test in small samples, suggests the existence of only 4 co-integrating vectors. This highlights an imporant point that the results of the λ_{max} and (λ_{trace}) tests can disagree and, therefore, providing evidence for different number of cointegrating vectors. In this case, as Enders (1995) suggested, the (λ_{max}) test is preferable since it has a precise alternative hypothesis. Therefore, from Table 6.3, we tentatively concluded that there are at least 4 co integrating relationships in the system.

5.3 VECM Model Results

After having verfied the cointegration relationships among variables in the model, VECM is applied to determine the long run and the short run relationships between these variables. Table 6.4 summarizes the results pertaining to Johansen and Juselius (1990) long run normalization results. As can be observed, the majority of the variables have coefficients with theoretically expected signs. For instance, the coefficient of real FDI stock (RFDI), the variable of interest, is found to be positive and statistically significant (t-ratio = 4.98212). That is, with other things being equal, an increase in real FDI stock by one percent will corresponds to, approximately, a 0.16 percent increase in domestic investment in the long run. This suggests the key role of FDI in promoting domestic investment. Specifically, the result makes obvious that investment by MNCs complements domestic investment in Sudan during the period studied. Furthermore, with

prevailing hostile business environment in the country, this result lends a great support to giving hope hypothesis as proposed by this study.

Table 6.4: Long-run co-integrating equation

Dependent variable	**Δ Log(DI)**			
Variable	**Coefficient**	**t-statistic**	**Standard Error**	**P-value**
Intercept	16.87			
GDPG(-1)	0.013***	[3.897]	(0.003)	0.0003
CRD(-1)	-0.004	[-0.534]	(0.008)	0.2989
LogRFDI(-1)	0.158***	[4.982]	(0.031)	0.0007
REXR(-1)	-0.180***	[-13.24]	(0.013)	0.0000
INFL(-1)	-0.010***	[-20.96]	(0.000)	0.0000
OPEN(-1)	0.011***	[3.941]	(0.002)	0.0002

Note: *⋆⋆⋆, ⋆⋆, and ⋆ indicate significance at the 1, 5 and 10 percent levels, respectively*

In consistence with accelerator principle, the increases in GDP growth rates are found to be positively correlated with domestic investment expansion. The variable has a positive and highly significant effect (t-ratio = 3.89732) on the dependent variable (DI) with estimated coefficient of 0.01 3285 confirming that growth in real GDP promotes domestic investment. Moreover, it is interesting to observe that domestic investment, compared to GDP growth, has a larger elasticity with respect to FDI stock. Specifically, a one percent increase in GDPG would boost domestic investment by, approximately, 0.01 percent while; a one percent increase in RFDI raises domestic investment, roughly, by 0.16 percent.

Complying with expectations, the results reveal that the availability of domestic credit has no long run impact on domestic investment with elasticity of, approximately, zero. This negative outcome has many justifications. First, the size of credit offered by domestic banks is limited and concentrated in trading activities. In other words, domestic banks restricted granted finance to the businesses with quick and guaranteed returns and mostly avoid granting long run loans requested by long run investments. Second, the majority of loans granted by these banks are devoted to consumption purposes. A related conclusion is that in the last two decades, due to exploitation of oil, Sudan economy has undergone through huge transformations in consumption patterns. Therefore, given these developments, a significant portion of credit by domestic banks was mainly directed to satisfy households' consumption from durable and luxurious goods.

As expected, the long run coefficient on trade openness (OPEN) is found to be positive and statistically significant at a one percent level indicating that increases in trade openness lead to growth in domestic firms. Keeping everything else constant, a one percent increase in the degree of trade openness generates 0.01 percent increases in domestic investment. In contrast, the reported results show a negative long run co integrating relationship between real exchange rate (REXR) and domestic investment. The coefficient of the variable is negative and statistically significant. Narrowing down, a real depreciation in Sudanese Pound exerts negative effects on domestic firms in the long run. This negative and significant effect may be attributed to the fact that the imports from both capital and intermediate goods become more expensive for domestic investors due to the deteriorated value of local currency. It has to be mentioned that in Sudan a large part of inputs such

as raw materials, machines and transportation vehicles are either directly purchased from abroad or require significant amount of imported components in production. Another interpretation could be that the continuous depreciation in Sudanese Pound against foreign currencies may create uncertainty among potential domestic investors and, thus, interrupts domestic capital formation.

The result also shows that the long run relationship between domestic investment and inflation rate (INFL), as an indicator for financial risk and macroeconomic instability, is negative. The coefficient associated with the variable is high and statistically significant (t-ratio = -20.9630) demonstrating that inflation hinders domestic investments. In particular, a one percent increase in inflation rate leads to reduction in country's investment by 1.0% percent (0.010707) given that all else is same. This result is consistent with prior expectations as well as it lends a great support for the profit's theory of investment since the uncertainty created by hyperinflation in both prices and costs may reduce planned investment spending. Estimation results of equation 4.9, as dynamic short run relationships, are provided in Table 6.5.

Table 6.5: The VECM results (the short run relationships)

Dependent variable	**ΔLog(DI)**			
Variable	**Coefficient**	**t-statistics**	**Standard Error**	**P-value**
Intercept	-0.731662***	[-3.66065]	(0.19987)	0.0015
ΔLog(DI)(-1)	0.087668	[0.48372]	(0.18124)	0.6336
ΔGDPG(-1)	-0.005648	[-0.76194]	(0.00741)	0.4546
ΔCRD(-1)	0.032976	[0.99483]	(0.03315)	0.3311
ΔLog(RFDI)(-1)	-0.375118***	[-2.76694]	(0.13557)	0.0064
ΔREXR(-1)	0.073699*	[1.79822]	(0.04098)	0.0742
ΔINFL(-1)	-0.000644	[-0.38167]	(0.00169)	0.7065
ΔOPEN(-1)	0.002524	[0.25732]	(0.00981)	0.7994
PRIV	1.102797***	[4.04468]	(0.27265)	0.0006
ECT(-1)	-0.691780***	[-4.10941]	(0.16834)	0.0005
R-squared	0.61			
Adjusted R-squared	0.45			
S.E. of regression	0.200719			
Sum squared resid	0.846050			
Log likelihood	11.83095			
F-statistic	3.700805***			
Prob(F-statistic)	0.006442			

Note: ⋆⋆⋆, ⋆⋆, and ⋆ indicate significance at the 1, 5 and 10 percent levels, respectively.

As can be noted from the table, the short run results for most of the variables are, to some extent, diverge from the observed long run outcomes. For instance, in contrast to its long run, the coefficient on the real FDI stock turns out to be negative. It is statistically significant at 1% level advocating that FDI has discouraging short run influence on domestic investors' decisions concerning new investments. However, the negative outcome exercised by FDIs on domestic firms in the short run has many justifications. First, the potential spillovers from FDI to domestic firms need ample time to be materialized. In other words, the positive spillovers such as innovations through workers mobility, forward and backward linkages, diffusion of managerial skills and business culture needs minimum incubation period to trickle into domestic sectors. Second, to internalize the "hopefulness" offered by FDI's presence, native investors need a recognition period that exceeds the short run. Third, this negative contribution can be also caused by the anticipated short run competition between national and foreign firms. It is worth mentioning that the domestic

firms working in the economy are mostly incapable to compete with MNCs. Thus, the incompetent firms are either enforced to exit the market leaving it to MNCs or they may adapt themselves to react to these new developments in national economy.

Contrary to prior expectations, the short run coefficient of GDP growth doesn't preserve the same sign as in the long run, although its estimate is insignificant. Also, compared to the long run, the insignificant coefficient accompanied trade openness variable indicates that domestic investment is less responsive to the temporary short run changes in trade policies. This demonstrates that the trade openness towards the rest of the world wouldn't stimulate growth in domestic firms unless it sustained for longer period of time. Surprisingly, the coefficient in front of real exchange rate variable shows that the domestic investment is positively and significantly affected by depreciation in national currency. Together with its negative long run impact, it can be concluded that, the depreciation in real exchange rates plays a significant role in shaping the path of domestic investment in Sudan.

Concerning the impact of privatization policy, the positive coefficient in front of Priv dummy variable captures the desirable effects of this policy on domestic investment. It's highly significance (t-ratio=4.04468) indicating that the implementation of the policy contributes considerably in rising domestic investment during the period studied. One should note that the coefficient in front of this variable exceeds one, implying more positive increases in domestic investments by reinforcing the role of private sector in running economic activities. Turning to the error correction term, as displayed in the bottom part of Table 6.5, it can be seen that the adjustment coefficient of the error correction term is -0.69 that is significant (t-ratio = -4.10941) and negative. It suggests that if disturbance from domestic investment long run equilibrium occurs, the error correction returns it to the equilibrium position with 69% speed of adjustment per year. This result provides strong support for the hypothesis that real FDI, real exchange rate, domestic credit, growth in real GDP and adopting privatization policy share a significant long run relationships.

Last, the estimated model indicates a good fit to the data since the estimated value of Adjusted R^2 shows that 45% of the short run variations in domestic investment are explained by variables incorporated in the model. Value of F-statistic is 3.7 and significant at one percent. More importantly, the diagnostic tests show no problem indicating that the model is well specified and have satisfactory diagnostics. Table 6.6 reports the results for set of diagnostic tests performed on the residuals pertain to the model estimated. As shown in the table, the results show that the residuals are normally distributed since Jarque-Bera statistics don't reject the null hypothesis of normality (statistic =0.182588 with p-value of 0.9127). Also the result shows no evidence of the serial correlation since the Langrage-Multiplier F-test (LM) for the serial correlation shows p-value of 0.2272.

Table 6.6: The residuals diagnostic tests

Diagnostic test	Estimated Value	P-value
Normality Test(Jarque-Bera)	0.182588	[0.9127]
Breusch-Godfrey Serial Correlation LM Test	[1]:F(01,20) = 0.350032	[0.5607]
	[2]:F(02,19) = 1.279225	[0.3012]
	[3]:F(03,18) = 0.833500	[0.4928]
	[4]:F(04,17) = 0.897636	[0.4869]
	[5]:F(05,16) = 1.560782	[0.2272]
ARCH heteroskedasticity test	[1]:F(01,28) = 0.922254	[0.3451]
	[2]:F(02,26) = 1.950051	[0.1625]
	[3]:F(03,24) = 1.260510	[0.3102]
Breusch-Pagan-Godfrey heteroskedasticity test	[1]:F(15,15) = 1.657208	[0.1693]
White Heteroskedasticity test (with no cross terms)	F(09,21) = 0.9392	[0.9392]
Residuals stability test (Ramsey RESET Test)	[1]:F(01,24) = 1.640084	[0.2126]

The model is also free from heteroskedasticity given that the results of Breusch-Pagan-Godfrey, ARCH, Harvey and White have strongly rejected the null hypothesis of homoskedasticity. Additionally, the model convincingly passes a test of Ramsey Reset Test stability at the 10% percent level of significance since the estimated value is 1.6400 with p-value of 0.2126. Based on this good performance of the model and the quality of diagnostic tests, it can be said that FDI has a positive impact on domestic investment in Sudan. Therefore, the results strongly support giving hope hypothesis during the period studied.

6. Conclusion and Policy Implications

This paper argues that the contributions of FDI in boosting domestic investment will not be restricted to traditional benefits (establishment of new plants, diffusion of technologies, transferring modern managerial skills, …, etc) only but exceeds that by creating motives and confidence among native investors to establish new businesses in their homeland. This is what the paper called the "Giving hope hypothesis". To give validity to this hypothesis, the paper formulates domestic investment function for Sudan incorporating, together with FDI, all other variables that their inclusion is theoretically and empirically justified. A time series data on Sudan economy covering the period of 1980 to 2013 have been used to conduct the empirical analysis. The methodology of co-integration and vector error correction model (VECM) has been employed to allow overcoming the econometric problems that could come out from applying OLS method such as endogeneity, imprecise estimates and spurious regression.

The empirical results show that, most of the variables' coefficients are statistically significant, accompanied with the correct signs, and are of interpretable magnitudes. Specifically, the empirical results indicate that FDI's presence exercises a positive impact on domestic investment in Sudan. In other words, a long run complementary relationship between the two types of investments has been confirmed. Also, consistent with accelerator principle, the findings show that there is a positive long relationship between growth in real GDP and domestic investment. Similarly, consistent with trade proponents' beliefs, trade openness is found to be playing a positive role in expanding domestic investment. Most importantly, the finding on the privatization dummy variable indicates the decisive role of this policy in deciding growth in domestic firms. In contrast, and as

expected, the findings demonstrate that both high rate of inflation and depreciation in real exchange rate exert negative impact on domestic investment.

Based on these findings, policymakers in Sudan might find it beneficial to encourage the integration between domestic and foreign investments. This goal can be accomplished by taking up two policy actions. First, the interdependence between foreign and domestic investments can be preserved by stimulating MNCs that supplement domestic firms with raw materials, sophisticated technologies and furnish them with access to foreign markets. Second, this desirable complementary relationship can be also reinforced by promoting the types of domestic investment that have a wide range of forward and backward linkages with FDI. This would help in providing FDI with intermediate goods instead of importing them from abroad. Such policy action, in addition to its contributions in domestic investments expansion, would also serve in reducing the pressure on the country's balance of payments. Finally, a third policy option could be added. In particular, this option embodies in attracting MNCs, which help directly in strengthening domestic firms and at the same time have potentiality to stimulate FDI inflows.

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Part Four: Industrialization

Rethinking Africa's Industrialization strategy using Kenya as an example

Simon GITHUKU[53], Paul ODHIAMBO[54] and Augustus MULUVI[55]

ABSTRACT

Kenya like other countries in Sub-Saharan Africa has experienced impressive economic growth rates in the past decade. However, this growth has not been sustained and its effect on poverty reduction and job creation especially for the youth was minimal as the result of limited industralization. This study analyzed conceptual issues surrounding the issue of industrialization in Africa using Kenya as an example. If industrialization is not well conceptualized from the outset, the development strategy can suffer from different problems and therefore fail to achieve the intended objectives. To achieve the study objectives, meta-analysis method which combines literature review, comparative case studies and secondary data analysis was utilized. Analysis of literature showed that it has wrongly characterized economic development and industrialization as a situation where agriculture must necessarily decline. This can create a wrong notion among policy makers that agriculture is not important for development. Industrial strategies that Kenya is using tend to be too broad and lack specificity thereby making their implementation difficult. The analysis has revealed that economic realities that Kenya faces support agriculture-led development and industrial manufacturing that is labor-intensive. A fresh look at the approaches of industrialization can create a mechanism for coordinating development efforts of both National and County governments in Kenya.

Key words: *industrialization, deindustrialization, economic development, industrial policies, economic structure, demographics.*

1. Introduction

Africa had been regarded as the biggest development challenge facing the world (Clark, Lima and Sawyer 2016). However, in the last two decades, Africa has realized relatively high levels of economic growth and emerged as one of the fastest growing regions of the world. Indeed, it has been touted that "Africa is rising". This has created the hope that African countries are finally catching-up with their developed counterparts. Figure 1 shows gross domestic product (GDP) growth rates and per capita incomes for sub-Saharan African (SSA) countries for the period 1980-2014. According to this figure, GDP growth rate started rising beginning early 1990s and reached its peak in year 2004 where a growth rate of about 9.41 per cent was achieved. The high economic growth rates could be attributed to low interest rates, high commodity prices, higher domestic

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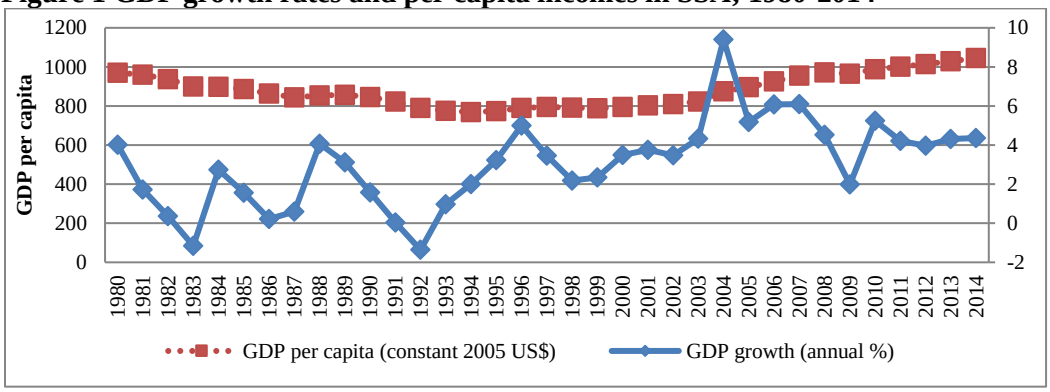
demand, rapid globalization, improved macroeconomic management and relative political stability in the world (Morris & Fessehaie 2014; Rodrik 2014).

A general observation of Figure 1 is that the economic growth rate has not been sustained. This could probably explain why increase in per capita income has been modest for the SSA countries. It is evident that the main drivers of economic growth rate experienced by SSA countries are exogenous to the continent and cannot be attributed to policy design or effort. Economic growth is usually expected to translate into structural change. This means that basic economic sectors-agriculture; manufacturing and services should change in their proportions and interrelations.

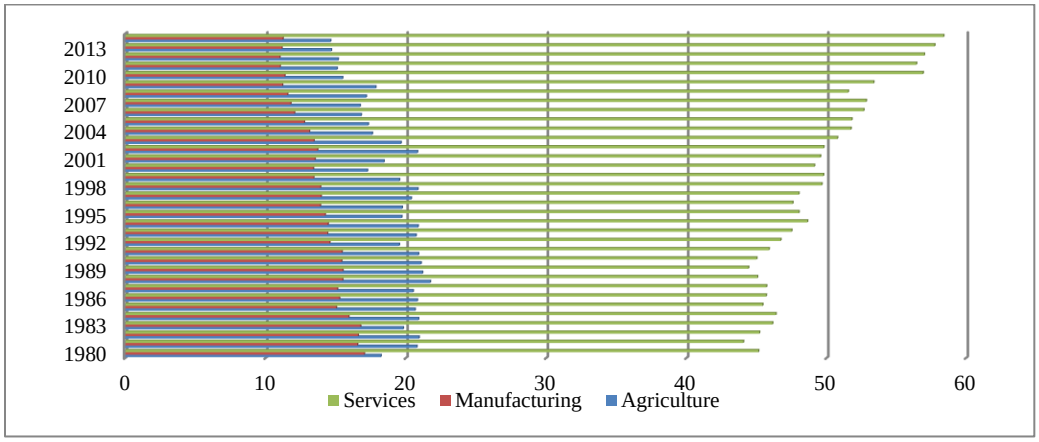
Figure 1 GDP growth rates and per capita incomes in SSA; 1980-2014



Source: WDI

Figure 2 shows how economic structure of SSA has been changing over the period 1980-2014. This figure indicates that service sector is the main economic sector The sectoral contribution of agriculture and manufacturing sectors to Africa's GDP has been on a steady decline while that of services has been rising. Thus, economic growth in Africa has been accompanied by expansion of services sector and not industrial manufacturing. This has been termed by Rodrik (2014b) as premature deindustrialization. Rodrik (2014a) observes that developing countries have to come up with a new growth model if industrialization is to materialize. For sustained economic growth to be realized, Africa requires structural transformation (Page 2012). As noted by Page (2012) Africa is deindustrializing instead of industrializing. This is evidenced by a declining manufacturing sector. Deindustrialization occurs when the service sector enlarges relative to agricultural and industrial sectors. For industrialization thesis to hold for Africa, manufacturing sector as a proportion of GDP must rise. O'brien (2001) defines industrialization as a socio-economic process where there is rapid transformation in the significance of the manufacturing activity as related to other forms of production and work undertaken in an economy.

Figure 2: Agriculture, Manufacturing and Services Valued Added (% of GDP) for SSA: 1980-2014



Source: WDI

There is renewed interest by African countries to industrialize. African leaders appreciate the role that industrial development can play in their economies. African Union (AU) Summit of 2008 had the theme: the industrialization of Africa. During the Summit, African leaders adopted Action for the Accelerated Industrial Development of Africa (AIDA). The AIDA strategy noted that industrialization was indispensable if socio-economic transformation was to be achieved for raising peoples' standards of living. Majority of African countries have developed national development blueprints (for example Vision 2030 in Kenya) to guide their economies towards attaining a middle income status. It is anticipated that such strategies will increase their resilience to shocks, increase productive capacity and sustain economic growth, create jobs and reduce poverty (UNCTAD 2013). Literature recognizes industrial manufacturing as an engine of economic growth (Kaldor 1966; AU 2008). Africa requires job opportunities especially for the young people and large-scale industrialization effort can reduce poverty and realize sustainable development (Morris & Fessehaie 2014). Any development or industrialization efforts have to take into account the prevailing circumstances in these countries if that is to succeed.

The main objective of this study is to analyze conceptual issues surrounding the concept of industrialization in Africa using Kenya as an example. Specific objectives include the following:

i. Analyze conceptual issues related to industrialization and economic development.
ii. Analyze prevailing realties in Kenya that can influence industrialization.
iii. Examine current industrialization strategies that Kenya is using by taking into account the prevailing realities.

As many African countries strive to industrialize, there is need for an appropriate architectural design of the industrialization strategy at the outset. This will prevent a situation of "original sin" while designing development programmes. That is to avoid instances where policies meant to promote industrialization process are not well conceptualized. Policies to promote industrialization should appreciate that each country is unique and may have some specific attributes such as natural endowments, cultures, tastes and preferences and other such considerations. This implies that there

might not be a "one-size-fits-all" industrialization strategy. Kenya is used as an example in advancing this argument; and the result of this study will also serve as a background paper as Kenya re-engineers industrialization strategies. This study relies on meta-analysis which will combine literature review, comparative case studies and secondary data analysis to achieve its objectives. Most of the secondary data were obtained from the World Development Indicators (WDI) of the World Bank.

The rest of the study is organized as follows. In section two, relevant literature for this study is reviewed. Section three gives a profile of Kenya which is useful when considering appropriate industrialization strategies. Section four provides an analysis of the current industrialization strategies that Kenya is using for development. Conclusions and policy implications are provided in section five.

2. Literature Review

This section discusses structural models of economic development, the process of industrialization, industrial policies, and approaches for industrialization.

2.1 Structural Models of Economic Development

Economic development involves transformation of the productive sector and accumulation of capacities necessary for the process to take place (Kaldor 1967; Chenery, Robinson & Syrquin 1986). Often, development is defined in terms of the size and importance of agriculture (rural) sector. Mellor (1986) considers economic development as involving the transformation of an economy that is mainly rural and agricultural to one that is highly urbanized, industrial and service in its composition. A main feature of economic development has been structural change of an economy where agriculture's share in output and employment declines while industrial manufacturing and services increase. Literature refers to this as economic transformation or structural transformation. Asian Development Bank (ADB) 2013)) identifies five components of structural transformation which include: reallocation of the factors of production across sectors of different productivity; diversification, upgrading and deepening of the production and export basket; use of new production methods and processes and different inputs; urbanization, a key feature of modern development and social changes.

Economists have associated economic development with structural change which is characterized with reallocation of labour from the agricultural sector to the industrial sector. This was a prevalent view in the 1960s and 1970s. According to Todaro & Smith (2012), structural models of economic development hypothesize that countries follow identifiable process of growth and change which is identical for all countries. Lewis (1954) and Chenery (1960) are two well known structural economists and this section describes their understanding of economic development.

2.2.1 Lewis Dual Economy Model

Lewis (1954) assumed a dual-sector model for an underdeveloped economy: rural and urban. In this model, the rural sector is large and has surplus labour while the urban sector is small and with

an industrial sector. The rural sector is overpopulated and with zero marginal productivity of labour. According to Lewis, surplus labour in the rural sector implies that it can be withdrawn from the agricultural sector without lowering its productivity. Urban sector is considered to be highly productive. Development process occurs when the urban sector grows and surplus labour is transferred from the rural to urban sector. The rural sector provides food for the urban sector. Industrial sector grows through accumulation of capital. Industries make profits and invest in new capital. This allows these firms to grow and demand more labour which moves from the rural sector. Labour is then used to produce products for sale to make profits. In this model, economic growth is conditional on urban sector capital accumulation. Thus, according to Lewis model, savings and investments are the main drivers of economic development.

Todaro & Smith (2012), provide a critique to the Lewis model. First, Lewis model makes a strong assumption that labour supply from the rural to urban sector is not limited. Empirical evidence does not support this assertion and can only hold due to seasonality and geographic exceptions. Second, there is an implicit assumption in the Lewis model that the rate of transfer of labour and employment creation in the urban sector is proportional to the rate of expansion in capital accumulation in the modern sector. Third, there is unrealistic assumption that there is a competitive modern-sector labor market that assures constant real urban wages until supply of labour is equal to demand. Finally assuming decreasing returns to scale in the industrial sector cannot hold when evidence shows increasing returns to scale to the sector.

2.2.2 Chenery's Structural Change and Patterns of Development

Chenery (1960) extends Lewis argument that structural change occurred only in the rural and urban sectors and it includes other economic functions such as changes in consumer demand from food and other basic necessities to manufactured goods and services. It also includes international trade and resource use as well as socio-economic changes such as urbanization and growth and distribution of the population. Chenery used an econometric approach to analyze the determinants of structural change of an economy. Results indicated that economic development was a function of size, geographic location and abundance of natural resources.

2.2.3 A critique of Structural Models of Economic Development

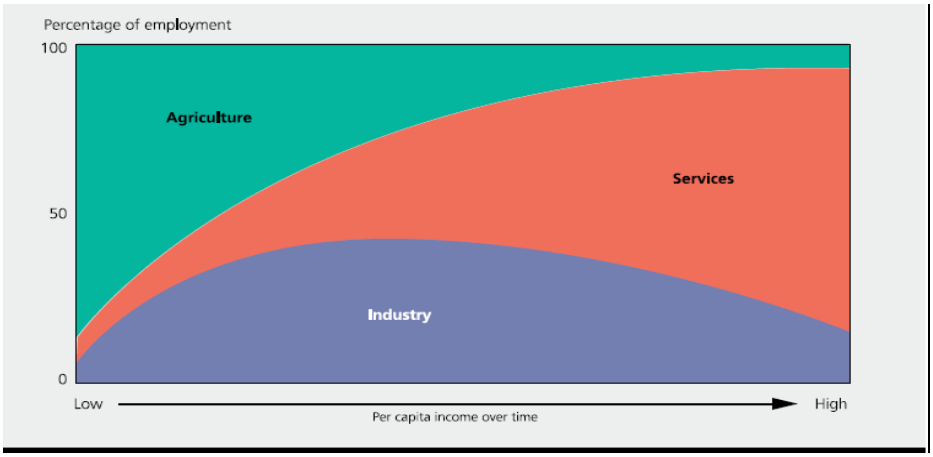
Structural change models of economic development can mislead policy-makers and make them draw wrong conclusion about cause and effect because of their focus on pattern of development and not theory (Todaro & Smith 2012). In addition, emphasizing industry as an engine of economic growth can mislead policy makers to neglect the agricultural sector. Declining share of agriculture to GDP in the process of economic development can mislead policy makers that the sector is not important for development (Stringer 2001).

2.3 The Process of Industrialization

Industrialization is usually associated with production that is based on the manufacturing sector (Murphy, Shleifer & Vishny 1989). Industrialization process is evaluated by comparing shares of

agriculture, industry and services in the overall GDP. Figure 3 shows the evolution of these sectors in the process of economic development.

Figure 3 The changing structure of employment during economic development



Source: World Bank: http://www.worldbank.org/depweb/beyond/beyondco/beg_09.pdf.

According to Figure 3, economic development is characterized by a decline of agriculture, a rise in industry (industrialization) which later declines and a rise in service sector (deindustrialization). In most developing countries such as SAA, agriculture is the most important economic sector. Most people in these countries live in the rural areas where poverty and deprivation are prominent (Diao, Hazel & Thurlow 2010). It becomes obvious agriculture is an important ingredient for development.

Industrialization occurs when people reduce their demand for food and shift their tastes and preferences to manufactured products. This happens when incomes of individuals start to increase. At the deindustrialization stage, people begin to demand less material goods in favour of services such as education, health and entertainment among others. Relative to agriculture and industry, service sector has a lower labour productivity because jobs in the sector are less machine-intensive. As a result, service sector share of GDP increases because it is more expensive than agriculture and industry. This can explain why unemployment in the services sector continues to grow because technological progress raises labour productivity and displaces workers as a consequence.

Table 1 gives characteristics of these stages of economic development. Agricultural sector tends to be labour-intensive while industry and service sectors tend to be skill and technology intensive. From the foregoing industrialization appears as a process where there is a structural shift of the economy from agriculture to industry and later to services. In East Asia, industrialization was led by the manufacturing sector while in Chile and India, agro-processing and export of services industries took the lead (Page 2012). Therefore countries can use different paths to achieve development.

Table 1 Stages of Economic Development

Characteristics	Stages: Preindustrial, agrarian	Stages: Industrial	Stages: Postindustrial, knowledge-based
Leading economic sector	Agriculture	Industry	Services
Nature of dominant technologies	Labor- and natural resource-intensive	Capital-intensive	Knowledge-intensive
Major type of consumer products	Food and hand-made clothes	Industrial goods	Information and knowledge services
Nature of most production processes	Human-nature interaction	Human-machine interaction	Human-human interaction
Major factor of economic wealth/growth	Nature's productivity (soil fertility, climate, biological resources)	Labor productivity	Innovation/intellectual productivity

Source: World Bank: http://www.worldbank.org/depweb/english/beyond/beyondco/beg_09.pdf.

2.3 Industrial Policies

There is no generally agreed definition among institutions or authors on the definition of industrial policy. World Bank (1993) sees industrial policy as government efforts to alter industrial structure to promote productivity-based growth. The United Nations Conference on Trade and Development (UNCTAD) considers industrial policy as a concerted, focused, conscious effort on the part of the government to encourage and promote a specific industry or sector with an array of policy tools. Krugman & Obstfeld (1991) view industrial policy as "an attempt by a government to encourage resources to move into particular sectors that the government views as important to future economic growth. Industrial policy is aimed at particular industries to achieve the outcomes that are perceived by the state to be efficient for the economy as a whole (Chang 1994). The most commonly used definition of industrial policy is by Pack & Saggi (2006) who defines it as any type of selective intervention or government policy that attempts to alter the structure of production toward sectors that are expected to offer better prospects for economic growth than would occur in the absence of such intervention.

According to Syrquin (2007), the main goal of an industrial policy is to anticipate structural change, facilitating it by removing obstacles and correcting market failures. Rodrik (2004) identifies two reasons why an industrial policy is required. First, is to overcome information externalities where entrepreneurs have to experiment with new products from established producers to uncover low production costs for the new activities to become profitable. This will counteract little investment and entrepreneurship before intervention and too much production diversification *ex post* (Hausmann & Rodrik 2003). Second, are coordination externalities where both the public and private sector investments have to occur simultaneously for the new industries to become profitable.

The global financial and economic crisis of 2008-2009 created a new interest on industrial policies among policy makers in an effort to create new sources of economic growth and employment creation. Countries are developing industrials policies for varied reasons depending on their individual needs. Some is to create balanced economic growth, increase production of the manufacturing sector or strengthen some specific sectors, technologies or areas of economic

activity for example green-growth and advanced manufacturing (Warwick 2013). For African countries to experience real and sustainable economic growth, it has to be based on industrialization and not export of primary commodity products of which they are price-takers in the world markets. This necessitates the formulation of appropriate industrial policies to kick-start the process of industrialization.

2.4 Approaches for Industrialization

Approaches that a country can use to industrialize can be broadly categorized into four as identified by Low & Tijaja 2013.

2.4.1 Import Substitution Industrialization (ISI)

Import substitution involves setting up of domestic production facilities to manufacture goods that were initially imported (Baer 1972). The ISI was a popular approach in the Latin America in the 1950s and later was adopted by other developing countries such as those in Africa. Primary aim of ISI was to escape the trap of specializing in primary commodities and promote industrial diversification in low-income countries. This industrial policy was implemented through production of strategic substitutes usually through heavy public sector involvement such as investment in infrastructure; erection of trade barriers to protect the industries and tailoring of monetary policy to favour import of noncompetitive intermediate and capital goods. The main undoing of ISI was small domestic markets, introduction of market distortions and supporting of sectors that were not viable and inability to compete with imported products (Ramdoo 2015). Despite the generalized failure of ISI, there were some notable successes or exemptions. Lall (2004) attributed the so called "East Asian Miracle" to ISI at least at the very early stage of the miracle where policy emphasized labor-intensive and export-oriented industrialization. Success of Bangladesh pharmaceutical industry has been attributed to ISI (Amin & Sonobe 2013).

2.4.2 Export-Oriented Industrialization (EOI)

The EOI is based on the production of manufactured products for purposes of selling them in the international market. It was advanced in part as a result of the failure of ISI and as model of development due to the success of East Asian countries (Ramdoo 2015). In the developing countries, this industrialization strategy targeted the textile industries particularly after the Agreement on Textiles and Clothing (ATC) in 2005. Developing countries have sought to go around challenges related to unfavorable domestic markets and have set up special economic zones (SEZs), export processing zones (EPZs), industrial clusters and industrial parks. Investors in these industrial zones are usually provided with land, basic infrastructure and tax incentives to be cost effective in production.

2.4.3 Resource-based Industrialization (RBI)

Export of primary products has been advocated as an export diversification strategy for developing countries that depend on commodities (Massol & Banal-Estañol 2014). According to Rodrik (2014b), SSA can accelerate and sustain economic growth by developing linkages to the natural resource sector. Fessehaie, Rustomjee & Kaziboni (2016) observe that RBI strategy was crucial in

the United States (US) at least at the early stages of development. Minerals such as coal, iron ore, copper and oil formed the basis of the manufacturing sector in the US in the 20th century (Wright & Czelusta 2007). However, Roemer (1979) noted that developing countries might find it difficult to enter resource-based processing because of domination by multinational companies especially in metal and petroleum industries.

2.4.4 Industrialization through Innovation (ITI)

This type of industrialization seeks to stimulate changes within firms. An assumption of this strategy is that strengthening of the innovation systems and technological capacity at firm level can enable it upgrade within the value chain. This has to involve setting of mutually beneficial networks and relationships among governments, suppliers, firms and consumers (Low & Tijaja 2013). Science and technology and research and development and such initiatives are crucial for this approach to succeed. An overview of literaturen indicates that economic development and industrialization appear as concepts that can be used interchangeably and both involve structural transformation. Literature creates the impression that for a country to be considered as industrialized, agriculture has to decline. While there are many goals of an industrial policy, the focus should be to create broad-based benefits to the greatest majority. There are varied approaches that a country can use to industrialize, but the selection of the approach should depend on the unique circumstances that a country faces.

3. A Profile of the Kenyan Economy

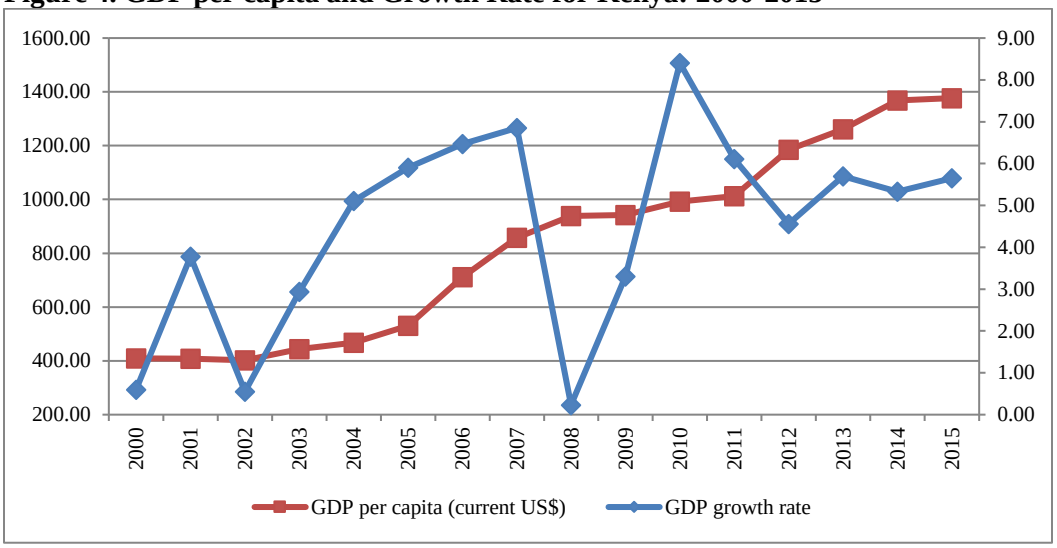
3.1 Introduction

In the process of industrialization, Kenya has to do a reality check, that is, examine the current prevailing domestic circumstances. It is upon this reality that the process of development or industrialization will take place. This section discusses some important aspects that have to inform industrialization strategies, that is, prevailing macroeconomic environment, economic structure, demographics and status education. Equally important is the fact that Kenya now has a devolved system of government. In this governance structure, there is the National government and 47 county governments.

3.2 Key Macroeconomic Indicators for Kenya

Kenya, like the rest of the SAA, is also unable to sustain GDP growth (Figure 4). However, per capita income has been rising steadily in the 2000-2015 period. By 2012, Kenya had attained a lower middle income status having surpassed US$ 1,045 per capita income which is the threshold according to the World Bank. Inability to sustain economic growth over a long period of time implies that the current economic model is not delivering the desired results. It will be difficult to reduce poverty and unemployment if GDP growth rate cannot be sustained.

Figure 4. GDP per capita and Growth Rate for Kenya: 2000-2015



Source: WDI

Table 2 gives time series data for annual headline inflation and weight of food in consumer price index. According to this table, food prices are a major contributor of inflationary pressures in these economies. From year 2000 to 2008, weight of food in CPI was 50.50 per cent, meaning about half of inflation can be attributed to food prices. This underlines the importance of agriculture in its relation to food production and its role in the process of economic development.

Table 2. Annual Headline Inflation and Food Weight in Consumer Price Index for Kenya

Year	Annual Headline Inflation	Food weight in Consumer Price Index basket, percent
2000	11.8	50.5
2001	9.9	
2002	6	50.5
2003	9.8	50.5
2004	11.6	50.5
2005	10.8	50.5
2006	6	50.5
2007	4.3	50.5
2008	16.2	50.5
2009	10.54	50.5
2010	4.08	36.03
2011	14	36
2012	9.4	-

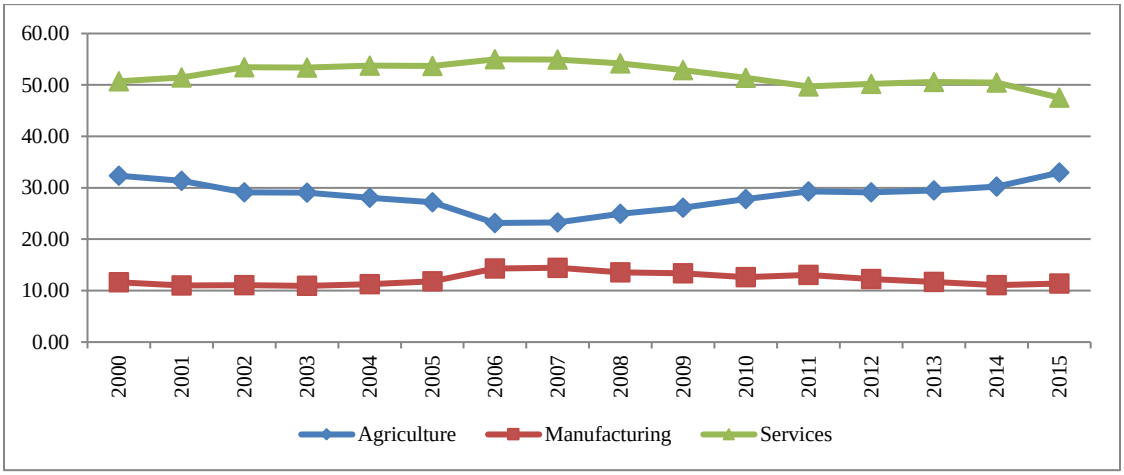
Source: EAC Open data portal

3.3 Economic Structure of Kenya

Economic sectors of any economy can be broadly categorized into three: agriculture, industry and services. Services sector is the largest economic sector in Kenya, followed by agriculture and

industrial manufacturing (Figure 5). Kenya can be said to be deindustrializing given that service sector is the largest economic sector. Industrial manufacturing contribution to GDP has stagnated for about 10 per cent over the past one and half decade.

Figure 5 Kenya's Economic Structure: 2000-2015



Data source: WDI

Doubts have been raised of the service sector in enhancing economic development of the developing countries. Rodrik (2014) observes that services may not play the role that industrial manufacturing played in economic development of developed countries because some of the services such as wholesale and retail trade cannot be traded. Services that can be traded tend to be skill-intensive. However, Ghani & O'Connell (2014) have argued that the service industry can assume the role that the manufacturing sector has played in promoting economic growth. It is not empirically clear about the impact of growth of the service sector on poverty reduction (Noland, Park & Estrand 2012.).

Agriculture is the second most important economic sector in Kenya, contributing roughly 30 per cent of GDP (Figure 5). Majority of Kenyans reside in the rural areas and farming is their main economic activity. This suggests that this sector cannot be ignored when considering policy options to fight unemployment and poverty reduction. Birdsall, Ross & Sabot (1995) note that shared economic growth has to be promoted to substantially reduce poverty and raise incomes of the majority of people in Africa. Such economic growth has to involve the agricultural sector which is one of the largest economic sector for majority of countries in Africa (Diao *et al.* 2010).

Manufacturing sector has been considered as an engine of economic growth. However, growth of this sector has stagnated in most African countries. Figure 5 shows stagnation of manufacturing sector for the period 2000-2015. Yumkella & Vinanchiarachi (2003) identified five challenges the manufacturing sector in Africa is facing. First, majority of the enterprises are small and information denying them opportunity to create backward and forward linkages. Second, strict environmental regulations make it difficult for firms in Africa to gain market access in developed countries. Third, majority of African countries suffer from low human and technological capacity to transform and upgrade the manufacturing sector. Fourth, Africa suffers from infrastructural deficits and high cost of doing business discouraging investments in the manufacturing sector. Finally, African countries

find it difficult in replicating best practices especially for agricultural products because of high cost of doing business.

Kenya has to take into account the prevailing global environment in the manufacturing sector which is increasingly being dominated by countries such as China and India. Diao *et al*. (2010) stresses that African countries have to contend with increased competition from India and China and may undermine their efforts in developing labour-intensive manufacturing industries. Rodrik (2012) argues that without industrialization, economic takeoff becomes very difficult and also acknowledges difficulties that new entrants into the manufacturing sector have to contend with especially because of China.

Table 3 provides some further details of the manufacturing sector in Kenya. Using Lall (2000) technological classification of manufactured exports, an overwhelming majority such as food and beverages and textiles fall into the category of resource-based manufactures or low technology manufactures. The implication is that Kenya has some catching up to do to scale-up the technological ladder of manufactured products.

Table 3 Employment and valued added indicators for the manufacturing sector in Kenya

Industry (ISIC Revision 3-2 digit level)	No. of People engaged	Manufacturing employment (in %)	In percentage to total manufacturing	
15-Food and beverages	132,157	36.89	27.78	38.48
16-Tobacco products	938	0.26	1.25	1.26
17-Textiles	35,845	10.01	1.87	8.51
18-Wearing apparel, fur	36,865	10.29	1.27	3.98
19-Leather, leather products and footwear	7,096	1.98	1.55	1.42
20-Wood products (excl. furniture)	11,920	3.33	0.82	1.07
21-Paper and paper products	9,227	2.58	4.41	2.09
22-Printing and publishing	9,362	2.61	2.86	7.48
23-Coke, refined petroleum products, nuclear fuel	299	0.08	11.86	3.52
24-Chemicals and chemical products	23,067	6.44	5.43	6.87
25-Rubber and plastic products	16,304	4.55	3.29	3.51
26-Non-metallic mineral products	11,370	3.17	11.72	3.01
27-Basic metals	10,327	2.88	4.23	1.86
28-Fabricated metal products	16,311	4.55	-	6.89
29-Machinery and equipment n.e.c	4,509	1.26	0.63	2.44
31-Electrical machinery and apparatus	3,583	1.00	2.02	0.08
34-Motor vehicles, trailers, semi-trailers	5,655	1.58	1.50	3.10
36-Furniture; manufacturing n.e.c.	14,911	4.16	1.32	4.43
Total manufacturing	358,256	100.00	100.00	100.00

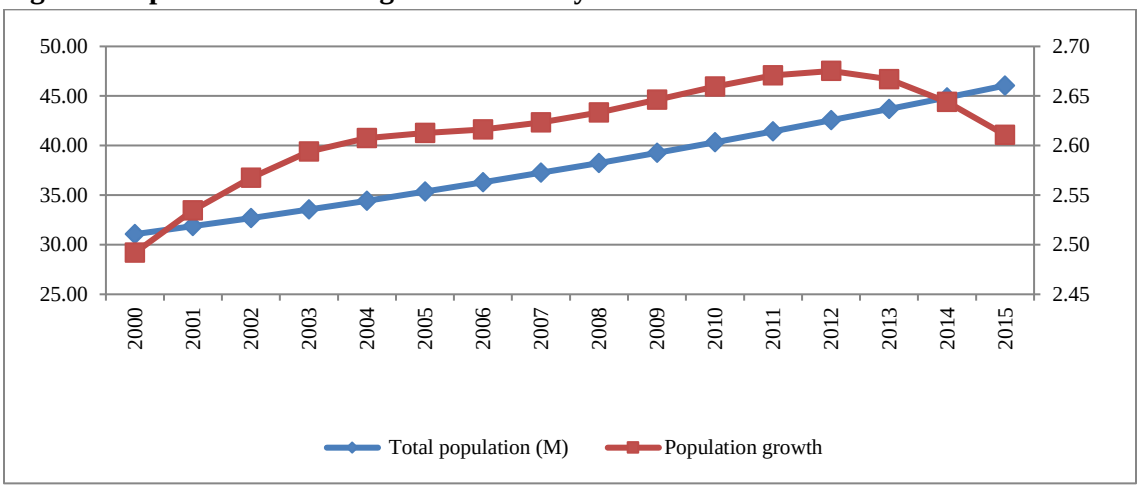
Source: UNIDO

3.4 Demographics

Population is an important factor in the process of industrialization. If the population has the requisite purchasing power, it can stimulate the manufacturing sector through demand of manufactured products. Population can affect industrialization negatively if it leads to food shortage (Zhou 2009). A well educated population can provide labour to the manufacturing sector.

Figure 3.3 provides total population and population growth rate for Kenya over the period 2000-2015.

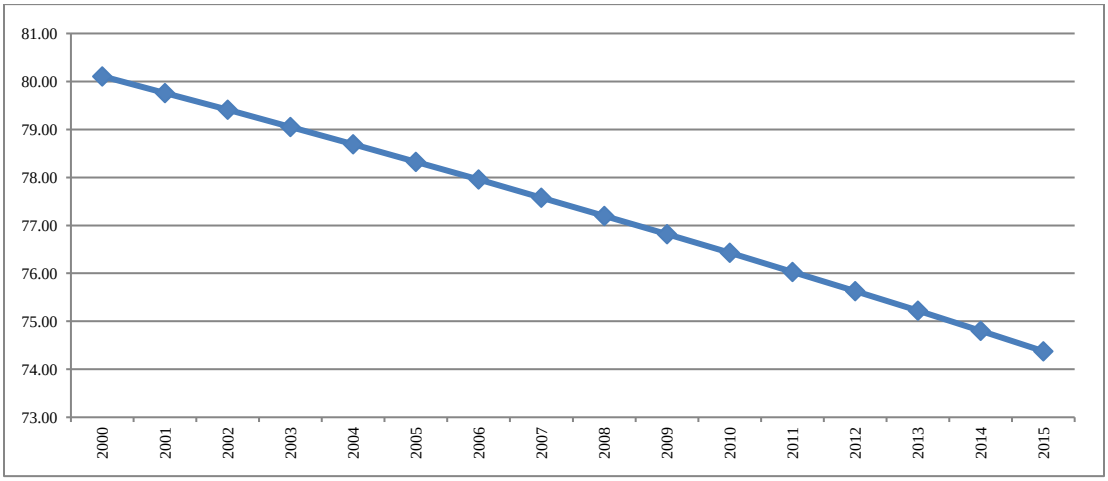
Figure 6 Population total and growth for Kenya: 2000-2015



Source: WDI

According to Figure 6 total population has been on an upward trend and was estimated to be about 46 million Kenyans by end of 2015. However, population growth started to decline from year 2012 to register a growth rate of 2.61 per cent in 2015. Zhou (2009) demonstrated theoretically that population growth can lead to food shortage and collapse of the process of industrialization. Mankiw, Romer & Weil (1992) theoretically and empirically proved that population growth has a negative effect of economic growth because it reduces capital per worker and hence lowers total factor productivity. Thus, population growth rate is an opportunity cost for productive activities (Bonnefond 2014). Most of the people in SAA reside in the rural areas where deprivation and poverty are most severe (Diao *et al*. 2010). This also applies to Kenya where 74.38 per cent of the total population was estimated to reside in the rural areas in 2015 (Figure 7).

Figure 7 Rural population in Kenya (% of total population)



Source: WDI

3.5. State of Education in Kenya

Skills and ability to acquire them is an important when thinking about building and industrial sector in Kenya. Industrial development requires skilled labour in different aspects which has to be continuously upgraded to meet varying needs (Yumkella & Vinanchiarachi 2003). Empirical studies have established a strong link between the extent of sophistication of manufactured exports and the size of the labour force that has education past primary school (World Bank 2007). Skills gap in Africa is large and also growing (Page 2011). It is difficult to reduce skill gap when expenditure of education is declining for Kenya which according to Table 3 reduced from 7.2 per cent in 2008 to 5.9 per cent in 2012.

Table 4 Education Statistics for Kenya: 2001-2012

Year	Literacy rate	Expenditure on education (%) of GDP	Transition rate (%), primary	Net primary enrolment rate (%)	School enrolment, secondary, female and male (% net)
2001	65	5.1	22.4	75.1	34.15
2002	0	4.5	21.7	77.3	34.67
2003	0	5.9	30.1	80.4	36.31
2004	0	6.13	36.1	82.1	39.18
2005	0	6.8	49.3	83.2	41.03
2006	61.5	6.7	67.5	87	42.28
2007	61.5	6.8	56.7	92	44.43
2008	61.5	7.2	51.6	92.5	49.71
2009	62	6.9	43.9	93	50.23
2010	62	6.5	52.2	91.4	0
2011	62	6.8	53.6	95.7	0
2012	62	5.9	0	95.3	56.51

Source: EAC Open data. Note School enrolment, secondary, female and male (% net) was obtained from WDI

According to Table 4 net enrolment for secondary school in 2012 was 56.51 per cent while that of primary education was 95.3 per cent. This shows that there is a major drop of students completing secondary education which has been used as a measure of human capital in empirical studies (for example Mankiw et al. 1992). Literacy level is just above average and was 62 per cent in 2012.

3.6 Devolved System of Government

There are many agents or actors that are involved in the process of economic development as governments, institutions and entrepreneurs. This makes coordination of their activities to be a critical component of economic development. Murphy *et al.* (1989) while advancing the idea of big push and industrialization underlined the importance of coordinating of investments across the different economic sectors to allow rapid growth. Rodrik (2004) stressed on the importance of the government and private sector collaboration in implementing industrial policy by identifying obstacles and proposing interventions to eliminate them. Constitution of Kenya 2010 introduced a devolved system of government which has two layers, the national and county governments. Coordination of development efforts by the two levels of government will determine the pace of economic growth and development.

4. Industrialization Initiatives by Kenya

4.1 Introduction

After analyzing the prevailing domestic condition in Kenya in chapter 3, this chapter analyses the industrialization strategies currently in use by taking that reality in account. Four approaches are analyzed: export processing zones, Vision 2030, Kenya Industrial Transformation Programme and the special economic zones (SEZs).

4.2 Export Processing Zones

Kenya inaugurated its Export Processing Zones (EPZs) in 1990 as part of the Government's Export Development Programme (EDP) not only to transform the economy from import substitution to export-led growth but also to integrate the country into the global supply chain and attract export-oriented investments into the EPZs (Waithera 2008). The EPZs were to create jobs, diversify exports, and enable technology transfer and creation of backward linkages between the zones and the economy. Currently, the zones are located in Nairobi, Athi River, Voi, Mombasa, Kerio Valley and Kilifi. There are plans to establish new zones in Kisumu and Lamu. The zones offer investors a 10-year corporate tax holiday, unrestricted repatriation of profit on capital and dividends from foreign exchange earnings, unrestricted foreign borrowing and capital and exemption from certain licensing requirements (Vastveit 2013). Investment in the EPZs is restricted to manufacturing, commercial activities and export-related services.

The establishment of the African Growth Opportunity Act (AGOA) by the United States government in 2000 was a watershed for the EPZs in Kenya as the number of enterprises and the level of investments increased significantly. The AGOA regime has contributed to textile and apparel industries with the zones as Kenya took advantage of the United States' market. It is estimated that between 70% and 90% of the EPZs exports are textile and apparel products (Vastveit 2013). With the end of Multi-Fiber Arrangement (MFA) in 2005, investment in textile and apparel declined in Kenya's EPZs. Kenya's EPZs are progressively diversifying to other sub-sectors including horticulture, food processing, call centers, human and veterinary pharmaceuticals. Despite the expansion to other sub-sectors, garment production still dominates the EPZs. Even though the country has experienced growth in EPZs, the manufacturing sector has stagnated in the last decade. However, it has been observed that EPZ exports have made modest change to the country's export structure. Moreover, the transition from low-value added production to high-value production is yet to be achieved. Kenya's improved infrastructure, human resource skills and political and macroeconomic stability have provided favorable environment for the growth and expansion of EPZs.

Amirahmadi & Wu (1995) identified several conceptual pitfalls of EPZs which have reduced their effectiveness as a model for development and in promoting manufactured exports in particular. First, their enclave nature denies them the opportunity of creating linkages and integration with other domestic economic sectors. Second, the EPZ system incentive structure has created import dependency thereby undermining exports. Third, creating the zones by being informed by cost consideration has promoted low-end and labour-intensive manufacturing sector. Fourth, they tend

to cater for the needs of foreign investors who may not be interested with the economic interests of the host country. Finally, many countries lack regional policies.

4.3 Kenya's Vision 2030

Kenya's development blueprint envisages that manufacturing sector will play a vital role in propelling the country's economy to a 10% annual economic growth rate (Republic of Kenya 2007). According to the Vision 2030, challenges to manufacturing sector in Kenya include high fuel prices, exchange rate risks, and inadequate and unreliable power supply. Four factors that have contributed to the lack of competitiveness in the manufacturing sector include high input costs, low productivity levels, inefficient flows of goods and services and unfavorable business environment. The country is optimistic that special economic clusters and small and medium enterprise parks will serve as the seed beds of Kenya's industrial take-off. Moreover, the Vision 2030 intends to make manufacturing sector more competitive both at regional and international levels.

The top three manufacturing sub-sectors that account for 50% of the sector GDP are food processing, beverages and tobacco; refined petroleum products and textiles, apparel, leather and footwear. Most of the manufacturing firms are owned and operated by families. Currently, the bulk of manufactured goods (95%) comprise basic goods such as food, beverages, building materials and basic chemicals. Even though Kenya is seen as the manufacturing hub in the region, most of the manufactured goods in the regional market are imports from China, India and other extra-regional states. Due to regional integration and deepened bilateral relationships with regional states, there is a huge potential market for manufactured goods. It is, therefore, expected that the country will gain from the regional market if the industrialization goals are achieved in the next ten years.

The vision of Kenya's manufacturing sector is the establishment of a robust, diversified and competitive manufacturing that will be achieved by focusing on three strategic thrusts including local production, regional market expansion and global market niche. Strengthening of local production capacity entails establishment of special zones and parks, industrial clusters. In 2007, Kenya claimed only 7% of the market share of the regional market for manufactured goods. While progress might have been made in terms of increasing Kenya's share, it is imperative to pay attention to the increasing manufactured imports from outside the region. Agro-processing sub-sector has been identified as a potential niche for the country in the manufacturing sector. It is important to develop a strategy that will attract investors to agro-based industry.

Key flagship projects for the manufacturing sector include development of industrials and manufacturing zones and development of SME parks. The agenda of the country is to promote regional specific industrial and manufacturing clusters since different regions of Kenya are endowed with a diversity of resources. On the other hand, the establishment of SMEs will be focused on urban areas. In order for the country to revamp manufacturing sectors certain measures have to be undertaken including reform of industry structure, strengthening negotiation capacity and the building of strong trade agreements, strengthening import regulations, encouraging both local and foreign investors in clusters, promotion of science, technology and innovation, improvement of critical infrastructure and improvement of business environment.

4.4 Kenya's Industrial Transformation Programme

Industrialization has been identified as a crucial tool for Kenya's economic growth and development. The country intends to accelerate the development of industries and factories that will drive Kenya's economic growth. The country's ultimate goal is to make Kenya a new industrial hub in the continent. The revitalization of the industrial sector is likely to contribute to job creation, generation of foreign exchange, attraction of Foreign Direct Investment (FDI), increase export of industrial products to address the problem of trade imbalance. Though the country has relatively well-educated labour force, developed financial services, information technology capabilities, relatively good infrastructure in the region and vast natural resources, Kenya's manufacturing sector has stagnated (see Figure 3.2).

In 2015, the Government of Kenya (GoK) launched the Kenya's industrial transformation programme (KITP) (Republic of Kenya 2015a). This KITP identified infrastructure and availability of land, skills and capabilities in priority sectors, quality of inputs, operational costs, market access and investor-friendly policies as some of the challenges that must be overcome for industrialization strategy to be realized. To guide the process of industrialization, the programme identifies a five-point strategy including: First, through launching sector-specific flagship projects that include agro-processing, fisheries, textiles and apparel, leather, construction materials and services, oil and gas and mining services and information technology. This will be achieved through the establishment of a food processing hub in Mombasa to process imported agro-products, launching of agro-processing zone to process local commodities in Kisumu, developing an integrated textile cluster in Naivasha, leather cluster in Machakos, low-cost housing ecosystem, developing local content requirements to support the local manufacturing and attracting international oil and gas and mining services among others.

The second strategy is the development of Kenya's small and medium enterprises. Under this strategy the Kenya will come up with model factories, strengthening subcontracting policy to improve links between large and small players and selection of 50 highest potential SMEs yearly. The third strategy is the creation of an enabling environment to accelerate industrial development through industrial parks/zones. Kenya plans to continue with the drive of ease of doing business reforms to reach top 50 by 2020. Other priorities under this strategy include building network of competitive industrial parks and zones, attracting local capital and FDI. The fourth strategy is the creation of an industrial development fund to respond quickly to investment opportunities in priority areas and accelerating the development of the required infrastructure for sector priority projects. Finally, the fifth strategy is driving results with the Ministerial Delivery Unit. The Unit will coordinate across ministries and implementing agencies and measure, track and report progress especially of the flagship projects.

4.5 Special Economic Zones (SEZs)

Kenya plans to transition from EPZ model to SEZ model as the former has not generated the anticipated success for the manufacturing sector. The country has come up with The Special Economic Zone Act (2015) to provide a legal foundation for the new model (Republic of Kenya 2015b). The Act defines SEZ as a "*designated geographical area where business enabling policies,*

integrated land uses and sector appropriate on-site and off-site infrastructure and utilities are provided, or which has the potential to be developed, whether on public, private or public-private partnership basis…" p.243. The Act states that the SEZ can be designated as single or multiple sector special economic zone and may include free trade zones, industrial parks, free ports, information communication technology parks, science and technology parks, agriculture zones, tourist and recreational zones, business service parks and livestock zones. Unlike EPZs that have been limited to manufacturing, commercial and service activities, SEZs will have more sub-sectors including agricultural activities, business processing outsourcing, call centers, management consulting and advisory services, headquarter management services, commercial activities, manufacturing and processing, information communication technology services, livestock marshalling and inspection, livestock feeding/fattening, abattoir and refrigeration, deboning, value addition, manufacture of veterinary products, tourism-related services. Currently, EPZ and SEZ models will operate in parallel until the former will eventually be phased out.

Special economic zone enterprises that are licensed are exempt from all taxes and duties payable under the Excise Duty Act, Income Tax Act, East African Community Customs Management Act and the Value Added Tax Act. The operation and regulation of SEZs will be mainly under the SEZ Authority and the Cabinet Secretary in charge of industrialization. The SEZ Authority is mandated to license SEZ developers, operators and enterprises.

5. Conclusions and Policy Implications

5.1 Conclusion

Literature characterizes economic development and industrialization as concepts that can be used interchangeably. One outstanding common feature of these two concepts is that they are processes where agriculture has to decline and be replaced by other economic sectors such as industrial manufacturing. This can create a wrong view that agriculture is not important in the process of development or industrialization.

Any development strategy by Kenya to tackle poverty and unemployment has to contend with the following realities for it to be successful: current economic model has not been able to sustain economic growth; food prices are the largest source of inflationary pressure; majority of Kenyans reside in the rural areas where farming is the main economic activity; education attainment levels by Kenyans can be said to be average implying that high skill and technology based industrialization strategy may not be feasible or appropriate at least in the short-run; Kenya has a devolved system of government and thus creates a complex bureaucratic web that can derail or slowdown development efforts. Most of these features favour an agro-based approach for development.

Policies currently in use to spur industrialization such as EPZs, Vision 2030, KITP and SEZs appear to have conceptual gaps in their design because of a number of reasons. First, generally these industrialization approaches appear to too broad and are not specific and this will make their implementation difficult. This lack of clarity is prevalent especially in the KITP where

manufacturing sector issues have been mixed-up with services and SMEs. Second, the role of education appears to have been ignored in these industrialization strategies. Education system must be in sync with industrial needs. Third, the role of county governments was not taken into account when designing KITP and SEZs. The KITP and SEZs offer an opportunity for coordinating National and County government's efforts towards industrialization. Third, little emphasis has been demonstrated in these strategies on the need for industrial upgrade to high skill and technology products in the future given that bulk of products from the manufacturing sector are low-technology or resource based manufactures. Lastly, for the industrialization to be sustainable and create shared growth, they have to take into account that majority of the people reside in the rural areas and education attainment levels is average.

5.2 Policy Implications

Kenya should focus on industrial development so that industrialization is one of the approaches that can be used for economic development. Agriculture and service sectors are other important economic sectors that can be used to create sustainable and inclusive growth. Prevailing conditions in Kenya suggests that at least in the initial stage, development strategy so designed should lean towards agriculture-led approach because majority of the people reside in the rural areas and manufacturing activities that are labour-intensive in nature to absorb labour. Industrial development offers an opportunity of creating a formula in which the National and County governments in Kenya can work together and in a synchronized manner. Both levels of government are currently struggling on how to work together. Approaches for industrialization require being more specific and precise. This will allow better targeting of interventions especially when designing and building infrastructure. For instance, it can be as specific as manufacturing breaks pads for motor vehicles.

5.3 Limitations of the Study

The study has provided a critique of the approaches that Kenya is using to industrialize but has not provided alternatives. This can be taken up by researcher to propose industrialization strategies that can work for Kenya. Further, external environment including regional economic integration has also not been analyzed. African Union and regional economic bodies such EAC already have industrialization strategies and it would be interesting to see how they link with domestic industrial policies.

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Supply Analysis in Wheat Industry and Contributions of Value Chain Analysis in Ethiopia: Cases from Arsi and East Shewa Zones in Oromia National and Regional State

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ABSTRACT

An attempt is made to analyze factors affecting supply issues at different functional nodes of wheat value chain. It also looks at roles of cooperatives and other institutions in supply issue. Interview schedules, informal group discussions and observations were used to collect primary data from actors in the wheat value chain included input suppliers, service providers, wheat producers, traders, cooperatives, wheat processing industries. Data were analyzed with the help of descriptive statistics, qualitative methods and stepwise multiple regression. The result indicated that cooperative as an actor has failed to supply adequate pesticide and herbicide to the wheat producers. As a result, input retailers manifested their opportunistic behavior and exploited asymmetric information on input quality at small shops and spot markets, which in turn, declined wheat productivity. Wheat producer's marketed surplus significantly increased with land size, fertilizer, extension services, and distance from the main road, producer's wheat value chain function, whereas decreased with crop rotation. About 90% of wheat processing industries faced shortage of raw materials as the number one barrier for wheat products supply. Concerned bodies should work on technology and extension service supply and coordination to address low raw materials and final products supply at each functional node of wheat value chain.

Keywords: *wheat marketed surplus, wheat product supply, wheat value chain*

1. Introduction

Industry chains are streamlined as either supply or value chains. It refers to the physical flow of commodities and includes input suppliers, service providers, producers, processors and traders. The wheat industry has many sectors which are strongly interlinked to each other. The failure of one sector is likely to cause failure in another. For instance, if upstream actors fail to deliver the right quality and quantity of inputs at the right time to wheat producers, they cannot deliver the right quality and quantity of wheat demanded to downstream sector. This implies that inadequate input supply in input markets has direct adverse effect on wheat productivity and supply. Moreover,

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insufficient input supply in the market has an effect on wheat product supply. Thus, supply chains rely on coordination between actors (Bryceson and Kandampully 2004).

Value chain analysis could be used to address supply issues, such as quality and consistency of raw product supply in the chains that may shrink the gap between demand and supply (Bryceson 2008). Policy like import bans or high tariffs create dearth of input, high costs and poor quality of inputs in input markets (FIAS 2007). The basic supply theory for farm commodities argues that commodity price, and the existence and extent of production alternatives have an effect on quantity supplied for some specified time period (Cochrane 1944; Nerlove and Bachman 1960). On the contrary, household farm model which is against the mainstream microeconomic theory states that prices of staple crops did not have significant effect on quantity supplied in rural areas of Japan (Kuroda and Pan 1978). Other scholars argue that changes in weather, market structure, government policies, demographics and technology (Nyairo and Backman 2009); prices of production inputs (Yevdokimov 2012) create variation in aggregate farm commodity supply. A dynamic land allocation model assumes that dynamic land allocation process leads to high crop yield whereas monoculture results in low land productivity because of depletion of nitrogen and accumulation of crop-specific insects, worms and diseases in soil which has direct impact on crop yield.

Ethiopia is well known for wheat production among COMESA countries, next to Egypt; where the bulk of wheat has been growing in the Oromiya region that was 58.67% of total wheat production of the country (CSA 2014). Particularly, Arsi zone is the most known for wheat production in terms of area coverage and annual total production which shared 25.3% of the total production of Oromiya region. East shewa zone is also known for wheat production but ranks the fourth position in wheat production. Other the major wheat producing areas in this region are, Bale (19%), West Arsi (16.52%), East Shewa (8.62%), North Shewa (8%), South West Shewa (7.89%) and West shewa (6%).

However, the gap between wheat demand and supply has been increasing from time to time due to changes in population size and dietary composition of wheat products (Mary *et al*., 2012) which has made the country net importer of wheat and still has failed to fill the gap despite its tremendous potential for wheat production and productivity improvement (Rashid 2010). Since 1991, the country has imported on average 40% of the total wheat domestic supply to narrow the demand and supply gap (Mary *et al*. 2012). Moreover, wheat processing industries have been working under capacity, for instance, capacity utilization was 40.4% for flour mills and 42% for macaroni and spaghetti (Dendena 2009). Particularly, dearth of wheat supply was also a serious problem in Oromia region (Mohammed 2009; Dendena 2009), the average marketed surplus of wheat in Arsi and East showa zones were about 23% and 28% respectively (CSA 2014) and 47% of the marketed surplus wheat in Ada'a, Alaba and Fogera districts (Berhanu and Hoekstra 2007). Variation in marketed surplus of wheat among wheat producers was another great challenge in the wheat value chain (Berhanu and Hoekstra 2007).

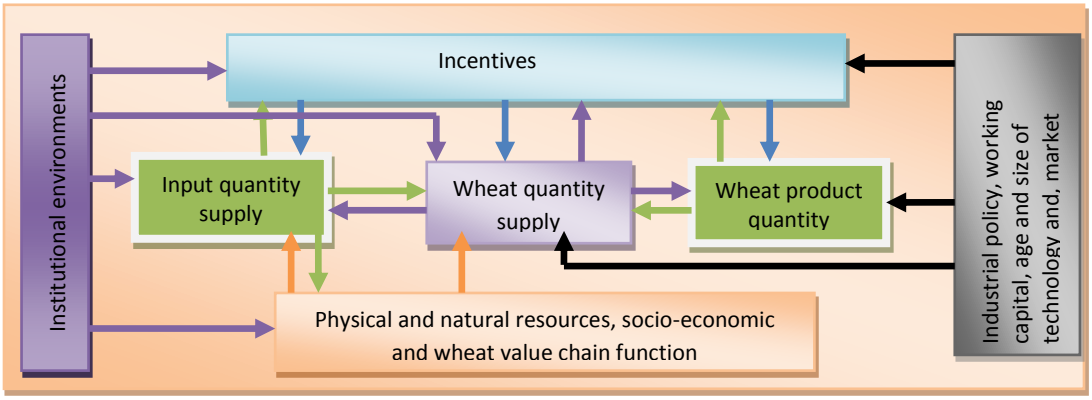
So far, constraints on wheat value chain (WVC) were studied by USAID (2010); Mohammed (2009) and Mary *et al*. (2012), but these studies lack detailed information on constraints of input, institutions and wheat processing industry supply. This study tests the effects of changes in

agricultural technology, dynamic land allocation and WVC function on quantity supply and identify factors affecting input and wheat product supply that the earlier studies did not address in their studies of factors determining wheat marketed surplus (e.g. Berhanu and Hoekstra 2007; Muhammed 2011). Moreover, value chain analysis in this paper is used as an analytical framework to identify supply issues in the wheat industry which was not used in earlier studies. One of the aims of value chain analysis is to enhance the quantity supplied at different functional nodes of a value chain (Anandajayasekeram and Gebremedhin 2009). Furthermore, it overcomes the weakness of sector analyses which focus on various economic aspects of production and examines dynamic linkages between productive activities that go beyond particular sector (Kaplinsky and Morris 2000). It adds new knowledge to the existing theory with regards to supply issue links between upstream and downstream actors. Thus, the result of this study is pertinent to generate useful information and bridge the existing knowledge gaps in marked areas.

2. Conceptual Framework

In this study, institutional environments are associated with input quantity supply and incentives (i.e., prices, costs). Incentive correlates with each quantity supply and industry and its policy. Industrial policy, working capital, age and size of the technology are associated with the amount of wheat product supply. Technology, resource and socio-economic attributes have interactions with actors' attributes. Particularly, WVC function, technology, resource and socio-economic attributes determine the actors' quantity of wheat supply. The conceptual framework is constructed on the basis of literature reviews and survey to display the causes-effects relationship at each functional node of wheat value chain (Figure1).

Figure 1. Relationship between commodities supply and various concepts



Source: Own construction

3. Methodology

This study adopted multistage sampling techniques to select sampling units such as zones, districts, kebeles and the key actors' in the WVC. In the first stage, Arsi and East Showa zones were purposely chosen due to its potential in wheat production. In the second stage, all wheat producing districts were listed and classified into major and minor wheat producing area on the basis of areas of wheat coverage. Three districts, Gimbichu from East shewa zone and Hetosa and Tiyo from Arsi zone, were randomly drawn from major wheat producing districts. In the third stage, two villages

(i.e., kebeles) were drawn randomly from each district. Probability proportional to size was applied to determine sample size of wheat producers in each selected village. In 4th stage, wheat producers were randomly selected from the land ownership register to be obtained from the Office of land administration from villages. All traders in spot and non-spot markets were visited at 6 markets. Input suppliers (retailers) were visited at small retailer's shops and spot market at different times of the day (morning, afternoon and evening) to interview all them present in three districts. Wholesaler input suppliers were interviewed at Addis Ababa. All firms such as bakeries, flour and food complex industries were sampled and interviewed with the help of fresh list of wheat processing industries. In addition to this, we visited traders and firms purposely in Adama, Assela and Bishoftu towns and Addis Ababa. To carry out formal survey, census was applied to collect data from indirect actors such as supporting business service providers and input distributors.

There is no common consensus on the formula that yields optimal sample size to run a regression model and the controversy is still unsettled. So, scholars have failed to reach consensus that led various researchers to use various methods to determine sample size. However, most statisticians and econometricians deem independent variables to determine sample size (i.e., sample size (m) is 10 or more times the number of relevant independent variables) in a given model (Edriss 2013). Sample size determination for other actors such as bakeries, flour and food complex firms and wholesalers in WVC relies on the numbers of these actors in the study area. Thus, based on the above justifications, data used in this paper were extracted from 220 wheat producers, a census of 50 wholesalers, a census of 30 wheat industries and a census of 25 institutions, namely 13 cooperatives, two Agricultural Research Centers, two Seed Enterprises, four Agricultural extension organization, one investment and industry bureau, three Oromia International Cooperative, development Banks in the study areas. The survey was carried out in 2015/16 in Arsi and East shewa zones. Moreover, data were extracted from 20 input suppliers (retailers). Five wholesaler input suppliers were visited in Addis Ababa city for interviews to collect data on constraints of input supply and its distribution. In addition to these, 20 traders, 15 wheat processing industries were interviewed in Addis Ababa, Adama, Assela and Bishoftu towns. Finally, we visited all indirect actors such as supporting business service providers and input distributors for an interview.

This paper acquired single round quantitative and qualitative primary data from key WVC actors. Sources of primary data include input suppliers, wheat producers, traders, cooperatives, wheat processing industries and institutions. Data collection techniques including semi-structured interviews, informal group discussion and observations were used to collect primary data from actors in wheat value chain. Quantitative analysis such as descriptive analysis, correlation analysis and stepwise multiple regression were used to address quantitative part of the objective whereas qualitative analysis including data reduction, mapping and conclusion drawing was applied to address qualitative part of the objectives.

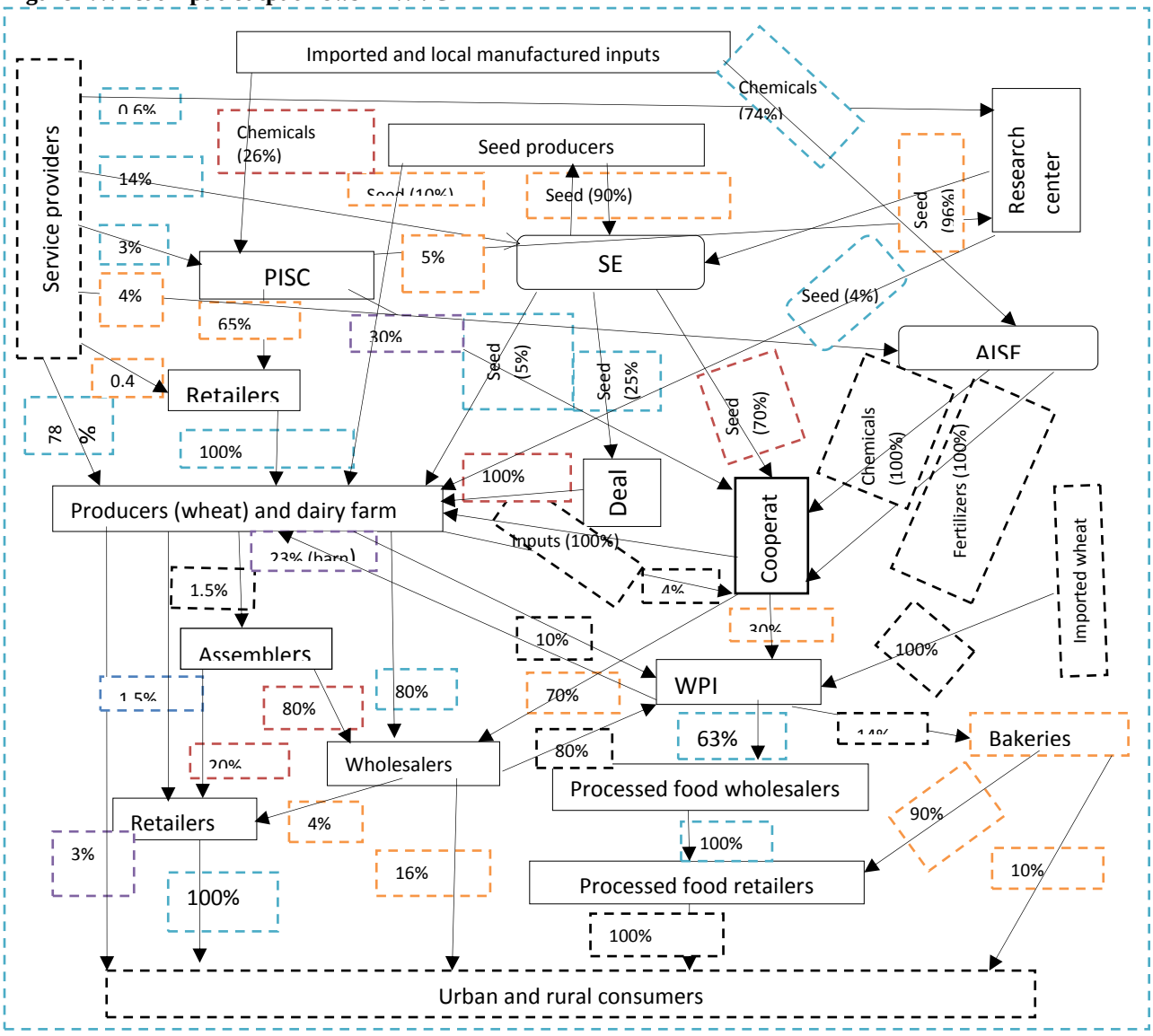
4. Empirical Results and Discussions

The results presented here are related to flows of commodities, wheat producers' socio-economic profile, technology utilization patterns, factors impeding actors' marketed surplus of wheat and wheat product supply in the WVC.

4.1 Flows of Commodities in the Wheat Value Chain

Typical actors in the wheat value chain were input suppliers, wheat producers, cooperatives, wholesalers, and wheat and wheat product consumers, wheat processing industry, baking industry, wholesalers and retailers of processed food and service providers. Services are provided including storages, rented tractor, rented combine harvester, rented oxen, supervision of production, fumigation (outsourcing) and credit and savings. The value of services provided in the WVC was estimated with the help of labor input method and direct price of rented tractor and combine harvester and oxen per hectare. These services were delivered by private enterprises, government and non-governmental organizations.

Figure 2.Wheat input-output flows in WVC



Source: own survey data (2015/16)
Where, PISC= private input supply company, SE= seed enterprise, AISE=agricultural input supply enterprise

4.2 Institutions in Wheat Value Chain

4.2.1 Seed Enterprises

Kulumsa, Debrezeit and other agricultural research centers generate and supply improved wheat varieties to seed enterprises. The seed enterprises multiplied and distributed the seeds to farmers through cooperative unions and direct seed marketing. For example, Oromia seed enterprise produced 88155 quintals of certified wheat seed in 2015, and distributed 58155 quintals to wheat producers through direct seed marketing and cooperative unions. About 14000 quintals were distributed through direct seed marketing. Leftover stock was distributed to wheat producers through cooperative unions. Oromia seed enterprise sold about 10% of the certified seed to Amahara, SNNP and Tigray regions, and 90% to Oromia region.

The seed enterprises supplied basic seed with free extension services to farmers. The farmers multiplied basic seed and sold 90% of the product to seed enterprises and the remaining 10% is preserved for later use. Seed enterprises supplied certified seed as per the prior demand to their registered distributors. The challenges were lack of basic seed and reliable demand for some seed variety due to mismatching demand report. Farmers claimed low seed quality supply (i.e., poor cleaning, low germination rate and seed impurity) and poor coordination which resulted in mismatch between farmers' inputs demand and supply. Input suppliers imported inputs such as chemicals, equipment, pesticides and herbicides from Germany and China. They supplied inputs to cooperative unions, wholesalers and retailers and even smaller retail shops. Input retailers operating in small shops and spot markets in the villages and towns sold the inputs to farmers. Combinations of different technologies like DAP, Urea, Pallas, Tilt, 2-4-D and Grandstar (Richway-750 WDG) were widely used in the production of wheat in the study area.

4.2.2 The Enabling Environment

Institutions created the enabling environment for economic actors in the value chain, which may have a positive effect on the entire value chain. For instance, industrial policy increased actual working capacity from 5,694 tons to 40,296 tons per year in Arsi zone. However, there was lack of policy environment that could facilitate the implementation of wheat and wheat product quality standard. In addition, there is no quality based pricing system in the wheat grain and processed wheat products' markets in the country (Mohammed 2009). This could be the reason for weak quality-based pricing system.

4.2.3 Service providers

GOs, NGOs and private enterprises support actors to transact wheat and render various services including input supplies (seeds, fertilizers, pesticide and herbicide, tractor and combine harvester), trainings, market information, and financial services. However, all value chain actors did not always get these services consistently and timely.

4.2.4 Cooperative unions

Cooperative unions provided limited amount of money to primary cooperatives in the form of credit. Primary cooperatives purchased wheat with the help of credit money from farmers at spot market and cooperative offices for only two month. This is because they cannot rotate the limited amount of capital. They sell it to cooperative union on average of Birr 35 profit per quintal, and then cooperative unions sell it to potential actors during peak period through auction. Primary cooperatives did not have self-governing authority to rotate money, sell the wheat to any actors and purchase inputs directly from companies. They were required to follow a blue print approach which took away their input and output market decision power. One wheat producer out of 30 has been forced to sell out his/her total marketable surplus of wheat to the primary cooperative because it purchased wheat during trough season for two months. Thus, they were limited to purchase only 25,074 quintals of wheat per annum from farmers at spot markets and cooperative offices in Gimbichu district, 13,792.36 quintals in Hetosa district and 782 quintals in Tiyo district.

Cooperative unions purchased and distributed inputs to primary cooperatives at predetermined price level which led them not to solve excess and/or under input supply. Primary cooperatives supplied insufficient Pallas and Rexdou, and distributed to only few members of the cooperatives which forced other members to purchase inputs from private traders at a relatively higher prices of Birr 200 per liter. On the contrary, private traders sold the inputs at relatively lower prices of Birr 100 per liter when the inputs were available at primary cooperatives which created excess input at stores of primary cooperatives. These procedures appear to be against the principles of cooperatives. In addition to these, long chain, inadequate finance, lack of storage facilities and offices, limited experts in quality and quantity led to poor performance of primary cooperatives.

Corruption or bribe weakened the power of institutions and discouraged regulatory affairs (i.e. experts who were assigned to control quality of inputs) which in turn led to existence of unpermitted chemicals at the input markets. Weak institutions at the input markets have caused low wheat productivity. Opportunistic behavior of traders influenced the wheat yield because they were engaged in the sale of adulterated, expired or low quality inputs to the wheat producers which influenced wheat supply in the aggregate term. About 30% of the farmers used low quality (i.e. low quality, adulterated or expired) pesticides and herbicides because of asymmetric information. Consequently, the affected farmers harvested on average 17 quintals of wheat per ha lower than 70% of farmers who used approved inputs. In general, cooperative as an actor had failed to access markets for output and input (i.e., pesticide and herbicide). The consequences were high transaction risks, costs and existence of expired or adulterated pesticide and herbicide in the input markets.

4.3 Wheat Producers in Wheat Value Chain

4.3.1 Producers' socioeconomic characteristics and marketed surplus of wheat

Under this section, wheat producers' socioeconomic characteristics and their relationship with marketed surplus of wheat are described with the help of mean, percentage and Pearson correlation. Wheat producers were 46, 44 and 44 years old on average in Gimbichu, Hetosa and Tiyo districts, respectively (Table1). Age was positively and significantly correlated with marketed surplus of

wheat at 1% level of significance (r = 0.35, p=0.000) because older one secured more land as compared with younger one. About 86.36% of wheat producers were male and 13.64% were female. There was no significant difference between male and female-headed households at 5% level of significance (r =0.009, p=0.89).

They had 5.1, 5.3 and 5.5 family sizes on average in Gimbichu, Hetosa and Tiyo districts, respectively. Family size made significant variation in amount of marketed surplus of wheat among wheat producers at 1% level of significance (r = 0.28 p=0.000). They supplied on average 4.12, 3.99 and 4.17 family labor forces to wheat production per year in Gimbichu, Hetosa and Tiyo districts, respectively. The conversion coefficients developed by Storck et al. (1991) were employed to convert woman and minor labor into adult-man units. Family labor supplied caused significant variation in amount of wheat supply to market at 1% level of significance (r = 0.33, p=0.000).

Average family education was 3.5, 4.3 and 5.4 grades in Gimbichu, Hetosa and Tiyo districts, respectively. It considered only male and female members of the respondents above 15 years old. Family education was negatively associated with marketed surplus of wheat and appeared insignificant at 5% level of significance (r=-0.06, p=0.315). Average distance from main road and wheat processing factory was 1.95 and 17.52 kilometers, respectively. The correlation coefficient between marketed surplus of wheat and distance from main road was found to be positive and significant at 5% level of significance (r-value= 0.146, p= 0.038). There was no significant correlation between marketed surplus of wheat and distance from wheat processing factory at 5% level of significance (r-value=0.09, p= 0.184). The result in Table1 indicates that wheat producers had kept on average 5.98, 4.74 and 5.66 TLU in Gimbichu, Hetosa and Tiyo districts, respectively. The conversion factor as recommended by Jahnke (1982) was used to convert livestock number into TLU in this study. Livestock number in TLU made significant variation in amount of marketed surplus of wheat among wheat producers at 1% level of significance (r= 0.43, p=0.000). Wheat producers owned 2.07 hectares of land on average.

Table 1: Distribution of wheat producers by socioeconomic profiles and their correlation with marketed surplus of wheat

	Gimbichu		Hetosa		Tiyo		Total		Marketed surplus
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	R-value
Age	46.4	11.9	44.0	13.4	43.9	12.0	43.5	12.4	.35***
Family size	5.10	1.53	5.3	2.16	5.49	1.77	5.32	1.84	.28***
Labor supply	4.12	1.32	4.0	1.49	4.17	1.44	3.10	1.42	.33***
Family education	3.5	1.3	4.3	1.52	5.4	1.27	4.41	1.37	-.068^{ns}
Land size	2.59	1.33	1.98	1.05	2.21	1.23	2.07	1.22	.79***
TLU	5.98	2.60	4.74	3.064	5.66	2.89	5.53	2.93	.43***
Oxen	2.55	1.03	2.14	1.37	2.36	1.08	2.34	1.18	.65***
Distance from road	2.02	1.65	2.93	2.11	2.33	1.95	2.43	1.95	.15**
Distance from factory	38.4	8.01	6.76	10.28	24.93	16.11	23.1	17.5	.09^{ns}
Extension	3.48	2.49	3.67	3.91	3.05	3.30	3.37	3.30	.24***
%	Yes	No	Yes	No	Yes	No	Yes	No	
Sex	84.38	15.63	88.57	11.43	86.05	13.95	86.36	13.64	.009^{ns}
Crop rotation	78.13	21.88	38.57	61.43	54.65	45.35	56.36	43.64	-.039^{ns}
Credit	42.19	57.81	32.86	67.14	36.05	63.95	36.82	63.18	.089^{ns}
Non-farm income	38.37	61.63	47.14	52.86	46.88	53.13	43.64	56.36	-.22***

Source: Based on own survey data (2015/16)

The average land size was found to be the highest in Gimbichu district and the lowest in Hetosa district. Marketed surplus of wheat significantly increased with land size at 1% level of significance (r=0.845, p=0.000). Farmers' participation in extension events were significantly and positively correlated with marketed surplus of wheat at 1% level of significance (r=0.24, p=0.000). They involved in extension events on average of 3.48, 3.67 and 3.05 times in Gimbichu, Hetosa and Tiyo districts, respectively.

About 56.36% of producers adopted crop rotation, but about 43.64% did not practice crop rotation. Crop rotation did not make significant variation in amount of marketed surplus of wheat among wheat producers (r=-0.038, p=0.569). Almost 63.18% of farmers were non-credit users for the following reasons: adequate money, no access to credit and fear of risk.

More than half of the wheat producers did not borrow inputs and money from cooperatives, local government offices and microfinance institutions. This is because fertilizers and other inputs were not delivered to farmers on credit. There was no significant relationship between credit and marketed surplus of wheat at 5% level of significance (r=0.08, p=0.12). About 44% of farmers engaged, but 56% not engaged in non-farm income generating activities. Specifically, 38.37%, 47.14% and 46.88% of them had involved in non-farm income activities to generate additional income to meet their social and economic needs in Gimbichu, Hetosa and Tiyo districts, respectively. It had negative effect on marketed surplus of wheat at 1% level of significance (r=-0.22, p=0.001).

4.3.2 Technology utilization pattern of wheat producers

According to the survey results, average seed used per hectare was the lowest in Gimbichu, and the highest in Hetosa (Table2). The average Rexduo used per household in Hetosa and Tiyo was 0.325 and 0.333 liter, respectively. But, farmers did not use Rexduo in Gimbichu due to absence of Rexduo in the market. The average Topic used per household in Hetosa and Tiyo districts was 0.225 and 0.233 liter, respectively. Average Tilt used per household was 1, 0.4 and 0.56 liter in the study districts as given in Table2.

Table 2. Agricultural technology utilization patterns by wheat producers

	Gimbichu (n=65)		Hetosa (n=71)		Tiyo (n=84)		Total (220)	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Seed (kg)	454	280	536	811	634	781	551	691
Seed per ha	221	64	342	729.7	320	405	298	485
DAP (kg)	296	190	230	179.	290	202	273	193
DAP Per ha	185	57	157	60	167	53	169	58
Urea (kg)	285	193	161	158	201	188	222	188
Urea Per ha	178	55	65	71	66	75	98	85
Pallas (liter)	0.53	0.46	0.48	0.56	.0.47	0.63	0.53	0.52
Rexduo (liter)	0	0	0.63	0.689	0.633	0.22	0.86	0.63
Topic (liter)	0	0	0.48	0.532	0.43	0.40	0.49	0.57
Tilt (liter)	1	1	0.41	0.22	0.56	0.42	0.67	0.34
Grandster (packet)	13.9	7.44	14.5	9.46	21.91	15.8	16.96	12.1
PWVCF in Birr	13385	9302	9231	7042	9958	7401	10724	8049

	Yes	No	Yes	No	Yes	No	Yes	No
Tractor %	0	100	90	10	61.63	38.37	52.73	47.27
Combine harvester%	0	100	100	0	90	10	67.73	32.27
Oxen %	96.88	3.13	85.71	14.29	91.86	8.14	91.36	8.64

Source: Based on own survey data (2015/16)

Average grandster used per household was 13.9, 14.5 and 21.91 packets in Gimbichu, Hetosa and Tiyo, respectively. The average fertilizer used for wheat production was 169 and 98.23 kilograms of DAP and Urea per hectare, respectively. The highest amount of fertilizer was used in Gimbichu district (185.45 kg of DAP and 178.5 kg of Urea per ha) and the lowest in Hetosa district (157.2 kg of DAP and 64.82 kg of Urea per ha). In Tiyo district, average fertilizer used was 166.63 kg of DAP and 65.68 kg of Urea per ha. There was significant variation in Urea utilization between Gimbichu and other districts. Variation in DAP consumption has significant and positive impact on marketed surplus of wheat at 1% level of significance (r=0.84***). The average fertilizer used was found higher in the study area than regional and national average.

About 90% of farmers had used rented tractor for first tillage and 100% had used combine harvester to harvest wheat in Hetosa district. The nearly 61% of farmers had used tractor for first tillage and 90% had used combine harvester to harvest wheat in Tiyo district. Both tractor and combine harvester were not employed in Gimbichu district due to rugged land scape. Farmers had their own oxen, for example, 96.88% were in Gimbichu, 85.71% were in Hetosa and 91.86% were in Tiyo districts.

Farmers' reasons for overutilization of seed as compared with recommended rate were to increase yield, reduce weeds and compensate low seed germination percentage due to heavy vertisols which is the dominant soil type in the area. Farmers' justifications for overutilization of DAP were to maximize yield and underutilization of Urea were to overcome lodging of wheat in Hetosa and Tiyo districts.

4.3.3 Wheat producers' value chain function

Wheat producer value chain function (WPWCF) is associated with its activities, namely land preparation, planting activities, fertilizer application, weeding and harvesting. The result indicated that WPWCF required about Birr 10345 per ha or Birr 2530 per ton to produce on average 4.1 tons of wheat per ha. Also, it partially demands tractors and combine harvester for preparing land and harvesting wheat in Hetosa and Tiyo districts.

Table 3: Distribution of household (HH) by output and marketed surplus and consumption in quintal

Variables	Gimbichu		Hetosa		Tiyo		Total	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Output per HH	71.6	46.2	72.4	61.5	78.4	53.6	74.5	54.1
Yield	38.7	8.8	41.8	12.2	40.3	10.6	40.3	10.8
Marketed surplus per HH	62.4	45.8	57.3	58.5	67.9	52.3	63	52.6
Consumption per HH	9.3	4.1	14.4	17.8	10.4	4.2	11.6	10.8

Source: Based on own survey (2015/16)

The study indicates that 15.55% and 7.11% of wheat output was consumed at home and used for seed, respectively and 77.43% of wheat was sold in the market. About 23% and 28% of wheat marketed surplus were in Arsi and East shewa zones, respectively (CSA 2014). Producers secured higher average yield (i.e., 4 tons of wheat per ha) as compared with national and regional average yield (CSA, 2014). In general, wheat was consumed by the people of the zones or transported to other parts of the country and consumed by others.

4.3.4 Determinants of wheat producers' marketed surplus

Assumptions of the multiple regression analysis were tested to check the healthiness of the model. The assumptions are briefly discussed and tested below.

Test for normal distribution: A normal distribution curve is symmetrical and bell-shaped. A symmetrical curve is one which theoretically has zero coefficient of skewness. A bell-shaped curve is mesokurtic with zero coefficient of kurtosis. For practical purposes, a distribution may be regarded as normal if its coefficient of skewness and kurtosis do not deviate significantly from the theoretical values (zero). If the calculated Z is less than 1.96, it is treated as not significantly different from zero at 5% level of significance. For a normal distribution assumption was tested. As the Z values of skewness and kurtosis for wheat marketed surplus and other variables were less than the critical value, 1.96, the distribution of these variables are deemed as normal.

Test for linearity of regression: Besides normal distribution of data, linearity was tested for multiple regression models. The result indicates that the calculated F values were less than the critical values of F, indicating that linear regression model was the appropriate choice.

Multicollinearity: Multicollinearity leads to spurious relationships, biased estimates and larger standard error of regression coefficient. For these reasons, multicollinearity has been checked during regression analysis with the help of zero-order correlations matrix. There was high multicollinearity between improved seed and land size. The problem is settled by omitting improved seed having high inter-correlations with land size.

Test for endogeneity: High relationship between any explanatory variable and error terms leads to biased and inconsistent estimates. For this reason, endogeneity test was carried out, and the result indicates that there was not endogeneity problem in the model.

Test for heteroscedasticity: Heteroscedasticity problem causes inefficient estimations and turns out important variable to be insignificant which leads to a wrong conclusion on the basis of the usual standard error.

The test detected the existence of heteroscedasticity. So, weighted least squares were applied to convert multiple regression equation with heteroscedasticity into homoscedasticity.

Test for the best fit of the model: R-squared or coefficient of multiple determination, adjusted R-squared, standard errors and F-test were used as criteria to appraise the best fit of the model in OLS regression. The result indicates that the model was the best fit as all these indices surpassed the criteria. Multiple linear regression analysis was conducted through stepwise method. In the first

stage, eighteen variables were entered into the model. Among them, variables, which have probability values that are greater than 0.23, were not chosen in stepwise multiple regression analysis. These variables, which were removed, were sex, family size, age, family education, labor supply, oxen number, cooperative membership, non-farm income, credit utilization and distance from main road. In the next stage, eight independent variables with high predictive values (i.e., p-value ≤ 0.23) were chosen and entered into stepwise regression analysis to generate the predictive model of marketed surplus of wheat.

Table 4. Relationship between marketed surplus of wheat and explanatory variables

Explanatory variables	Coefficient	Std. Err.	t-value	P>|t|
Livestock number (TLU)	0.56^{ns}	0.47	1.18	0.2201
Distance from main road (kilometer)	2.21 ***	0.81	2.72	0.0071
Producers' wheat value chain function (Birr)	0.77 ***	0.187	4.12	5.51e-05
Total land size (hectare)	2.87 ***	0.58	4.91	1.78e-06
Crop rotation (dummy)	-14.11 ***	3.48	-4.05	7.06e-05
Extension participation (frequency)	1.83 ***	0.48	3.77	0.0002
Fertilizer use (kilogram)	0.11 ***	0.016	6.58	3.54e-010
Tractor utilization (nominal)	7.45 **	3.28	2.27	0.0242
Constant	-17.80 ***	4.43	-4.02	8.25e-05
Observation	220			
R-squared	0.82			
Adjusted R-squared	0.81			
F(8,210)	117.55			
P-value	0.000			

Sources: Authors' estimation based on 2015/16 survey data.
*Note: *** and ** are statistically significant at 1% and 5%, respectively, ns=non significant at 5% level.*
This study does not consider output marketing decisions as two step processes as marketed surplus of wheat is continuous variable. The marketed surplus of wheat refers to quantity of wheat sold by wheat producers to wholesalers in quintal. The results are estimated using multiple regression model since it is appropriate to analyze the relationship between continuous dependent variable and independent variables (i.e., mixed continuous and categorical explanatory variables) (Gujarati 1995; Maddala 1989; Wooldridge 2002, and Edriss 2013). Crop rotation refers to growing different crops in succession on the same piece of land to control weeds, pests and diseases and maintain the fertility and the nutrients of the soils. Crop rotation and tractor utilization are treated as dummy variable (1 for user, 0 otherwise). Wheat producer value chain function refers to activities including land preparation, planting, pesticide application, cultivation, fertilizer application, weeding and harvesting to produce wheat. It is measured in costs to convert various measurement units into the same measurement unit. Scores are assigned to producers' participation in extension events in form of frequency.

Assumptions of the multiple regression analysis were tested to check the healthiness of the model. The coefficient of multiple determinations (R^2) of the eight variables was 0.82 which explained about 82% of variations in marketed surplus of wheat in the aggregate term.

The relationship between marketed surplus of wheat and distance from main road were found to be positive and significant at 1% level of significance which was contrary to a prior expectation as farmers had access to all weather roads and could communicate, negotiate price and arrange farm gate transaction with wholesalers on mobile phone. Producers' WVC function had significant and positive effect on marketed surplus of wheat at 1 % level of significance as total wheat output significantly increased with producer wheat value chain function. There was a positive and significant relationship between rented tractor use and marketed surplus of wheat at 5% level of significance. There was a positive and significant relationship between participation in extension and marketed surplus of wheat at 1% level of significance. The possible expectation is that extension service could lead to improve wheat productivity through controlling weed, pest and disease.

There was a negative and significant relationship between crop rotation and marketed surplus of wheat at 1% level of significance. This is because practice of crop rotation down scales share of wheat farm land. It does not mean that crop rotation caused a decline in wheat yield. A strong positive relationship, significant at the 1% level, was found between land size and marketed surplus of wheat because farmers with more land size allocate more land for wheat cultivation as compared to farmers with smaller land size. Theoretical justification for the observed relationship was that resource (large land size), generally, increases output.

Fertilizer used was found to be positively associated with marketed surplus of wheat at 1% level of significance because fertilizer increased the productivity which, in turn, increased marketed surplus of wheat.

4.4 Wheat Processing Industries

Wheat goes through different sectors with significant value addition before it reaches to final consumers. Wheat processing industries converted wheat into wheat flour and barn, flour into biscuits, pasta, macaroni and bread that add value to the product and to satisfy market requirements. Wheat processing industries (WPI) purchased domestically produced wheat at market price from traders and farmers, and imported wheat at subsidized price from government. They sold former one to wholesalers and retailers at market price and distributed later one to bakeries at subsidized fixed price. Specifically, WPI purchased about 80% of wheat from wholesalers, 10% from government quota wheat, and 10% directly from farmers.

The result indicates that industrial policy increased the capacity utilization from 41% to72% for flour, 42% to 80% for macaroni and biscuits. In other words, total capacity utilization grew from 156 tons to 1104 tons per day after industrial policy implementation. This study covered only 10 wheat processing industries in Adama town which used about 65% of their full capacity.

A. Bakeries

Baking industry is processing wheat flour into final wheat products (bread) and delivering it to local institutions, final consumers and retailers. They purchase government quota flour from flour factories at fixed price. Amount of quota wheat flour varies across places and number of industries in particular area because of the size of consumers. On average, 12 bakeries in the study areas baked 5.5 quintals of flour per day in Assela town and 2.4 in two districts.

B. Milling

A number of milling service provider was found in Hetosa and Tiyo districts which milled on average 8 quintals of wheat per day and 15 quintals of wheat per day in Chefedonsa town for urban and rural consumers.

C. Wholesalers

Wheat processing industries distribute wheat products to wholesalers and retailers through their agencies throughout all regions.

4.5 Factors Impeding Key Actor's Wheat Product Supply

Actors in WVC were asked to point out major barriers that act against wheat product supply. They pointed out that working capital; credit accessibility, raw material supply, size and age of technology, networks with actors and market structure were highly interlinked with the volume of output and working capacity utilization. Wheat product supply of flour largely was associated with working capital, wheat supply, size and age of milling machine and market structure.

About 90% of wheat processing industries faced shortage of raw materials as the number one barrier for wheat product supply. A few number of WPI addressed number one challenge by purchasing 90% of wheat directly from farmers through their own agencies and themselves. Thus, they could utilize above 90% of their full capacity, but electricity and water supply acted as barrier not to realize their full capacity.

About 60% of WPI claimed that capital was the second impediment to supply more wheat product to market because it acted as barrier not to create strong linkage with many wholesalers and farmers that ensured reliable wheat supply. About 30% and 40% of respondents replied that size and age of milling machine and access to credit were as the reason for low wheat product supply. Almost 100% of bakeries expressed low consumers' demand as first reason, government intervention (fixed flour quota and fixed bread price) as the second and high utility for homemade bread as the third reason impeded bread supply. Input supply companies justified consumers' seasonal demand; working capital and hard currency as the major reasons for low chemical supply, such as herbicide and pesticide. Cooperatives supplied inadequate and/or excess inputs due to incorrect demand forecast.

5. Concluding Remarks

This study looked at the effect of wheat producer's socio-economic characteristics, wheat value function and technology utilization on wheat marketed surplus, and effect of other factors on WVC actor's wheat products. The result indicates that cooperative as actor failed to supply adequate input, namely pesticide and herbicide which caused input retailers to manifest their opportunistic behavior and exploit asymmetric information on input quality at small shops and spot market, which in turn, declined wheat productivity. Econometric analysis result indicates that wheat producer's marketed surplus significantly increased with land size, fertilizer, extension service, and distance from main road, producer's WVC function, and decreased with crop rotation. Working capital and network with wheat processing industries were found to be constraints for trader's wheat supply for wheat processors. About 90% of wheat processing industries faced shortage of raw materials as the number one barrier for wheat product supply. About 16% of WPI addressed number one challenge by purchasing 90% of wheat directly from farmers through their own agencies and themselves. Almost 100% bakeries justified low consumer's demand as first reason, government intervention (fixed flour quota and fixed bread price) as the second and high utility for homemade bread as the third reason impede bread supply. Concerned bodies should establish strong coordination mechanisms among WVC actors to ensure reliable technology supply with technical trainings, wheat and wheat products supply. They should attempt to improve land productivity, existing ineffective and inconsistent extension services; provide training to wheat

producers on WVC function management, and particularly ensure stainable vertical linkages between wheat producers and WPI.

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Annex

Table A1: Zero-order correlations matrix

	1	2	3	4	5	6	7	8
Livestock number	1							
Distance from main road	-0.07	1						
Producer's wheat value chain function	0.43	0.02	1					
Total land size	0.54	0.03	0.78	1				
Crop rotation	0.21	-0.1	0.14	0.21	1			
Extension participation	0.15	0.034	0.14	0.185	0.12	1		
Fertilizer use	0.41	0.06	0.83	0.79	0.02	0.1	1	
Tractor utilization	0.02	0.15	-0.02	0.02	-0.26	0.09	0.015	1

Multicollinearity test, T-value= 1.95, P-value = 0.053

Performance of State-Owned Enterprises: A Comparative Analysis of Ethiopian Airlines, Ghana Airways and Malév Hungarian Airlines

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Abstract

This paper examines the performance of three state-owned airlines: Ethiopian Airlines, Ghana Airways and Malév Hungarian Airlines, which were formed between the late 1940s and the mid-1950s. While Ethiopian Airlines continues to operate successfully, the other two airlines have gone out of business. In an industry characterized by heavy competition and a high rate of failure, the success of the state- owned Ethiopian Airlines is intriguing. The evidence shows that Ethiopian Airlines outperforms the industry on some important benchmarks. Specifically, it outperforms both African and global industry indicators such as revenue per kilometer growth (RPK), available seat kilometer (ASK) growth, passenger load factor (PLF) and operating profit margin (OPM). These findings suggest that being a state enterprise is not necessarily a characteristic that leads to failure. Corporate culture and governance appear to be important factors in the success of Ethiopian Airlines.

1. Introduction

There is a perception that state-owned enterprises (SOEs) are less efficient than privately owned enterprises (POEs). Yet, state enterprises have proven to propel emerging economies forward, often at a rate faster than they would have otherwise developed.

In the 1950s and 60s, when many African countries became independent, they saw the state as the only entity that could marshal the resources to set up enterprises that could lead to faster growth. In the 1950s and 60s, when many African countries became independent, they saw the state as the only entity that could marshal the resources to set up enterprises that could lead to faster growth; in the former Soviet Union and the Eastern Bloc nations of Europe, a similar philosophy prevailed. In Africa, Ghana set up several state enterprises including Ghana Airways. Ethiopia also set up a state airline, Ethiopian Airlines. Hungary, under Soviet influence, had a similar approach, setting up many enterprises including the Hungarian state airline, Malév. Of the three SOEs, only Ethiopian Airlines survives. In spite of the success of some of the SOEs, the perception that they operate inefficiently persists.

An SOE is an enterprise in which the state or the government owns more than 50% of the shares. According to Buge et al. (2013) more than 10% of the world's largest firms are state owned and have a combined total sales volume of 3.6 trillion dollars, as of 2011. Further, while most of the

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enterprises are from emerging economies – China, UAE, Russia being the top three, the list also includes enterprises from bastions of free market developed economies such as Germany, Norway and Finland.

In theory, there is no reason for an SOE to fail or succeed any more than a POE. They both suffer from the same information asymmetries and bounded rationality. Moreover, according to the Sappington-Stiglitz (1987) Fundamental Privatization Theorem, the performance of POEs is superior to SOEs under very stringent and often unrealistic assumptions. Whether an enterprise should be private or public or a combination is therefore purely a matter of preference. Since it is a matter of preference, and ownership is not a significant factor, then why do so many SOEs, especially in poor countries perform poorly?

The failure of state-owned enterprises is an interesting subject area that has received attention in economics and management literature. Economic theory posits that firms exist to maximize some objective function, and in the case of POEs, usually profits or shareholders' wealth. Depending on the structure of the industry in which they operate, firms may or may not have control over pricing decisions and hence, profit. An SOE may not seek to maximize the same objective function as POEs. The airline industry is often described as oligopolistic—due to its high entry and operating costs—but it is also a good example of a contestable market. There are studies, however, such as Kanoria (2007) that suggest that the minimum efficient scale (MES) of operation of airlines is small: for the US only eight aircrafts. If the MES is small, then the barriers to entry are not high, and the industry barring legal barriers should be competitive. The high fixed and variable costs mean that an airline operator requires a large initial capital outlay and sometimes has to sustain losses for a while before it becomes profitable or breakeven.

In this paper, we first discuss the origins and performance of Ethiopian Airlines, Ghana Airways and Malév. Secondly, we attempt to address the question of whether the continued operation of Ethiopian Airlines is matter of just a surviving SOE or the case of a competitive and efficient airline. To address the latter, we compare the performance of Ethiopian Airlines with some industry standard performance indicators.

The paper is organized as follows: Section II reviews the literature on the failure of enterprises both private and state; Section III presents a detailed discussion on each of the three airlines; Section IV examines the performance of Ethiopian Airlines relative to industry performance indicators; and Section V presents the summary and conclusion.

2. Literature Review

The failure of state enterprises is an interesting subject area in business and economics literature. According to Mellahi and Wilkinson (2010), an organization fails when it is unable to meet expected or actual standards. Economic theory posits that firms exist to maximize some objective function and if they consistently fail to meet the objective they have set as standard, they are forced to liquidate. Economists often use profit or shareholders' wealth as the objective function that is being maximized. State enterprises may not seek to maximize profit or shareholders' wealth, although they can. More often than not, they are set up to correct some market failure.

According to Boko and Qin (2011), state enterprises are established for a variety of reasons: to promote industrialization and speed economic growth, or to prevent foreign domination and exploitation of certain sectors of the economy. In addition, there are certain industries that are considered critical to the economy because of the beneficial externalities they bring, but which, because of the large initial capital outlay required, do not easily lend themselves to local private participation. An SOE may also be set up because of capital market failure; an enterprise that can be successful in the long run may require too long a gestation period for its financing to be appealing to the market. In a review of the literature of enterprise failures, Mellahi & Wilkinson (2010) attribute the causes to both internal and external factors. The internal factors include asymmetric information, lack of a clear business strategy and frequent changes in the management team. One might also add the lack of internal proper controls.

The most important aspect of asymmetric information that can cause a failure is the principal-agent problem. Whether an enterprise is private or state-owned, there is often a separation between ownership and day-to-day control of the enterprise. The owners of the enterprise be it the state or shareholders, the principals, cede day-to-day control to managers, the agents, because they do not have the time or the expertise to manage the business. Where the incentives of the agents are not compatible with those of the principals, the agents may pursue short-term objectives that may in the long run lead to the collapse of the enterprise.

Sometimes businesses fail because of the because of an unclear business strategy or no business strategy at all. Not having a business strategy is equivalent to traveling to a place but not knowing the roads to get there. As a variation of the old saying goes, "if you do not know how you are going then anyhow is just as good." State-owned enterprises that don't have a coherent strategy risk subpar performance.

Proper internal controls ensure that the business meets its goals and objectives; consequently, the lack of proper internal controls leads to the eventual demise of the business. Proper internal controls ensure that all employees are accountable, corporate assets are safeguarded, the company is in compliance with applicable laws and regulations, and deviations from acceptable practices are quickly detected and corrected. In a well-designed environment, all systems in the business will be well-integrated and functioning to achieving common goals. Each unit knows its functions and its limitations and each unit carries out the directives of management efficiently with minimal chances of failure. Weaknesses in internal controls lead to fraud.

The external causes for failure can come in several forms: gradual small changes in the business environment which management may not respond to appropriately or in a timely manner, or a sudden minor unexpected event or series of events which may interact nonlinearly with other events and produce a bigger effect on the enterprise. The external causes may also be in the form of an abrupt change in the business environment. For example, a change in the production process caused by a new technology, a political crisis or economic crisis could all happen suddenly and management may not have the time to react to it. A change in the market structure in which the enterprise operates could reduce profitability and force the failure of an organization. For an enterprise that operates internationally, currency fluctuations could make the enterprise more or less competitive. If it becomes less competitive, this could lead to ultimate failure. Mwawura,

(2007) writing about reforms being made in Kenya to make SOEs more efficient, argues that not hiring chief executives on a competitive basis and giving them more autonomy make SOEs inefficient. He also argues that for the privatized sectors, the absence of a corporate regulatory framework with high standards of corporate governance is responsible for the lack of prudent management. Obara et al. (2014) cites that the lack of fiscal transparency and accountability led to the collapse of SOEs in Nigeria, and that clarity of roles and responsibilities, public availability of information and open preparation and proper implementation of budgets would have minimized the failure of the SOEs.

3. Discussion of the Three Airlines

3.1 Ghana Airways

Ghana Airways started operation on July 4, 1958 with a start-up capital of £400,000, (US$ 1,120,000).[i] The initial agreement was with British Overseas Airways Corporation (BOAC), which had a stake of 40% with the remaining 60% held by the Ghanaian government. The plan was for BOAC to train Ghanaians and offer management assistance to get the nascent airline on its feet. The airline was meant to be a source of pride for the country and to generate profit for the government. At the time, air service in Ghana was provided by foreign carriers and there was no domestic commercial air travel. Initial routes were from Ghana to Europe and then from Europe to other destinations on other airlines. The Airline ceased operation in July 2004. It was later reorganized as Ghana Airways and then as Ghana International Airlines. After five consecutive years of losses, with a debt of US$170 million, comprising loans of US$50 million, overdue suppliers' credits of US$100 million and arears of US$21 million, it ceased operation in 2004.

It is not clear that Ghana Airways was established with the sole purpose of maximizing shareholders' value, notwithstanding the stated objective. It, like many state enterprises in Ghana, operated under multiple objectives, some of which may have been in conflict. There is no doubt that the government saw it as potential revenue contributor, but it was also meant as a showcase for the newly independent county and its ability to manage its own affairs. In addition, it was probably meant to generate employment. A compilation of articles by Prokopenko, and Pavlin (1981) cites the many reasons for failure of state enterprises, but chief among the reasons is what management experts refer to as the paternalistic and the clear absence of incentive compatibility. A paternalistic management style controls subordinates who are expected to be loyal and obedient and toe a line set by management, who in most cases are appointed by the government and thus are also subject to paternalistic control (Soylu 2011).

In such an environment, creativity that entails risk is shunned by employees and management alike. Further, there is often no incentive compatibility between the owner of the enterprise, the government on behalf of the people, and the agent, in this case management, appointed by the government. In theory, the government is a principal, but in reality the government is an agent for the people. The fact that the government, an agent of the people, is acting as a principal and appointing managers who are agents introduces a further layer of insularity, making it difficult for incentives to be made compatible.

The government as agent and principal, can and does make decisions which may not be in the best interest of the people (the principals), by simply appointing managers/agents whose interests align more with the government as agent than the government as principal. The problem is accentuated by the fact that the public cannot exit the relationship easily, and thus inefficiency can persist (Pennington, 2011).

The misalignment of incentives leads to a lack of proper monitoring and accountability and perpetuates inefficiency and/or corruption. In the case of Ghana Airways, the government sought to right things by seeking to exert even more control over operation with frequent changes in the Board of Directors and management. According to Amankwah-Amoah and Debrah (2010), in an interview they conducted with retired personnel of the airline, there were 39 different chief executives during the airline's 40-year history. Such a large turn-over of the CEO position suggests that either the management appointed were incompetent, or that the government intervened too much in the running of the airline. The high turn-over is not without cost. The airline business is complicated and requires a high degree of expertise in transportation economics and management as well as years of experience; this is the very reason the initial set- up required an alliance with an already established airline with years of operational experience, BOAC.

With CEOs being replaced every year, it is difficult to imagine any CEO having the time to craft a viable strategic plan and executing it. There is reason to believe, according to Amankwah-Amoah and Debrah, that some of the executives did not know much about running an airline and were appointed for other reasons, such as having been captains for a long time in the corporation. Instead of the government/principal setting the outcome, it sought to control the process. This amounted to meddling in day-to-day operations, undercutting managerial independence and ultimately creating unwillingness within management to take risks for fear of failing and job loss. Table 1, below, culled from Chivakul and York, summarizes the factors that confirm the non-commercial orientation of the airline.

Table 1 Orientation of Ghana Airways

Managerial Independence				**Relations with Government**		**Financial Conditions**			**Governance Structure**	
Pricing policy		Employment policy		Loan guarantees	Tax & other exempt	Profit	Creditworthiness		Stock listing	Outside audits
Cost recovery	Non-market	Enterprise specific	Civil servants in mgt.				Debt level	Debt cost		
Yes	**No**	**Yes**	**No**	**Yes**	**Yes**	**-**	**-**	**-**	**No**	**Yes**

Source: Chivakul and York, 2006

Managerial independence refers to the ability of the management team qua agents, once appointed, to be free of interference from the owners qua principals, in the day-to-day operation of the business, including what price to charge for the product or service and whom to employ. In theory and practice, this happens only when the incentives of management coincide with those of the principal. It has already been argued that it is difficult to separate the role of the government as principal from its role as an agent. The ability to set price is one of the characteristics of

independence, but according to Chivakul and York (2006), price was set to recover cost and not to maximize profit or shareholders' wealth.

The airline had authority to employ its own personnel who were not civil servants. There is no doubt, however, that with its close links to the government, civil service employees would have been favored by the government. Further, even though price was set to recover cost, many people familiar with the operation of the airline suggest that many employees and their family members flew free or at deeply discounted prices. In the years immediately preceding the collapse of the airline, its revenue was not enough to cover operating cost. This explains why, at the time of cessation of operation, the airline had accumulated a debt of US$750 million.

The relationship between the airline and the government made the airline a non-independent corporate entity. The airline enjoyed a tax-exempt status and its loans were guaranteed by the government. Under these conditions, the airline did not have to demonstrate credit worthiness to obtain credit. Treated as another government entity, it could operate at a deficit and not be worried about creditors shutting it down. When it was finally shut down the government ended up with all its debts. In essence, the airline knew it could not be left in the lurch, and for some forty years it was not. Because the stock of the airline was not listed, no external pressure was brought upon it by the market. Further, even though it was supposed to be audited by the Ghana Audit Service, which audits all state enterprises, a thorough search by one of the authors at the Ghana Audit Service, the State Library and Archives, and the Library at the Parliament could not produce any audited copies of any report. Thus, it appears that the airline was not audited by outside auditors. If there was ever an inside audit, copies have not been made public.

The potential for Ghana Airways to succeed was quite high. For the most part, it operated in a market that was favorable. In addition to being a monopolist in the domestic market, it was one of a handful of airlines that provided regional service in West Africa. In the early days, the domestic routes were from Accra to Kumasi, Takoradi and Tamale, and later to Sunyani. Regional routes included flights from Accra to Abidjan (Ivory Coast), Bamako (Mali), Bathurst (Gambia), Conakry (Guinea), Dakar (Senegal), Freetown (Sierra Leone) and to Monrovia (Liberia), along the Atlantic coastline of West Africa. Another route, inland and up north, originated from Kumasi to Tamale (Ghana) to Ouagadougou (Burkina Faso/Upper Volta) to Mopti, Ségou and then onto Bamako (all in Mali).

From October 1996 until its final demise in 2004, the airline also had a monopoly on flights from West Africa to the east coast of the US. At the time, it was the only airline ferrying passengers between the US (JFK in New York and Baltimore in Maryland) and Kotoka International Airport, in Accra. Travelers to the sub-region of West Africa were all transiting to their respective countries through Accra from the US. Accra had, in essence, become the hub for air passengers traveling to West Africa. Indeed, it was the dream of the airline to turn Accra into a regional hub.[ii] Securing Category One landing status from the US Federal Aviation Administration made Ghana Airways only the second sub-Saharan African airline (the other being South African Airline) to have that prestigious status. It meant that the airline was capable of meeting the rigorous application process and to exercise the difficult oversight it needed over its operation; it demonstrated that the airline could operate efficiently.

In spite of this monopoly and the initial demonstration of competence, the airline was unable to capitalize on it to buttress its advantage. Complaints about its operation continued to mount. For example, a log of complaints to the US Department of Transportation indicates that between January and September of 2004, Ghana Airways received the most complaints of all foreign airlines that flew to the US. Of the 186 flight problems lodged against all international airlines, 75 (or 31%) were against Ghana Airways. Flight problems are defined as "cancellations, delays or any other deviation from schedule, whether planned or unplanned." The airline also registered 4.84% of all problems with refunds defined as "problems in obtaining refunds for unused or lost tickets, fare adjustments, or bankruptcies." The airline also appeared to have had problems with its baggage handling; 4.3% of baggages handling problems were against it.[iii] Table 2 below summarizes the discussion.

Table 2: Complaints

Problems	Total Complaints	%age of Total	Rank
Flight Problems	58	31.18%	1st
Refunds	9	4.84	3rd
Baggage	8	4.3	7th
Total	75		

Source: Adapted from USDOT, Air Travel Consumer Report, 9/2004, Issued 11/2004

Two caveats are in order to put these figures in proper perspective:

i. Ghana Airways ceased operation in July 2004. This means that the number of reported complaints understates what it would have been had it continued operating to the end of the reporting period.
ii. The data includes several large airlines such as British Airways, Air France, KLM, Lufthansa, Alitalia, Emirates and EL AL, several of which have numerous flights a day to different cities in the US, compared to the two or three a week that Ghana Airways flew.

What these suggest is that, adjusted for the period and the numbers of flights, the complaints against the airline were more severe than the raw numbers and percentages presented above. When the airline was finally banned from flying to the US in July 2004, it was against a background of gross mismanagement and inability to remedy safety problems raised by the US DOT.

The potential for running a profitable airline business in West Africa, especially an international airline, is enormous. With a large diasporic population in Europe and North America, there is frequent to and from by this population. For example, in 2010 there were close to 350,000 foreign born Nigerians and Ghanaians in the US.[iv] Most of this population resides in the Northeastern US. With the impressive economic growth numbers posted by countries such as Ghana, Nigeria and Senegal, the volume of traffic between West Africa and the rest of the world has been increasing. With the demise of Ghana Airways, Delta Airlines (and later United Airlines) began to run regular flights between the US and West Africa. Delta currently has over 20 flights to West Africa with an excess of 5,000 seats per week, garnering 30% of the US to West Africa market.[v]

3.2 Malév (Hungarian Airlines)

The Hungarian-Soviet Airlines, Maszovlet, the predecessor of Malév, was founded on March 29, 1946[vi]. In 1954, Hungary bought out the Soviets for 165 million dollars, and on November 26, 1954, the fully Hungarian-owned Malév was born. Although its safety record was unusually bad, the company grew steadily and by the end of the socialist era, it became a medium-sized European airline with significant brand recognition. In 1979, annual passenger traffic reached one million, which almost doubled by the end of the 1980s. In 1983, Malév introduced First Class, the next year it joined the international ticketing agency, IATA. In 1985, the size of Budapest Airport, Malév's hub, doubled. In 1988, Malév started to replace its Soviet-made fleet with Boeing planes; it leased several 737s and bought two Boeing 767s. While the company expanded, its management hardly changed—Malév had only five top managers in its first 35 years.

Under socialism, Malév operated similarly to most typical state-owned enterprises in a Soviet-type planned economy. Profit and efficiency requirements were secondary and were replaced by target measures often defined in kind. A process known as "plan bargaining" helped shape the company's relationship with state agencies. In theory, in a planned economy, central government agencies determine several non-pecuniary targets for individual companies. However, to be able to come up with plausible plan targets, regulatory agencies need information and cooperation from the individual enterprises.

This situation created certain enterprise bargaining strategies that lead to major principal-agent problems with moral hazard. During plan bargaining, in order to obtain necessary assets and receive more funding, the managers of socialist enterprises constantly exaggerated potential gains from certain projects, underestimated costs, and did not report potential technical, environmental and other problems. Their goal was to get permission to begin the desired project. They realized that once a project was started, it became almost impossible to stop, and government agencies would eventually provide additional funds if necessary, just to be able to complete the project.

Managers also knew that since the authorities lacked the necessary information, they would not be able to prove any intentional managerial dishonesty or wrongdoing. One of the byproducts of this bargaining process with asymmetric information was a phenomenon that Hungarian economist Janos Kornai called the "soft budget constraint"[vii] of socialist enterprises— managers were certain that in case of any exigency the government would bail them out. The most important implication of the soft budget constraint was imprudent managerial behavior.

Management systematically neglected efficiency considerations and settled for satisficing business strategies. This is how Malév operated as a socialist enterprise and this is how it continued to operate in the market economy even after communism collapsed and the institutions of the planned economy, including plan bargaining, ceased to exist.

Malév's as a state-owned enterprise in a market economy: after the fall of communism, former countries of the Eastern Bloc chose different methods to privatize state-owned firms. In the early 1990s, as part of the transition from a Soviet-type planned economy to a market economy, Hungary restructured and corporatized most of its large state-owned enterprises and looked for buyers,

frequently abroad. Until its final bankruptcy in 2012, Malév was privatized and re-nationalized a couple of times, but as far as Malév's role and operations were concerned there was a political consensus in Hungary; the governments of the post-communist period, regardless of their political affiliations, wanted Malév to remain the national carrier, but never wanted to run it as a state-owned enterprise. They thought that the state's role should be limited to preparing Malév for privatization, and running the company until the appropriate buyer was found. In many respects, this approach made those relatively long periods between 1991 – 2012, when the Hungarian state owned Malév, temporary and uncertain. Government-appointed managers knew that their tenure at the airline was going to be short, and the new owners would most likely modify their plans.

On the other hand, they also knew that to be able to sell the company, the government had to keep Malév afloat at almost any price, and the state was going to go on covering expenses and subsidizing operations. Therefore, from the early 1990s until its final bankruptcy, Malév continued to have a soft budget constraint and government agencies had to struggle with similar principal-agent problems as during socialism. Political cycles had an additional negative effect on Malév's management and operations. New governments meant new management, scrapping old projects, starting brand new ones and acting on new ideas regarding to whom Malév should be sold. In this period, there were several other new developments that made Malév's situation even more difficult: Europe's airline industry became deregulated; competition got stronger due to the appearance of numerous budget airlines; costs, especially fuel prices, grew fast; and Hungary became a member of the European Union. This made the company subject to European laws and regulations and, most importantly, made the subsidization of unprofitable firms like Malév quite difficult.

Let us examine some facts that illustrate the survival/recreation of the soft budget constraint and the principal-agent problems at the company. In 1991, as a prelude to privatization, Malév was corporatized. In the next year, 35% of Malév's shares were sold to an Italian state consortium, Alitalia-Simest. Although the Italians invested 6.5 billion HUF in Malév, the consortium soon decided to get rid of its Malév shares in order to improve its position in Italian aviation market. The privatization contract made this quite easy since it included a re-purchasing guarantee clause. According to this clause, if Alitalia wanted to sell its Malév shares, Hungary was obligated to buy them back.[viii] Two large Hungarian banks bought Alitalia's shares in 1997, and two years later they sold their stake to the Hungarian government. In 1999, Malév again became fully state-owned.

In 2000, the Hungarian government developed a new privatization strategy for Malév. 10% of Malév's shares were offered for sale, and, according to the plan, the buyer could have acquired additional 35% via raising capital. This privatization attempt was a complete failure due to a lack of interest. Malév produced more and more losses that stemmed from strong competition with low-cost airlines, increasing fuel prices and the negative effects of September 11th on the world aviation markets. It did not help either that in every two - three years Malév hired a new CEO.[ix] These managers were often political appointees, who frequently lacking the necessary expertise. They arrived with brand-new business strategies, and started new projects just a short time before they left the company. A good example of this is that in 2001-3, amid increasing losses, when the airline could not pay the interest on new government loans, Malév completely renewed its fleet.

To cover Malév's losses in 2001, the Hungarian state gave a 9.2 billion HUF capital injection to Malév. In the same year, an additional 20 billion HUF state guaranteed loan was given to the airline through the state-owned Hungarian Development Bank (MFB). Two years later, an additional 3.5 billion HUF subsidy was provided to Malév right before the country joined the European Union.

In 2004, Hungary became a member of the European Union, which impacted Malév on many levels. Malév faced increasing competition in Europe's liberalized aviation market. In addition, the competition policy of the European Union prohibited any subsidy to failing state- owned firms.[x] After 2004, the Hungarian government was desperately trying to find a buyer for Malév, without much luck. Letting Malév go bankrupt was repeatedly discussed but the idea was rejected mostly on political grounds. Since the collapse of communism, left and right governments alternated being in power but none had the will or the political courage to close down the failing national airline. Between 2001-2005 while waiting for an investor-buyer Malév gradually lost several of its most valuable assets[xi]. Finally, at the end of 2006, a buyer appeared on the horizon: The Russian businessman Boris Abramovich. After short negotiations, Malév was sold to Abramovich. However, Airbridge, the Abramovich Company that owned Malév, soon went bankrupt, and Malév's shares were taken over by Airbridge's main creditor; the state owned Russian bank, Vneshekonombank (VEB). In 2009, the Hungarian government faced the same dilemma again: what to do with Malév?

At that time, Hungarian authorities had three options[xii]: 1) buy time, make an agreement with the Russians, somehow keep Malév afloat until a new buyer was found; 2) let Malév go bankrupt; 3) let Malév go bankrupt but simultaneously create a new national carrier that would take over Malév's routes and some of its assets. In 2009, nothing happened; the Hungarian Government chose the first option, most likely because of political considerations. At that time, Hungary had a weak caretaker government that wanted to avoid making important, politically sensitive decisions. However, in February 2010, just two months before the new elections, the Hungarians and the Russians made a deal that resulted in the renationalization of Malév. Airbridge reduced Malév's capital to zero, the Hungarian government converted Malév's 22 billion HUF Debt to Capital, gave additional 3 billion HUF cash, while Airbridge converted 1.5 billion HUF Malév debt into capital. The airline became renationalized: The Hungarian state owned 95% of the shares, with Airbridge (VEB) owning just 5%. An important part of the deal was that Hungary guaranteed all of Malév's outstanding loans to VEB. Malév's most important assets became the collateral for these loans, and Malév was forbidden to sell these assets.

Meanwhile, the European Commission initiated an investigation regarding illegal state aid to Malév. In 2010, Wizzair, a Budapest-based competitor airline, notified the European Commission twice about alleged state aid violations. The European Commission conducted a preliminary investigation and determined that the allegations were well-founded. As the Commission stated in a letter[xiii] to the Hungarian government, during the procedure that led to the renationalization of Malév, the airline received cash, capital injections, tax deferments, and loans that, according to the Commission, constitute state aid. The Commission's letter also stated that a "one time, last time" rescue aid was permissible only if the European Commission was notified in advance and, most importantly, the aid accompanied a restructuring plan. However, as they pointed out, the European Commission was never notified and there did not seem to be a restructuring plan for Malév.

The new Hungarian government that came into power in the middle of 2010 did not have any original idea regarding Malév's fate. They tried to find an investor but nobody was interested. It was well understood that Malév could not attract investors because it had so much unpaid debt to VEB. Also, the size of the airline's fleet was considered to be suboptimal; it needed either a much larger or a much smaller fleet to generate profit. In 2011, Hungary had to spend an additional 28 billion HUFs on Malév just to keep the airline solvent. The European Commission's concerns were never addressed, and their letter remained unanswered. The Hungarian government had neither the money nor the will to restructure the airline. The European Commission completed its investigation in early 2012. On January 9, 2012, the Commission declared that between 2007-10 Malév received 390-million-dollar illegal state aid that the airline had to pay back.

At that point, the airline could have been saved by a controlled bankruptcy. As numerous analysts[xiv] explain, a new airline could have been founded that could have taken over Malév's assets and some of its employees. The Hungarian government did not choose this path. It let the 66-year-old Malév go bankrupt a few days after the European Commission's verdict became public.

Malév as a private enterprise in the market economy[xv]: for a relatively short period, between 2007-10 Malév operated as an entirely private enterprise. The fact that Malév, as a private firm, quickly went bankrupt could indicate the end of the soft budget constraint and the disappearance of old moral hazard issues. However, a closer look at what happened in this period proves otherwise: privately-owned Malév went bankrupt at the same time it had a soft budget constraint and when its relationship with government agencies was still marred by serious principal-agent issues.

In early 2007, the Hungarian authorities' privatization efforts finally bore fruit—Malév was sold to Airbridge consortium. 49% was of the shares of the company were owned by the Russian businessman Boris Abramovich, 51% by two Hungarian citizens. In reality, Abramovich owned the whole firm; the Hungarian owners were needed only because under European Union laws non-EU citizens could not have a majority stake in an EU-based airline. Abramovich's business plan was simple and seemed viable: his Russian airlines (he owned several airlines in Russia, including a major one, KrasAir) would carry Russian passengers from Siberia to Europe through Budapest, bypassing Moscow's expensive, crowded airports.

Since Malév's losses stemmed partly from the low load factor on most of its European routes, a steady stream of Russian passengers on these routes could have significantly improved Malév's finances. While the purchase price was extremely low (200 million HUF), Airbridge was mandated to raise Malév's capital by 20 million euros at the time of the purchase, and later, to provide an additional 30 million euros as capital or credit to Malév, which was guaranteed by the Russian bank VEB. Airbridge met these requirements, and everything worked well until 2008, when, mostly due to the financial crisis, Abramovich's Russian airlines went bankrupt. This eventually led to the insolvency of Airbridge in early 2009.

In 2007, right after the privatization of Malév, the European Commission announced an investigation of the circumstances of Malév's sale. Two issues raised the Commission's suspicion: the two Hungarian owners of Airbridge seemed not be real owners, only Abramovich - proxies. The second issue was how, before the privatization, a newly created state-owned firm took over

some of Malév's outstanding debts. The Commission suspected that this arrangement violated EU rules on the prohibition of state aid. These investigations never produced any conclusions and were superseded by new allegations and investigations regarding state subsidies to Malév. However, the method of the removal of some of Malév's debt from its books before privatization resulted in a situation in which Malév could more or less preserve its soft budget constraint even after privatization.

In 2001, the Hungarian state-owned bank, Magyar Fejlesztesi Bank (MFB), gave Malév a 76-million-euro short-term loan. It soon became clear that Malév could not repay the loan so it was converted into a state guaranteed long-term loan: until 2017 Malév had to pay only the interests, and then it had to pay back the capital in lump sum. To avoid violating EU laws on state subsidies, potential buyers of Malév were notified that they were going to be obligated to pay back that loan. This condition alone made potential buyers disinterested. In the Airbridge privatization, this problem was solved in an unorthodox manner: some of the most valuable assets of Malév (the brand name, a fuel pipeline that connected Budapest Airport to an oil refinery, and a Boeing 767 plane) were given to a newly created, state-owned asset management company (Malév Vagyonkezelo Kft), which also took over the 76-million-euro loan, so this loan was not on Malév's books anymore. The privatization contract specified that Airbridge was obliged to lease these assets for a fee that was equal to the loan's interest. In addition, Airbridge promised to buy the brand name and the pipeline for 76 million Euros by the end of 2017 at the latest.

The Russian bank VEB gave a loan guarantee for ten years in the value of 32 million euros, meaning that if Airbridge did not pay the lease/interest to MFB, VEB would. Then, a few months after the privatization, Abramovich signed a contract with VEB that made Malév's assets the collateral of this loan guarantee. What this arrangement implied was that although, in theory, the guarantee on Malév's VEB loans was Abramovich's private assets, in fact one could reasonably assume that in the case of Abramovich's insolvency the Hungarian government would provide funds to prevent Malév's bankruptcy. Thus, VEB's loan guarantee in conjunction with Malév's assets as the collateral generated a serious moral hazard. Due to this arrangement, it became less risky to finance Malév's losses, making it possible to keep the unprofitable airline in business for a longer time and to delay important decisions about its fate.

When, in 2008, Abramovich's wealth melted away and Airbridge stopped paying the leasing fees, VEB took over Abramovich's 49% stake in Malév. It then became impossible to abrogate the privatization contract with Airbridge and quickly re-nationalize Malév. However, VEB continued to finance Malév's operating losses even after Airbridge became insolvent in early 2009. By 2010 Malév owed VEB about 112 million euros. Why did VEB not start a bankruptcy procedure upon realizing that its loans to Malév were not performing? There were political reasons for that. VEB is a state-owned Russian bank, with prominent public figures, like Vladimir Putin, on its board. A publicized bankruptcy procedure against Malév could have become a political liability because public opinion could have considered it an admittance of reckless investment. In addition, a Malév bankruptcy would have made VEB immediately the owner of Malév, something VEB wanted to avoid.

On the other hand, how could it happen that the Hungarian government did not declare the privatization contract void when Malév and VEB stopped paying Malév's debt and certain taxes? The Hungarian authorities could not have acquired Abramovich's shares because the shares were already transferred to VEB, and, at least legally, they could not subsidize Malév because of EU regulations. The Russians could have subsidized the airline, but could not own the majority stakes. This was an impasse and its resolution needed the involvement of politicians and governments. Until the political resolution of this impasse, it was in everybody's interest to keep Malév afloat, and this is what VEB and several Hungarian government agencies did. The Hungarians' job was especially difficult.

In order to conceal state aid, the Hungarian authorities applied certain tricks. For example, in 2009, the Hungarian State Asset Management Agency announced that it wanted to buy a Malév affiliate (Malév Ground Handling) and transferred a 15.6-million-euro advance to Malév. A few days later, the agency changed its mind and decided not to buy, but never asked for the advance back. Also, APEH, the Hungarian tax agency, granted several tax deferments to Malév. By March 2010, Malév owed 13.7 billion HUF taxes and social security contributions to the Hungarian state. Privately-owned Malév had a soft budget constraint just like Malév, the state-owned enterprise, and between 2007-10, Hungarian authorities had to deal with more principal agent problems and moral hazard issues than earlier, when Malév was a socialist firm.

3.3 Ethiopian Airlines

The growth and transformation of a *"transportation system"*[xvi] is fundamental to the overall economic growth and development of a country. During the last decade or more, Ethiopia has been characterized as being among the fastest growing economies, not only in Africa, but also in the world. The Ethiopian Airlines (Ethiopian, henceforth) has shown resilience under three different types of political regimes for the 70 years it has existed.

The Emperor Haile Selassie Period (1946-1973) **—** Emperor Haile Selassie, following the end of WWII, pleaded to the governments of America, England and France to assist him starting an airline company, and founded Ethiopian in 1946. Ethiopian began its operation as a joint venture with an American airline, the Trans World Airlines (TWA). Five US Government surplus C-47 aircraft were purchased for venture.[xvii] Ethiopian began its first fight in a Douglas C-47 Skytrain from Addis Ababa to Cairo, Egypt with a stopover in Asmara, Eritrea in 1946.[xviii]

The Marxist-Leninist Period (1974-1991) — The Military junta leader, Mengistu Hailemariam, introduced a Marxist-Leninist political ideology, ruling the country for seventeen years. Ethiopian was able to survive even during this intrusive period, however things improved when Mengistu invited back from New York Capt. Mohammed Ahmed to run Ethiopian without government interference from 1980-1991.

The EPRDF Period (1992-Present) — The Ethiopian People's Revolutionary Democratic Front came to power in Ethiopia after the previous regime was forced to exit (May 1991) without bloodshed in Addis Ababa. Although political stability was not certain initially, as time passed, the

EPRDF was able to consolidate power. The EPRDF regime has been in power now for over 22 years, during which (see the various Figures), as an SOE, Ethiopian has expanded considerably.

After 70 years in the business of air transportation, Ethiopian has been transformed; its fleet now owns several state-of-the-art Boeing 787-Dreamliners.[xix] It has received recognition for many types of merits, with several awards granted in 2011 alone.[xx] Undeniably, Ethiopian is characterized as the fastest growing company in Africa and is ranked first among African airlines.[xxi] Today, Ethiopian's markets have expanded significantly, covering every continent. Ethiopian was named as Africa's Best Airline for Staff Service at the 2013 World Airline Awards,[xxii] followed by South African Airways, Air Seychelles, Air Mauritius and Kenya Airways.

In 1985, Ethiopian was characterized as "Ethiopia's Capitalist Airline".[xxiii] After three regimes with differing governments, Ethiopian remained as state-owned enterprise, but its management continued to flourish under the patronages of corporate organizational culture. The seeds of this corporate culture were planted during Ethiopian's commencement under TWA's sponsorship in 1946. The corporate culture inherited from TWA was kept unbroken in Ethiopian's operation. The decision to keep the connectivity with TWA's corporate culture has insured profitability and ever-expanding international service by Ethiopian**.**

The literature underscores that **"**Ethiopian has skillfully maintained its corporate culture in order to provide excellent air transportation services sustainably.**"**[xxiv] For example, during the award, Mr. Tewolde Gebremariam, the CEO of Ethiopian, stated in his acceptance speech as follows:

> "…. As a customer service organization, we clearly understand the value of high quality service delivery and accordingly we have been investing heavily in training and development of our staff on one hand and state of the art information and communication technology and fleet on the other hand…."[xxv]

3.3.1 The Factors Influencing Ethiopian's Success

There are political, economic, social, technological, environmental and legal factors influencing the success or failure of Ethiopian as a national flagship of air "transportation system." Ethiopian has sustainably shown a successful and profitable business venture throughout its existence, more so during the last two decades. Observers and air transportation experts have provided evidence to this effect. According to Henok Teferra Shawl, Vice President for Strategy and Alliances at Ethiopian, pointed out that the success of Ethiopian is centers on its 'strategic capture' of the African market by establishing a multi-hub system of major connectivity within the continent and expanding its strategic market penetration through global markets.[xxvi]

By all accounts, Ethiopian has shown sustainable growth and has expanded profitably in Africa. Ethiopia's geographical location has given Ethiopian the best comparative advantage to serve the African air-travelling population and other travelers from the Middle East and the Far East. Thus, Ethiopian is benefiting greatly from continental and international traveling population. In "Ethiopian Airlines: A glass half full" (June 2013), the CEO of Ethiopian, Tewolde Gebremariam,

has enumerated four major factors that have given Ethiopian its success: *(1) its fleet, (2) infrastructure, (3) human resources, and (4) IT systems*.

These four pillars are a system of integrated factors acting as the engines of Ethiopian's success. As a result of Ethiopia's rapid economic growth and development, including growth within the country's civil aviation activities (increases in flight, passenger and cargo traffic growth in pattern and volume; increases in manufacturing, and maintenance-repair-overhaul activities; increases in new airports and business developments, etc.), the transportation sector needs qualified personnel. Therefore, the number of institutions in higher education (university level) within the framework of the civil aviation sector has increased significantly.

According to IATA, Ethiopian is ranked high as a leading airline in 'revenue and profit' making. In 2014, IATA ranked Ethiopian as the largest airline in Africa in revenue and profit.[xxvii] To ensure that it remains globally competitive and profitable, Ethiopian has devised a 15-year strategic plan—**Vision 2025**—a multifactor competitive policy *[Ethiopian International Passenger Service; Ethiopian Regional Service; Ethiopian Cargo; Ethiopian MRO; Ethiopian Aviation Academy; Ethiopian In-flight Catering Service and Ethiopian Ground Service]*.[xxviii] Accordingly, Ethiopian has confidently surpassed both Egypt Air and South African Airlines.[xxix]

3.3.2 Ethiopian's Business Model: The full-service network carriers

Currently, there are seven airlines in Africa—South African Airways, Egyptair, Kenya Airways, Ethiopian, Royal Air Maroc and Air Algérie—that one can characterize as "full-service network carriers." What are the advantages and disadvantages of this model for Ethiopian?

Management Strategy: State ownership: from what we have been able to determine from the data and from interviewing the most senior strategist at Ethiopian, Mr. Henok Teferra Shawl, VP Corporate Strategy, Communications and Alliances, Ethiopian is 100% government-owned, while its operation is strictly based on private business discipline.[xxx]

Management stability matters in the functioning of a global organization like Ethiopian. A closer examination of Ethiopian's Annual Report reveals that over 75% of the board of directors has remained in their post for over a decade. The longer these board members stay together will ensure the trust between them, thus generating a much-needed *social capital*. The 2014/15 Annual Report underscores that Ethiopian "Act in an open fashion and be result-oriented, creative and innovative"[xxxi] The growth of an organization like Ethiopian is an inevitable transformational process.

In the last two years, Tewolde Gebremariam, CEO of Ethiopian, was interviewed by many business organizations, such as CNN and The International Air Transport Association (IATA), and had projected the following:

> "By 2025, that should mean that Ethiopian is a $10 billion airline. And it will also be an aviation group with several business units and four hubs in Africa—in the east, west, central, and south. Africa is a big place and you can't serve it through one hub. We will be operating some 120 aircraft flying to 90 international destinations and carrying around

18 million passengers per annum. We will carry 820,000 tonnes of cargo and the number of employees will grow from 7,000 today to 17,000."[xxxii]

Ethiopian's Capacity Building: Ethiopian is a transformational organization with a well-defined capacity building process,[xxxiii] which includes:

1. Ethiopian is self-sufficient in all aviation training systems, and has been since the 1960s. Other African countries' aviation trainees were receiving their training at Ethiopian.

2. The training academy provides training services and management assistance to many other countries. It also provides recurrent training to technicians, pilots, marketing & sales staff and cabin crew.

Thus, a well-designed and functioning organizational structure and/or culture contribute positively to the attainment of *"capacity building"* is a long-term process. Ethiopian is "currently in the second year of a huge three years, $60 million dollars' capacity building project." There are no obvious signs that indicate otherwise. For example,

"Ethiopian as a national carrier currently enjoys state of the art maintenance facilities that maintain not just its own aircraft, but also over 75 African and Middle Easter airlines. It maintains Boeing 767, 757, 727, and 737 and Fokker 50 model airplanes and their components."[xxxiv]

Ethiopian's organizational transformation of the entire air transportation system is commensurate with standards laid out and approved by "the Federal Aviation Administration (FAA) and a number other international regulatory bodies…"[xxxv] In March 2015, Ethiopian hosted "the 18th African Aviation Maintenance, Repair and Overhaul (MRO) conference in Addis Ababa's Hilton Hotel, attracting participants from every part of the world."[xxxvi]

The Ethiopian Aviation Academy: the Ethiopian Aviation Academy (EAA) is evidence of how far the company has come during the last 50 years, compared to its institutional maturity/capacity of the 1960s and 1970s, during which Ethiopian was still flying DC-6s and Boeing 707s and 720s. The EAA is one of trademarks of Ethiopian's sustained transformation. According to Gebremariam, the EAA is the largest aviation training school on the continent.[xxxvii] Mr. Gebremariam further asserted that "the EAA is going to play a leading role in making sure that Africans are well educated and prepared for 21st Century African aviation."[xxxviii] The following are the EAA's two objectives:"[xxxix]

1) Make sure Ethiopian is not challenged by the shortage of skilled manpower.

2) Train African youth to enable them to acquire the tools so they can get high quality jobs. This could be at Ethiopian or (over) the entire continent of Africa.

By 2025, the EAA hopes to train 4,000 students a year with five training schools,[xl] including, but not limited to: 1) the pilot training school, 2) aviation maintenance training school, 3) commercial school, 4) ground service school and 5) leadership school. According to the International Air

Transport Association (IATA), the EAA has recently been transformed into a profit center of Ethiopian. It is certified by the Ethiopian Civil Aviation Authority, the U.S Federal Aviation Administration, the European Aviation Safety Agency (EASA), and IOSA (IATA Safety Audit).[xli] Mr. Gebremariam points out that the EAA will become a launching pad for African aviation trainees at all levels. Currently, all African airlines combined control only 20% of African air transportation, compared to 80% controlled by non-Africans. According to Mr. Gebremariam, Ethiopian should go forward with the current vision and mission of 2025 to control both their continental and international traffic.[xlii]

Ethiopian's Networking and Code Sharing: Ethiopian has code share agreements with 26 airlines companies and is increasing the number of hubs within Africa. The main hub being Addis Ababa, with a second hub **ASKY** is a multinational private airline based in Lomé, Togo. On July 11, 2013, a third hub emerged with Malawi Airlines. Ethiopian has now 42 destinations in Africa.[xliii]

The core strategy for Ethiopian as a "full-service network carrier" focuses on the strategically expected benefits—*networking and code sharing*—influenced by regional and international factors. Ethiopian is expanding beyond the Addis Ababa hub, opening additional hubs and spokes[xliv] in Africa as well as other non-African countries, serving approximately 83 international and 20 domestic destinations across Africa, Asia, Europe, the Middle East, and North America. It is also operating an extensive domestic and international cargo network. Ethiopian became a member of Star Alliance in December 2011.[xlv] The expansion of hubs and spokes provides several network advantages both in the short run and long run.[xlvi] Ethiopian operates the youngest fleet in Africa with an operating fleet of 76 aircraft.[xlvii] Ethiopian has a commanding lead in terms of Africa-East Asia capacity with 18, 494 (non-stop seats) by carrier (6-Oct-2014 to 12-Oct-2014, CAPA – Centre for Aviation & OAG.)

4. ETHIOPIAN PERFORMANCE MEASURES

4.1 Trend and Comparative Analysis of Ethiopian Airline Performance

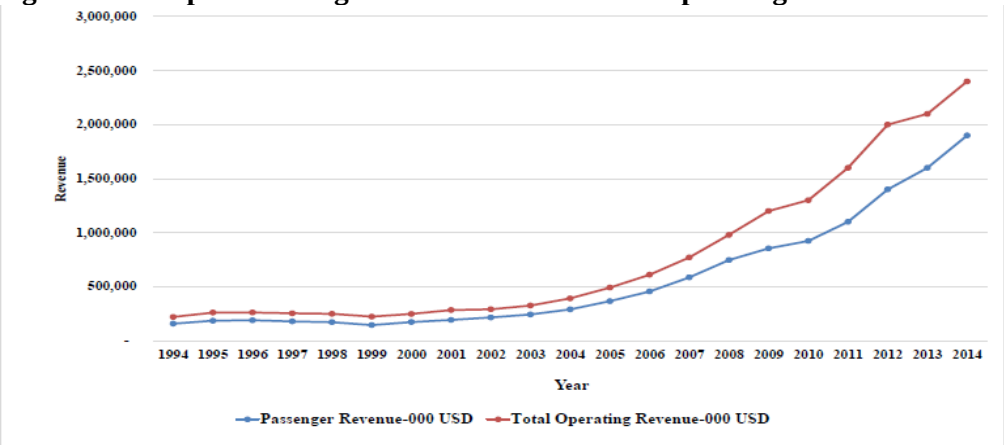
In the previous sections of this paper, we discuss three airlines—namely Malev, Ghana Airways and Ethiopian Airlines—with the objective of highlighting the fact that the former two airlines failed and the later survived. In this section, we attempt to present a descriptive analysis of Ethiopian Airline's performance using both trend and comparative analysis. The goal is to determine whether Ethiopian is just another surviving national airline or one that meets or even exceeds industry performance expectations.

4.1.1 Trend Analysis

Trend analysis has long been employed to gain insights into the performance of corporate entities over time, usually with the goal of discerning temporal changes that require management attention. In the context of Ethiopian, Figure 1 below presents the temporal performance for two indicators, namely passenger revenue and operating revenue. While both indicators increase from 1994 to 2014, the total revenue indicator has consistently outperformed the passenger revenue, suggesting that Ethiopian has since-1994 diversified its revenue generation stream into other services beyond

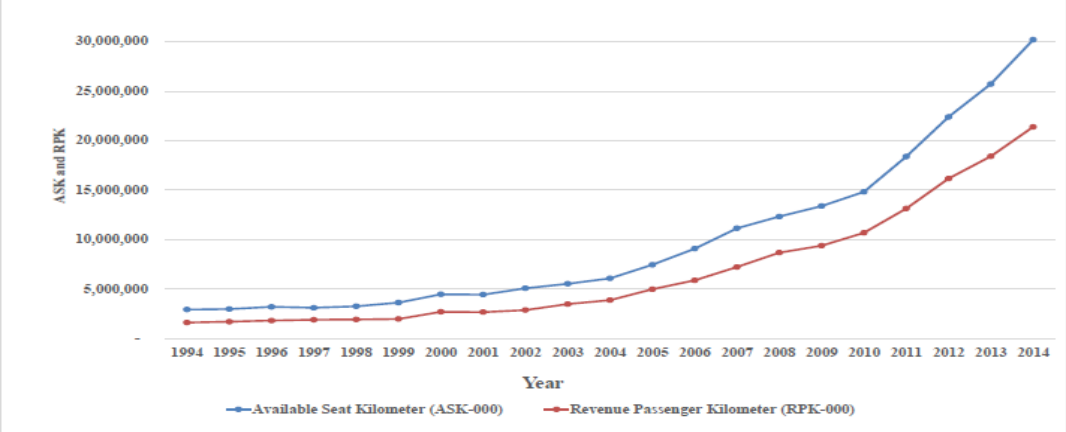
passenger haulage. It is even more interesting to note that the divergence between passenger revenue and total operating revenue spiked after 2005, indicating the generation of more revenue from non-passenger related services and diversification of its revenue sources.

Figure 1: Ethiopian Passenger Revenue versus Total Operating Revenue



In Figure 2, Ethiopian's Available Seat Kilometer (ASK) is compared to its Revenue Passenger Kilometer (RPK). *Available Seat Kilometers* (ASK) captures the total *flight* passenger carrying capacity of an *airline* in *kilometers*. It is obtained by multiplying the total number of *seats available* for scheduled passengers and the total number of *kilometers* those *seats* were flown. Revenue passenger kilometers (RPK), on the other hand are a measure of the volume of passengers carried by an airline. Both indicators have increased since 1994 with an apparent increase in growth since the early 2000s. It is evident that the airline has, since that period, increased its excess capacity, which we take to be the difference between its carrying capacity and the volume of passengers actually carried. These trends are consistent with the growth of Ethiopian in the last decade as globally recognized airline.

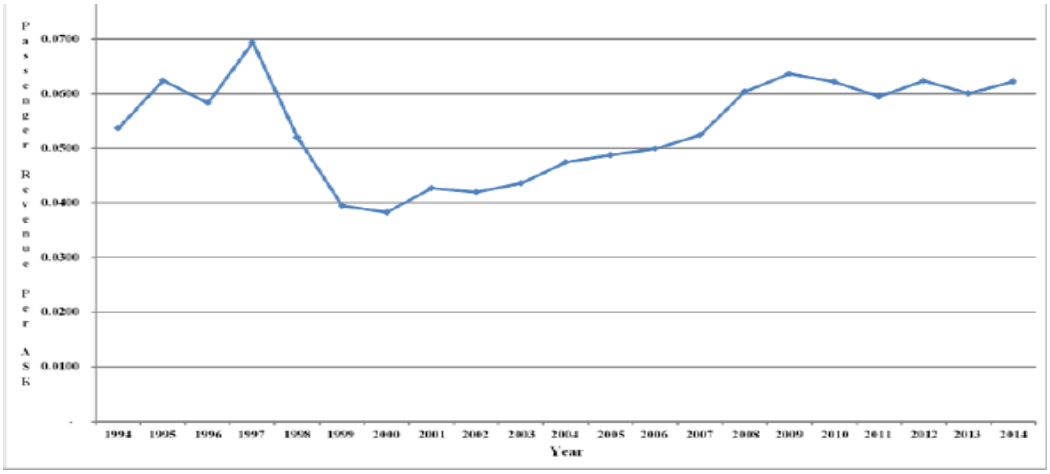
Figure 2: Available seat kilometer (ASK-000) Revenue Passenger Kilometer (RPK-000), 1994-2014



In Figure 3 below, the Passenger Revenue per ASK is shown. This indicator captures the total passenger revenues earned per available seat kilometer of the airline. "It is obtained by dividing passenger revenues by total available seat kilometers."

After a sharp drop between 1997 and 2000, we see an upward trend for the past decade and half (between 2000 and 2014). In that case, Ethiopian Airlines appears to be increasing its passenger carrying capacity while maintaining or increasing its revenue generated per passenger. It is therefore not surprising that our comparative analysis below shows that Ethiopian Airlines outperform both African and Global industry operating profit margins.

Figure 3: passanger revenue per ASK



4.1.2 Comparative Analysis

While the trend analysis above points to several indicators reflecting positively on Ethiopian Airlines, there remains the question of how Ethiopian performs relative to its peers in the Airline industry. In Table 1 below, performance indicators of Ethiopian such as Revenue per Kilometer (RPK), Passenger Load Factor (PLF), Available seat Kilometer (ASK) and Operating Profit Margin are contrasted with industry indicators at the African and Global level. It is evident that Ethiopian outperforms all four indicators at the industry level, except the Global Industry indicator for PLF. The OPM of Ethiopian is nearly double that of the Global Industry indicator and about eight times that of the African industry margin. Similarly, Ethiopian RPK and ASK performance easily more than doubles the African and Global industry averages. For example, the "Available seat Kilometer (ASK) grew by 17.2%, and traffic measured in revenue passenger kilometers (RPK) increased by 16%."

Table 1 Ethiopian Growth vs. Africa & Global Average

	RPK Growth	ASK Growth	Passenger Load Factor (PLF)	Operating Profit Margin
Africa Industry*	5.8%	6.5%	68.7%	0.8%
Global Industry*	5.8%	5.7%	79.6%	4.3%
Ethiopian**	16%	17.2%	70.8%	7.9%

Source: Adapted from: Annual Report 2013/2014
Note: *IATA-Jul 2013 –Jun. 2014; ** ET July 2013 – Jun 2014

The descriptive information on Ethiopian Airlines suggest that it did not just survive while Ghana Airways and Malev collapsed but has since demonstrated, through performance indicators, that it is a well-managed airline in terms of expansion and growing revenue generation over the last decade. The existing evidence, as shown above, also suggests Ethiopian is not only a government-owned Airline that has survived while others collapsed, but actually an airline that is competitive and better managed in terms of African and Global Industry standards. In general, these insights regarding the performance of Ethiopian point to the fact that state enterprises are not by default inefficient or less competitive.

Ethiopian is a classic case of a state enterprise that has not succumbed to the well-established notion that state enterprises are by nature destined be inefficient. While the successful performance of Ethiopian Airlines over the years has been established on a temporal as well as a comparative basis, the question still remains as to which factors are responsible for its performance. Because of the lack of adequate data to do causality tests, we do not address that question and leave it to future studies.

5. Summary and Conclusion

This paper has investigated the factors affecting the success and failure of state-owned airlines. Of the three airlines considered, Ethiopian was successful, while Ghana Airways and Malév failed. While the sample size is too small to arrive at definitive conclusions, we can speculate a few factors that contributed to success and failure. First, Ethiopian airlines had a long relationship with TWA which may have helped create a corporate culture that lead to its success. Second, governance seems to be a significant factor in the success of state-owned airlines. One limitation of this paper is the lack of data for the failed airlines. Since history tends to be written by the winners, it is not surprising that we found much more information for Ethiopian than we did the other airlines.

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