

**ASSESSING TRADE LIBERALISATION ON FOOD SECURITY IN  
SUB-SAHARAN AFRICA (SSA)**

**BY**

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LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT  
FOR THE AWARD OF MPhil ECONOMICS DEGREE.**

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## DECLARATION

I, BAYE SILVANUS RICHMOND, hereby declare that this thesis is the original research undertaken by me under the guidance of my supervisors towards the award of an MPhil Degree in Economics at the Department of Economics, University of Ghana. I hereby declare that except references cited in the work, this thesis is a product of my effort.

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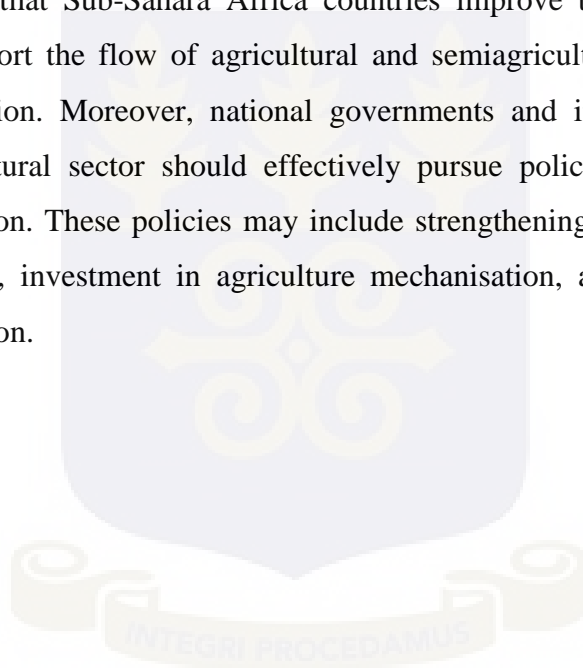
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## ABSTRACT

The primary goal of governments, development partners and Non-Governmental Organisations to end hunger and ensure food security for all by 2030 under the United Nations declaration remains a key policy drive especially for developing countries. This study as a result, examines the effect of trade liberalisation on food security in Sub-Saharan Africa from 1970 to 2014. The study adopts the System General Method of Moments (GMM) econometric technique in investigating the effect of trade liberalisation on food security. Finding consequently points to the relevance of trade liberalisation to food security in Africa, specifically, trade liberalisation is found to significantly contribute to food security in Sub-Saharan Africa. In addition, cereal production within Sub-Saharan Africa countries has a positive effect on food security. The study, therefore recommends that Sub-Saharan Africa countries improve their international trade policy regimes to support the flow of agricultural and semi-agricultural products to aid in domestic food production. Moreover, national governments and international aid related funding in the agricultural sector should effectively pursue policies that would support domestic food production. These policies may include strengthening competitiveness in the agriculture value chain, investment in agriculture mechanisation, and support dry season farming through irrigation.



*Keywords:* Trade liberalisation, food security, food self-reliance, and System GMM.

## DEDICATION

This thesis is dedicated to all my loved ones and especially Mr Paul Favour Baye and Mrs Freida Elavanyo Kwadzie Baye for their support in helping me pursue this degree..



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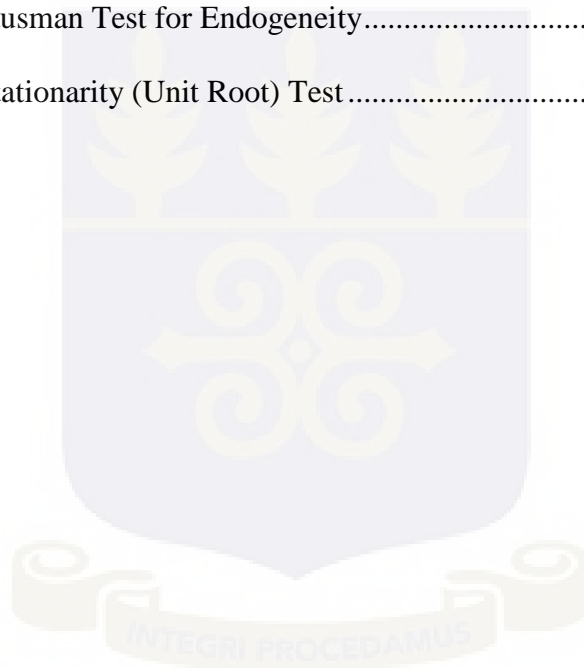
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## LIST OF ABBREVIATIONS

2SLS	2 Stage Least Squares
AR	Arellano and Bond
ASEAN-AFTA	Association of South East Asian Nations' Free Trade Agreement
ATPSM	Agriculture Trade Policy Simulation Model
CGE	Computational General Equilibrium
DES	Dietary Energy Supply
DWH	Durbin-Wu-Hausman
EU	European Union
FAO	Food and Agriculture Organization
FE	Fixed Effects
GATT	General Agreement on Tariff and Trade
GDP	Gross Domestic Product
GMM	General Methods of Moment
H-O	Hecksher-Ohlin
IMF	International Monetary Fund
MDG	Millennium Development Goals
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
PAI	Population Action International
PEM	Partial Equilibrium Model
RE	Random Effects
SAC	South Asian Countries
SAP	Structural Adjustment Programme
SDG	Sustainable Development Goals

SSA	Sub- Saharan Africa
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environmental Programme
UNSTATS	United Nations Statistics
US	United States
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VIF	Variance Inflation Factor
WDI	World Development Indicators



## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background of the study

In 2015, the Food and Agricultural Organization (FAO) estimated that nearly 795 million people do not have access to sufficient food in the world (FAO, 2015). This estimate has decreased compared to the 925 million food-insecure people in the year 2010.

Despite marked global success in reducing poverty and food insecurity, Sub-Saharan Africa<sup>1</sup> (SSA) countries remain relatively food insecure. Globally, one out of nine people were estimated to be hungry in 2015. Given this estimate, Sub-Saharan Africa's case is worse; one out of four people is estimated to be hungry (FAO, 2015).

Estimate show that global incidence of undernourishment fell from 18.6 percent in 1990-1992 to 10.9 percent in 2014-2016. Over the same period, although relatively still high, SSA saw a decline in the incidence of undernourishment from 33.2 percent in 1990– 92 to 23.2 percent in 2014–16. The reduction in the number of undernourished, perhaps, might be due to the effort made by most countries to achieve the first goal of the Millennium Development Goal (MDG). That is, at the end of the target year 2015, the proportion of the poor in the world should have been reduced by half. However, most developing countries could not achieve the set target at the end of 2015. Some SSA countries fall into this category as is reinforced by FAO in 2012 as the only continent experiencing the highest number of food emergencies. As a result of the distressing nature of food insecurity and hunger in the world, there has been a further call by the United Nations (UN) to end hunger, achieve food security and improved nutrition, and

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<sup>1</sup> Sub-Saharan African countries are countries that lie south of the Sahara

promote sustainable agriculture <sup>2</sup> through increases in agricultural production and productivity by 2030 (Sustainable Development Goals [SDG], 2015).

Following Amartya Sen's 1981 polemic, 'On the Causes of Famine', the entitlement approach to food security was introduced - that is, the means and the ability to access food. One could argue that Sen's work, with its emphasis on accessibility, prompted the need for an all-embracing food security definition by the Food and Agriculture Organisation. The organisation defined food security as "a situation that exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2003, p. 28). The above universally accepted definition of food security rests on the dimensions of food availability, access to food, food utilisation and lastly stability in the supply of food.

Before the above definition, food security had long been conceptualised as meeting food demand with food supply. The result being that policy was limited to, increasing agricultural production or slackening population growth (Von Braun et al., 2008).

Food accessibility includes local production, national food stocks, import capacity, and food aid, whereas stability in food supply looks at permanency in food supply (FAO, 2003). From this, it can be deduced that discussions on food availability is hinged upon two important considerations namely, food self-sufficiency and food self-reliance. Food self-sufficiency refers to a country's dependency on domestic food production to satisfy the domestic demand. According to Cleaver et al. (1995) in the 1960s, food production in SSA grew by 2.1 percent per annum, but by the early 1970s to the 1980s, food production had declined to 1.1 percent

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<sup>2</sup> Sustainable Development Goal (SDG 2). Retrieved from <https://sustainabledevelopment.un.org/>

per annum. The drop in local food production over the period, however, confirms some level of growth achieved under this policy in the 1960s. For example, Ghana between 1969 and 1972, under Busia's government, released vast acres of land in the Volta region for rice farms and production to curtail the overdependence on imported rice.

Conversely, food-self-reliance policies have been characterised by the purchase of food in the international market to act as a buffer for domestic supply (FAO, 2003). One problem with this approach, however, is that consumer choice is broad and diverse but domestically produced goods become relatively expensive, impacting on local farmers' livelihoods and leaving a country increasingly dependent on food imports. Most countries that have adopted this policy of food self-reliance have also supported market liberalisation and export-oriented agriculture. For instance, East Asian economies in the 1980s that practised outward-oriented policies saw massive growth gains in their economies (Herdt, 1998).

Under the guidance of the International Monetary Fund (IMF) and the World Bank. Most SSA countries in the wake of the 1970-1980 debt crisis adopted the Structural Adjustment Programmes (SAPs) in the 1980s, which included trade liberalisation reforms (Williamson, 1990). The aim of the adjustment reforms was to promote economic growth and ensure food security, reduce inflation, achieve equitable income distribution and improve the terms of trade (Williamson, 1990). However, over the last three decades, food production in SSA has seen a decline coupled with an increased deficit in net trade in food crops and agricultural commodities.

## 1.2 Problem Statement

Sub-Saharan African countries have experienced food insecurity from the 1980s to date. According to a report by Harvest-help<sup>3</sup> in 2013, SSA countries have experienced some episodes of food insecurity over the period. Some of these events include the 1983-1985 famine in Ethiopia; the 2005 Malawian food crisis where an estimated five million people were affected; the 2005-2006 Niger food crisis, which also saw approximately three million households affected and, the 2006 Horn of Africa food crisis in Ethiopia, Kenya, Somalia, and Djibouti. Furthermore, an Oxfam<sup>4</sup> report in 2012 mentioned the 2010 Sahel drought that affected circa 10 million people from Mali, Niger, Senegal, Burkina Faso, Chad and Mauritania. The Economist<sup>5</sup> in 2011 also makes reference to the 2011 Horn of Africa famine, by which about 10 million people in Ethiopia, Somalia, Kenya, Eritrea, Tanzania and Djibouti were affected.

According to FAO statistics (2013), 78 percent of arable land in SSA has remained unused, 65 percent of the population is engaged in agriculture, and an estimated two percent of the population are undernourished coupled with the lowest crop productivity in the world. Although Africa is estimated to commanding about 60 percent of the world's uncultivated arable lands its share of contribution to world food is estimated at 10 percent (FAO, 2015). The degree of low productivity situation is made worse with a smaller number of its labour force engaged in commercial agriculture coupled with a projected exponential growth in the population (Ribaud et al., 2011). This has prompted questions about why episodes of hunger and famine in SSA have persisted from the 1980s to 2000s. Questions also remain about the role of trade liberalisation on food security in this regard.

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<sup>3</sup> Harvest help is an online website that reports issues of food emergencies, food crisis and international response to food insecurity. Sourced from [harvesthelp.org.uk](http://harvesthelp.org.uk)

<sup>4</sup> Oxfam is an international confederation of 17 organizations working in approximately 94 countries worldwide to find solutions to poverty and what it considers injustice around the world. Sourced from [www.oxfam.org.uk](http://www.oxfam.org.uk)

<sup>5</sup> The Economist offers authoritative insight and opinion on international news, politics, business, finance, science, technology and the connections between them. Sourced from [www.economist.com](http://www.economist.com)

According to Trueblood and Shapouri (2001), achieving food security and increasing trade gains has been one of the major policy concerns in SSA. Generally speaking, international agricultural trade has the potential to affect food security in most countries. However, not much can be said of most SSA countries. Although most SSA countries have liberalised their economies to agricultural trade, episodes of food insecurity have and still prevail in the region (Shapouri & Trueblood, 2001).

To suffice, though trade theory literature suggests a positive relationship between trade liberalisation and economic growth translating into food security, the lasting impact remains uncertain. Empirical studies produced by (Khor, 2008; Prachason, 2009; Vivas, 2009), argue that the potential gains from trade liberalisation cannot be guaranteed, and its ability to improve the food security of all groups within a society remains questionable. These divergent conclusions prompt the need for further questing the effects of liberalising trade and its subsequent effects on cereal availability (food security) in SSA.

### **1.3 Research Questions**

This study proposes the following research questions to assess the effects of trade liberalisation on cereal availability in selected countries in SSA. In this study, cereal availability is used as a proxy for food security. This is because cereals contributes to about 60 percent of dietary intake in the region.

- What is the trend of food security in SSA?
- Has there been a positive net effect of trade liberalisation on food security in SSA?
- What other factors contribute to food security in SSA?

#### **1.4 Research Objectives**

The main aim of the study is to examine trade liberalisation and its effect on food security in Sub-Saharan Africa for the period 1970 to 2014. Specifically, the study seeks to:

- Explore the trends in food security in SSA
- Examine the effects of trade liberalisation on food security in SSA.
- Examine other factors that affect the level of food security in SSA.

#### **1.5 Justification for the study**

The quest to “end hunger, achieve food security and improved nutrition and the promotion of sustainable agriculture by 2030” (Sustainable Development Goals, 2015), provides justification for this study to drive policy action. Food security has over the years remained a policy concern for most SSA countries. As noted by (FAO, 2015), despite the general progress made in reducing global poverty and ensuring food security, SSA countries have the highest number of undernourished people compared to other regions.

The 2012-2014 estimate by FAO shows that SSA countries have a malnourished population prevalence rate of 23.8 percent, as compared to 15.8 percent in Southern Asia and 20.1 percent in the Caribbean. This phenomenon has caught the attention of researchers who sought to explain the possible reasons for the low performance in reducing food insecurity in SSA over the years. Prominent among the contributing factors is the inability of SSA countries to produce more food to feed its populace, though it commands about 25 percent of the world’s arable land. Secondly, most farmers within the region rely on rudimentary tools for farming, and they are also faced with stiff competition in the international market from farmers from developed countries who are supported by their governments. As a result, farmers hailing from SSA are unable to realise the perceived gains from trade.

Also, economic theory suggests that trade liberalisation policies may expose consumers to a wide variety of goods and services and at a lower price, hence making consumers better off than if trade was restricted; but whether such a relationship exists in reality remains an empirical issue. A plethora of studies has been conducted in this context over the past decades, (Ford & Rawlins, 2007; Oduro & Kwadzo, 2007; Dorosh et al., 2009; Bezuneh & Yiheyis, 2014). However, the findings of these studies are not conclusive on the link between trade liberalisation and food security, thereby calling for further research on the topic.

At both the theoretical and empirical levels, studies on the effects of trade liberalisation on food security seem not to be in congruence with each other. Most of the empirical studies are country case studies - a significant section was involved comparing a before and after events of trade liberalisation policies on the indicators of food security (Opolot & Kuteesa, 2006; Ford & Rawlins, 2007). Their findings have lacked some statistical techniques and validation of the underlying hypotheses. Some studies within this domain have also used Computable General Equilibrium (CGE) models to examine the effects of trade policy reforms and its implication on food security. However, both individual country study and cross-country studies that have used econometric techniques in this regard in SSA is rather thin.

This study consequently, looks at Twenty-One (21) SSA countries to investigate the level of trade dependence required to ensure food security in SSA, examine the other determinants of food availability in SSA, and examine the trends and patterns of food security in SSA to assist in the proposal of workable recommendations for improved food security in the post-2015. Hence, an interrogation of SAPs will form a central part of the argument.

More so, the study contributes to the existing literature by examining the link between trade liberalisation and food security in SSA. It also seeks to review other works and findings critically to produce an informed study that better analyses trade and food security issues at the regional level. For policy purposes, the study will also seek to examine other factors that affect cereal production in the region.

Furthermore, because of a possible problem of endogeneity,<sup>6</sup> the Durbin-Wu-Hausmann test for endogeneity is performed on the variables to validate the presence of endogenous variable in the model. The test is performed after testing for both random effect and fixed effects in the model. The confirmation of endogenous variables in the model validates the use of System GMM to estimate the model for consistent and reliable estimates.

## **1.6 Scope and source of data for the study**

The study uses a long time panel data on twenty-one (21) SSA countries selected from the East, Central, Southern and West Africa for the period 1970–2014 (44 years) for which consistently sufficient data are available. The countries selected are based on history of food insecurity and food emergencies over the years, similar political systems, similar economic characteristics and similar climatic characteristics regionally. The countries include; Benin, Burkina Faso, Cameroun, Cote D'Ivoire, Chad, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Senegal, South Africa, Tanzania, Togo, Uganda and Zambia. Data for some of the variables analysed is extracted from the FAO database. That is, [www.faostat3.fao.org](http://www.faostat3.fao.org), the UNSTATS, the United States Department of Agriculture (USDA)

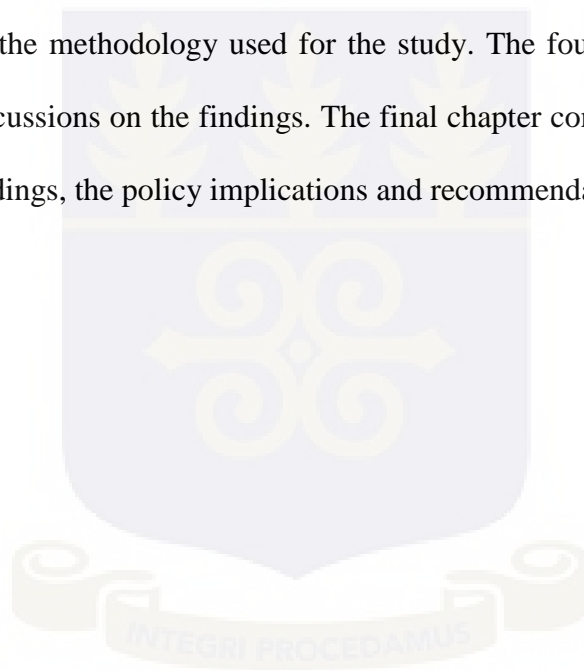
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<sup>6</sup> Endogeneity occurs when the predictor variables are correlated with the idiosyncratic error term. Endogeneity could also occur when there is a reverse causality between the predictor variable and the output variable.

sourced from [www.ers.usda.gov/datafiles](http://www.ers.usda.gov/datafiles) and the World Bank's World Development Indicators (WDI) online database (2016) sourced from [www.data.worldbank.org](http://www.data.worldbank.org). STATA (13) software is used to analyse the results.

### **1.7 Organization of the study**

The study is presented in five main chapters with each chapter containing subsections. Chapter one entails a general introduction to the study. Chapter two presents the conceptual framework and both theoretical and empirical literature on trade and food security. Chapter three focuses on the development of the methodology used for the study. The fourth Chapter presents an analysis and further discussions on the findings. The final chapter concludes the study with a summary of the key findings, the policy implications and recommendations for post-2015 era.



## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter has six main sections. The first section explains the concept of food security. The second section provides the theoretical literature on trade liberalisation. The concept of trade liberalisation is presented in section four followed by a section that links trade liberalisation to food security. The last part provides relevant empirical literature conducted.

#### 2.2 The concept of food security

According to FAO (2015), food security is defined as “a state when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences of people for an active and healthy life”. The above definition is hinged on four pillars: (1) food availability (classical approach), (2) food accessibility (the entitlement approach), (3) food utilisation, and (4) stable supply of food. According to Barrett (2010), the four dimensions of food security depend on each other hierarchically. That is, food availability is necessary, but conditioned on food accessibility, a dimension that in isolation is not sufficient to reach adequate nutritional outcomes. In other words, to achieve and maintain an appropriate nutritional status, food must first be available and easily accessible by all. Stability in supply emphasises the permanence and the sustainability of the other three dimensions over time.

*Food availability:* This dimension of food security captures the supply of food from domestic production, imports, the existence of food stocks, and food aid. Food availability reflects the amount of food from various sources (Barrett et al., 2009). This is then affected by all the factors that have an effect on the domestic food supply and the capacity to finance food imports.

Two main policies have been identified to affect the amount of food in a country. The policies include; food self-sufficiency and food self-reliance. Other policy areas at the household level, such as an agricultural subsidy programme, exchange rate depreciation or appreciation, and policies to spur investment in agriculture can also affect the degree of food supply in a country.

According to FAO (2012), total food produced globally is more than enough to feed the entire world. However, the distribution of food globally has not been equal. The evidence is reiterated by FAO report in 2015 that globally, Asia has the highest number of hungry people, that is, over 500 million inhabitants. Whereas, SSA has the highest prevalence of undernourishment in the world. Estimates according to FAO shows that about 23.2 percent of the population in SSA is hungry.

Projections for 2050 by Akinyoade et al. (2012) indicate that SSA is dreaded to become severely food insecure. This prediction is likely to be true if the current levels of food production and productivity do not increase. This is coupled with an increase in population, civil unrest and harsh climatic conditions. According to Akinyoade et al. (2012), the growth in population in SSA does not commensurate with its contribution to global food supply.

Despite the gloomy picture presented at the regional level, food availability in SSA has improved by nearly 12 percent over the past 20 years (FAO, 2015). Individual nations like South Africa and Botswana have also made tremendous strides in achieving food self-sufficiency in recent times (The Economist, 2012). Other countries within the region can reach this milestone if organic systems are employed to increase food availability (United Nations Environment Program - United Nations Conference on Trade and Development [UNEP-UNCTAD], 2008).

*Food Accessibility:* Access represents the “economic, physical, and social ability to acquire adequate amounts of food” (FAO, 2015). Food can be accessed through a combination of either or varied sources such as domestic food stocks, purchases, farm cultivation and collection, barter, gifts, food aid, personal income, borrowing and remittances. In more simple terms, access to food relates to being able to buy what is available.

One’s ability to access adequate levels of food for a healthy living remains a prominent concern and not just the physical availability of food. The entitlement approach by Sen. (1981) as cited in FAO, (2015), supports the view that “hunger is caused by a lack of income, not of food supply”. Despite the sufficient supply of food, one might not be able to buy an adequate and preferred nutritious food for healthy living. Access to food to a large extent is dependent on food prices and household resources.

Generally speaking, the allocation of household resources to access food is either directly through own crop cultivation or indirectly through income generating activities. The return to the investment in own crop production and personal income can be complemented by remittances from family and friends, international institutions and the state to improve access to food (Hoddinott, 2012). Given the price of food and the income level of an individual, the choice behoves on the individual to either consume more of food or other competing goods of interest.

The price of food in the international market via the exchange rate could affect both the quality and quantity of food that an individual or household can acquire given his income and current resources. An appreciated currency in a food import dependent economy is likely to cause

prices of food imports to decline. This implies that people within such an economy would be able to buy more food to ensure their food security.

The global supply of food and the general demand for food has a role to play in affecting the price of food in the international market. Access to food may not necessarily be different from food availability to both the individual and household levels. One may argue to support the assertion that, in regions where the local markets are malfunctioning, households may depend on domestic production as a means to have access to food, in which case food availability and access to food may overlap (Jones et al., 2013). However, even in regions where local markets are well developed, household food cultivation and production can be a primary source of income in some developing countries (Jones et al., 2013). For instance, a rise in the price of cereals will be an inducement for cereal producers to boost cereal production in the short run for an increased return. Nonetheless, this phenomenon is likely to affect access to food positively in the long term through the growth in cereal production which may drive prices down. The resulting increase in income may further improve food access although one may also argue of a higher cost of food.

Access to food can be improved through a reduction in the transaction cost. This can be achieved if there is an investment in infrastructural development like road construction from the food producing areas to the distribution centres, creating meaningful employment avenues for the populace, granting of subsidies to local rural farmers to cut down their operational costs and a substantial investment in the agricultural sector.

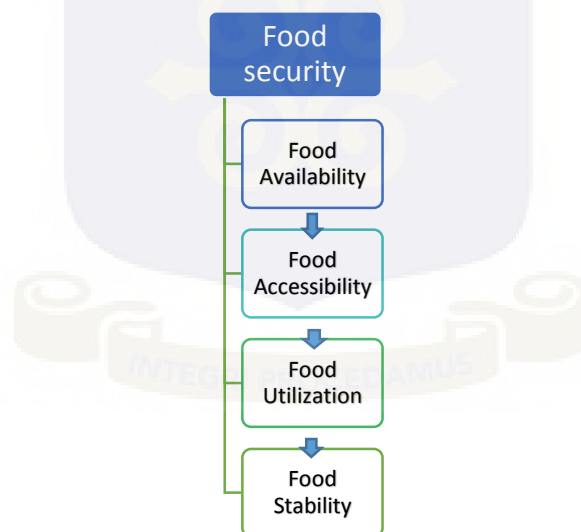
*Utilisation:* The nutritional status of an individual is determined by his ability to use appropriately the food accessed for healthy living. Hence, utilisation may refer to the appropriate use of food (FAO, 2015). According to Pellegrini and Tasciotti (2014), access to food cannot guarantee good health status, but rather, contingent on a well-balanced diet. Therefore, educating people on nutrition is essential for ensuring value for food in developing countries. Adequate knowledge on nutrition, food preparation and diversification of diet can help to have balance food practice. It is this light that “emphasis has been placed on ‘nutrition-sensitive agriculture’ with the aim of increasing an all-year-round food availability, access to and consumption of a diverse range of food necessary for a healthy diet. This can be done via food production, dietary diversification to improve diets, and food fortification to combat micronutrient deficiencies, and to raise levels of nutrition” (Brooks & Mathews, 2013 pp.30).

*Stability in Supply:* Stability in the provision of food looks at the consistency and permanency in the food supply. The success of the above three criteria for measuring food security depends on the stability in the supply of food. Periodic inadequacies in access to food remain inevitable over time. The time dimension on the stability in the supply of food could either be transitory or chronic. Transitory food insecurity relates to a sudden decline in the ability to produce or access food that could either be due to natural (climate variability, natural disasters, etc.) or human-induced (unemployment, political instability, market price volatilities of food crops, food wastage, etc.) factors. Hence, the need for a stable supply of food to ameliorate the risk of malnutrition and starvation. Stability depends on domestic food production, income, market structure, government policy and private transfer, adverse weather, price fluctuation, political and economic factors like unemployment, and fluctuation of food prices in the market (FAO, 2015). All these factors affect the sporadic inadequacies of food supply and access to food over time.

Transitory food insecurity over time is likely to permeate to chronic food insecurity if the above-listed factors are not controlled. Chronic food insecurity is mostly due, to poverty and insufficient access to productive resources over a sustained period (FAO, 2014).

Figure 2.1 describes the four dimensions of food security. For a country to be food secure, food must first be made available either through domestic production, food aid and food imports. The availability of food does may not necessarily mean people can access it. What this means is, people within an economy should be able to have access to food at a reasonable price. However, the ability to have access to food might not mean that one is food secure but contingent on his ability to have diverse food for a sustainable and healthy dietary preference at all times.

*Figure 2.1: The dimensions of food security*



Source: Author's conceptualisation.

## **2.3 Trade theory**

In 1817, David Ricardo developed the classical theory of comparative advantage to explain the rationale for trade among nations. Further modification of the theory using mathematical techniques to explore the patterns of trade amongst countries has emanated the Ricardian model. The model is developed based on the assumption that there exist cross-country differences in technology. The model has been propounded to explain free trade, which leaves each country better off when it completely specialises in the production of goods it has a comparative advantage. The Ricardian model was developed based on the following assumptions; there are two goods, two countries, one fixed in supply factor of production (Labour) which is immobile across countries.

Later modification of the Ricardian model led to the development of the Heckscher-Ohlin (H-O) theory of trade. The theory relaxes the assumption of one factor of production to include capital as a factor of production to explain the basis for trade amongst countries. As countries trade amongst themselves, a vent is created for a larger market to trade. It is worthy to note that the H-O theory and the vent for surplus theory explain why SSA countries produce and export agricultural products.

### **2.3.1 The vent for surplus**

Adam Smith (1937) developed the theory of vent for surplus to explain an outlet of the overproduction of goods generated in the domestic market. It was expanded in the context of developing nations. First of all, this theory assumes a positive relationship between economic growth and international trade. As the theory holds, free trade overcomes the small nature of domestic market and provides a large market base for domestic produce through the vent for

the surplus generated in the domestic economy. Surplus productive capacity in the country will be created in the absence of trade.

The theory was further used by Myint to evaluate foreign trade expansion in developing countries. According to Myint (1971), the "vent-for-surplus" theory offers a more practical approach to explaining the international trade development in the developing economies like those in SSA than the comparative advantage theory. This is because the theory has been adopted to explain why two countries with similar factor endowment and similar product differ in their terms of trade. He explained why one of the countries remains a net importer while the other remains a net exporter of goods. In his explanation, he underscored that population density and the demand for goods accounts for the difference in the state of net import and net export of the countries. Hence, a country with a huge population is likely to demand more food crops than a country with a relatively sizeable population.

In conclusion, Myint has argued that the vent for surplus theory applies more to less developing countries than the comparative cost theory. According to him, there is more utilisation of unused national and natural resources, opportunities for reallocation of resources, and the capacity to increase the export production of developing countries;

### **2.3.2 Heckscher-Ohlin (H-O) Theory of Trade**

The Heckscher-Ohlin (H-O) theorem states that a country will export the commodity that intensively uses its relatively abundant factor. The theory was developed based on the flaw in theory of comparative advantage. Under this theory capital and labour are homogeneous and perfectly mobile. The rationale for this assumption is to rule out the effects of demand based factors. Secondly, differences in the factor endowment of nations help explain the comparative

advantage of a country. The model further assumes that labour productivity is fixed for different commodities and different countries - this is because countries are endowed with different factor supplies. A constant return to scale production function is assumed, and finally, there is an assumption of a non-existent market distortion factors like tariffs, labour unions or imperfect competition that could influence the production or consumption decision.

According to the theory, a capital-abundant country will export the capital-intensive good and import labour-intensive goods. Whereas, the labour-abundant countries will export the labour-intensive goods and import capital-intensive goods to benefit mutually from trade. An inference from this discussion is that SSA, which is more labour abundant, should produce more of labour intensive goods for exports and import more of capital intensive goods. Whereas the rest of the world should export more of capital intensive good and import labour intensive goods from SSA.

Lawrence et al., (1993) have criticised the model with an evidence to suggest that there has been increases in intra-industry demand for skilled labour. An empirical evidence presented by Leontief (1953) cited in (Guo, 2015) suggests that the United States (US) which is a capital abundant country, exports labour intensive goods and import capital intensive goods. This anecdotal evidence by Leontief debunks the H-O theorem of trade. However, Linder's hypothesis suggests that the US exports are labour intensive goods because its labour force are highly skilled.

The basic assumption of factor endowment in the H-O theory might not be the only factor to influence commodity price. However, factors like technology, demand, location, natural factors, the production mix and the quality of labour could determine the commodity price.

Despite the abovementioned drawbacks of the H-O theorem, the theory has its own merits to the development of the theory of international trade. A simplification of the theory by taking into account of commodity and factor prices provides a simplifying and satisfactory explanation of the rationale for trade among nations.

#### **2.4 The concept of trade liberalisation**

The assumption of the General Agreement on Trade and Tariff (GATT) in 1948 and its subsequent rounds of agreement between and among nations has promoted free trade among countries. The United States initiated the agreement following a series of bilateral trade agreements with some countries to lower trade barriers between 1934 and 1946. The agreement was to promote free movement of goods between countries and to eliminate all forms of quantitative restrictions in a move to encourage trade among member states.

In more general terms, trade liberalisation involves policies that promote the free movement of goods between countries. A plethora of definitions and measurements for trade liberalisation has been conceptualised over the years. One such measure by the World Bank (1990) is the trade liberalisation index. According to their definition, trade liberalisation “is any change that leads a country’s trading system towards neutrality in the sense of bringing its economy closer to the situation which would prevail if there were no government interference” (Edwards, 1993 pp. 1367). The index was constructed by asking individual country authors to create an index for trade liberalisation (Michealy et al., 1991 as cited in Edwards, 1993). The index ranged from 1 – 20. Where 1 took the case of a highly controlled trade regime and 20 for a liberalised regime during the period 1948 to 1985. The categorisation according to this measure of trade liberalisation, classified most countries in Africa as closed during the period (Edwards, 1993). The above measure for trade liberalisation may have prompted reactions of this measure of

trade liberalisation. One such criticism of the trade liberalisation index is because the construction of the index was on the personal predisposition of individual countries (Edwards, 1993).

In response to the criticisms of the trade liberalisation index, the Sachs and Warner criterion for measuring trade liberalisation was introduced in 1995. Under this measure, a 10- year gap is constructed within which a country opens up to trade. A dummy variable is used to denote the decade within which the liberalisation event took place. A country is classified as closed if its average tariff rate is equal to or more than 40 percent; a socialist economic system exists; the state monopoly exists on the main exports; nontariff barrier is in place covering more than 40 percent of trade and; when the black market exchange rate is depreciated by more than 20 percent relative to the official exchange rate (Wacziarg & Welch, 2008).

Rodriguez and Rodrik have criticised the Sachs and Warner measure of trade liberalisation. They underscored that the classification of countries is based solely on black market premium and export market criteria. Hence, many African countries under this measure of trade liberalisation were classified as closed during the 1970 – 1980 period (Wacziarg & Welch, 2008).

The decade dummy categorisation flaw in the Sachs and Warner measure of trade liberalisation may have prompted Wacziarg and Welch to update the measure of trade liberalisation by adopting a slightly different approach to measure trade liberalisation. Instead of using a decade dummy as in the case of the Sachs and Warner approach, their measure rather focused on the liberalisation dates of each country. Wacziarg and Welch argued that using a decade dummy to represent a country's degree of openness to trade will only present a rough idea of the periods

under which a country engaged mostly in trade. However, using liberalisation dates would give a robust picture of trade liberalisation.

Based on the different states of definition and measure of trade liberalisation, trade liberalisation could be defined as the ongoing process of opening up to global trade through a decrease and the removal of tariffs and other non-tariff barriers between trading parties (Bezuneh & Yiheyis, 2014). Premised on the above definition, it is argued that through trade liberalisation policies, consumer welfare is improved. Trade liberalisation may also promote the economic growth of countries; it may also increase the income-earning potential of the poor, create employment opportunities, and finally it may also increase domestic food supply through food aid and imports to meet domestic consumption. According to Berg and Kruger (2003), trade liberalisation improves the terms of trade in developing economies.

Similarly, a report according to FAO stated that Africa had shown a positive and encouraging results in improving food production over the past years and reducing inequality as a result of liberalisation policies (FAO, 2015).

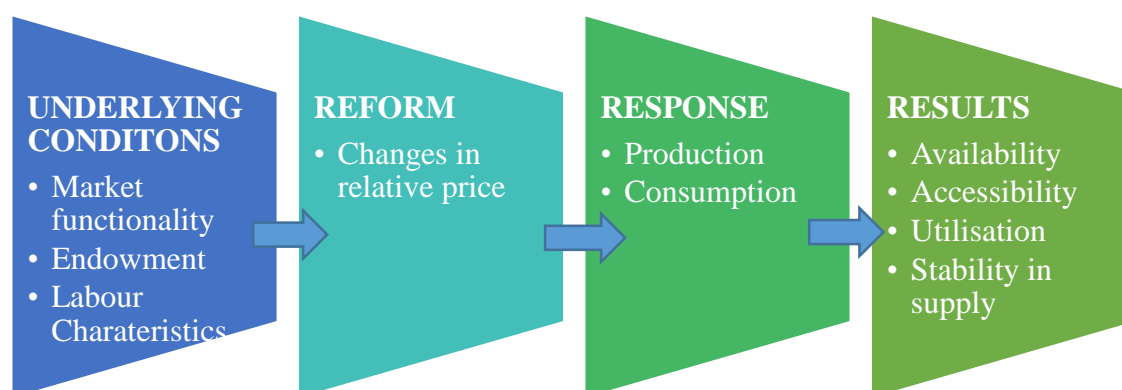
However, despite the above-mentioned benefits of trade liberalisation, Berg and Krueger (2002) have argued that the process of trade liberalisation drives down wages and jobs to developing countries. Intrinsically, the decline in wages and employment means one's ability to purchase food for consumption will decline. This argument is further reinforced by Weisbrot and Baker (2003) as they argue that, "even if there are reasons for believing that expanded trade can help to promote growth in developing countries, it is unlikely that trade liberalisation by itself will qualitatively improve the plight of people in the developing world".

## 2.5 Linkages between trade liberalisation and food security

The Reform – Response – Result framework by FAO (2005), has been adopted for the study. Under this context, given underlying conditions, trade liberalisation will cause a relative change in food crop prices at a given exchange rate. As prices change, individual and household consumption and production levels will also change. This response will then determine the outcome of the individual or the household food security status. As to whether it will lead to market improvement or deterioration, will depend on the underlying conditions.

The underlying conditions include: endowment (arable land, cereal productivity, total land under irrigation, and GDP per capita); labour functionality, that is, the productivity of labour in maximising output, and market functionality which entails matching market demand with market supply, ensuring price stability or responding to changes in price levels all help in determining the food security status of an individual, household or a country. It may be prudent to argue that well-functioning underlying conditions can improve the level of food security in any country. However, a malfunctioning underlying condition will not ensure a stable supply of food for the populace. Figure 2.2 shows the reform response result framework adopted from the FAO as a conceptual framework for the study.

**Figure 2.2: The Reform – Response – Result framework**



Source: FAO (2005). The state of food and agriculture 2005, p84

Based on the reform response result framework, the relationship between trade liberalisation and food security at both the household and national level is discussed.

Trade liberalisation plays a very significant role in complementing food shortages in net food importing countries through the “vent” from the net food exporting countries (Brooks & Mathews, 2015; Mathews, 2015). Without trade, food prices are likely to be higher in net food importing countries (Brooks & Mathews, 2013). This is because domestic demand is likely to outstrip domestic supply. To arrive at equilibrium, national food demand must equate national food supply. This can be achieved either through a reduction in demand or boosting supply which may or may not be realized in the long run. On the other hand, without trade, prices of food are likely to be cheaper in net exporting countries. This is because of their excess capacity. This situation is usually preferred by consumers because they will buy at a much lower cost. Nonetheless, food producers, on the other hand, remain the losers. To avoid food wastage, they would have to sell their food crops at a lower price to consumers to offset some of the losses. This is not an ideal situation in both cases, hence, the need for international trade, to clear the surpluses from surplus producing regions to food deficit areas for equilibrium to be restored in both economies.

Secondly, through efficiency gains from resource allocation, countries can generate the foreign exchange necessary to import some quantities of food to buffer domestic deficits (FAO, 2012). The emphasis here is that trade has a role to play in reducing poverty in labour abundant countries, because, it will increase wage rates. A favourable trade policy through imports may be able to cut down the price of cereal crops, its volatility and its variability in supply in most developing countries. However, this might not be the case because locally produced food crops remains a vital source of food for most developing and developed countries (Brooks, 2013).

Thirdly, trade liberalisation has a role to play in offsetting adverse supply shocks that might be caused by climate variability, political instability, population growth rate and soil related problems. Thus, in times of national food emergencies, trade liberalisation has the potential to ameliorate the situation by providing support through food aid from international donors to salvage the food crisis. Dijk and Meijerink (2014) elucidates about both direct and indirect processes through which agricultural trade affects the level of food security in a country. Through the direct channel, agricultural trade can increase domestic food supply through imports. The increased local food supply reduces food prices, which increase food accessibility. Through the indirect channel, agricultural trade promotes economic growth through which incomes of people are improved which hence improves access to food.

However, trade liberalisation could impact domestic food supply through the world market trading system. This is particularly the case when food crop price is subject to volatilities. This could affect the stable supply of food. One other such case is when there is an increase in demand for biofuels in the international market. This is likely to affect the price of grains for consumption because of the stiff competition from a close substitute. More so, increases in the price of imported food are more than likely to affect the import bills of net food importing countries. Over time, the current account position of these countries worsens. The situation is generally felt when there a depreciation of the local currency. The depreciation of the local currency is mostly felt in the domestic market since it translates into higher prices of various foods.

## 2.6 Empirical Literature

According to Rodrik (1998), the effects of trade liberalisation on food security is an issue of double standard and that it has become imperative to question its benefits to developing countries. Studies over the years have tried to establish a relationship between trade liberalisation and food security at the global, regional and national levels. The findings from the available studies are, however mixed. Some find a positive effect of trade liberalisation on food security; others find a negative relationship. Others find no significant effect of trade liberalisation on food security.

The inconclusive results of these empirical findings have depended on the methodology adopted. Whereas some of the studies are based on panel data models and time series estimation techniques, others use before and after analysis, some studies have also used either the static or the dynamic Computable General Equilibrium (CGE) models. While some have adopted the Partial Equilibrium Models (PEMs) to examine the effects of trade liberalisation on food security.

An empirical study by Vamvakidis (1999), using, 51 cases of trade liberalisation events conclude that countries have grown faster after liberalisation. The increase in economic growth implies a reduction in poverty and improvement of food security. Similarly, Madeley, (2001) as cited in (Bezuneh & Yiheyis, 2014) in an empirical study on the effects of agricultural trade liberalisation in Mexico, concluded that trade liberalisation has the potential to improve food security.

Bouët et al. (2005) used the Computable General Equilibrium (CGE) model for their study. The study investigated the impact of multilateral liberalisation in the agricultural sector of developing countries. The study suggests that full liberalisation of trade in developing countries reduces poverty and improves the production efficiency and output of the less developing countries. The reduction in poverty and improvement in the production efficiency could imply a decline in food insecurity. They conclude that periods of trade liberalisation had the most positive effects on agriculture.

Chang and Sumner (2004) conducted an econometric study on the trade impact on food security in China. Their study used 1200 rice consumption household as a metric for food security. An analysis of their study concluded that opening the border to grain imports has resulted in lower domestic price which has improved the general level of food security for rural farm households in China. The study used data from 1991 to 2000. Similarly, Herath (2014) observed that after the formation of the Association of South East Asian Nations' Free Trade Agreement (ASEAN-AFTA) per-capita daily dietary energy supply in these countries has improved.

Zakaria and Xi, (2014) also used econometric panel analysis. The purpose of the study examined the effects of trade liberalisation reforms on food security in South Asian Countries (SACs) over the period 1972 to 2013. Their result indicated that trade liberalisation had a positive effect on food production and food security in the region. Similarly, Dorosh (2008) argued that trade liberalisation policies pursued in Bangladesh through which there was private participation in the rice and wheat production has largely contributed to the enhancement of national food security. He further highlights that permitting the involvement of the private sector in trade would enhance the level of food availability for domestic consumption during periods of low food production.

More so, a multi-country study using 67 low-income developing countries by Shapouri and Trueblood (2001) indicated that global market liberalisation would have a small but positive impact on reducing the food gaps in low income, food-deficit countries. The study used a baseline scenario. Food gaps is proxied for food security. The study used the partial equilibrium model for its analysis using the following trade reform characteristics as removal of domestic support, the effects of rising food prices and the foreign exchange earnings of agricultural trade liberalisation. The data period for the study was between 2000 and 2010. In their findings, trade liberalisation has the potential to reduce food insecurity in low-income, food deficit countries. The baseline projections for food availability in the case of SSA saw a decline in per capita food availability in SSA and some Latin American countries. The study recommends a substantial external investment and assistance in the agricultural sector of these economies. And the need for an improvement in domestic food production in most food insecure countries.

Ivica (2013) conducted a study on food security and agricultural policies using a panel data of 58 developing countries between 1990 and 2009. For a more robust study, the study employed OLS, GMM and 2SLS estimators. The study expected that a higher degree of agricultural trade liberalisation would encourage the production of export crops at the expense of staple foods in the domestic economy leading to food insecurity. However, the paper found evidence to support that an equal land distribution, greater trade openness and higher domestic food production had a positive impact on food production in the selected countries. In her findings, domestic food production had a strong positive effect on food security.

More specifically, in SSA, a study by Dorosh et al. (2009) confirms that prices for maize and cassava fell significantly in areas where there were open borders in SSA. This supports the assertion that regional trade has the potential to improve food security within the region

because a well-functioning local market can reduce the price of food crops. The uncertainty in supply and its price volatility is also reduced as a result of trade. A case in point is where food surplus zones in South Africa, Northern Mozambique, Southern Tanzania, and Eastern Uganda are being traded in the deficit markets in southern Mozambique, Malawi, and Kenya.

According to Heidhues and Obare (2011), Ghana, Kenya, Uganda and Malawi were the first to adopt trade liberalisation policies in the 1980s under the SAPs. Ghana, for example, witnessed a positive effect on agricultural supply together with a decline in food insecurity (FAO, 2012. cited in Oduro & Kwadzo, 2007). Similarly, Imad and Karim (2003) analysed the implications of world trade liberalisation on trade and food security in Sudan. Using an extended form of a multi-market partial equilibrium model which includes other characteristics of agriculture in Sudan like substitution effects and stages of production. The model revealed that a higher world market price would lead to measurable increases in food security and agricultural trade in Sudan. Their estimates also showed an adverse effect if the cost of production is higher. A further investigation shows that national and international policies in Sudan matter in boosting domestic food supply. The paper recommends that the country should reorient its domestic policies towards export promotion so as to gain from the emerging trading opportunities in the world market.

Opolot et al. (2006) studied the impact of Policy Reforms on Agriculture and Poverty in Uganda using a before and after analysis. Their study concludes, policy reforms have yielded positive results on food security. That is, there was a three percent improvement in aggregate per capita availability of calories from 1992 to 2005 whereas, the proportion of undernourishment reduced by four percent over the same period. The percentage of food secure households according to the study increased from 60.9 percent to 71.9 percent during the period

1995 to 2003. A similar study by Oyejide et al. (2006) shows a positive effect of trade liberalisation on food security in Nigeria. The study used undernourishment, calorie intake, and import dependence as a proxy for food security and import tariff reduction as a measure of open trade.

However, a before and after study by Ford and Rawlins (2007) of agricultural trade policy and food security in the Caribbean found that policy reforms introduced in the 1980s and 1990s were linked to increased food insecurity and loss of rural livelihoods. This was observed as traditional export crops lost access to markets, the domestic food was crowded out by cheaper imports from other countries with comparative advantage. Likewise, Skarstein (2005) argued that the SAPs which included trade liberalisation reforms contributed in part to the stagnation of agricultural growth in Tanzania during the period 1985 to 1998.

Duncan and Chen (2008) have used a computational general equilibrium model to examine the effects of trade reforms on food security in China. Their study identified a decline of 1.548 percent in overall food self-sufficiency. There was also a drop of 0.063 percent in grain self-sufficiency over the period. This result indicated that food insecurity had worsened after the adoption of the reforms. This was observed in the reduction of the incomes of local domestic farmers. The decrease in income of rural farmers meant their inability to purchase basic food crops for sustenance and to buy seeds for crop production.

A similar study by Panda and Ganesh-Kumar (2009), employed a computational general equilibrium model to evaluate trade liberalisation, poverty, and food security in India. Their study concluded that an increase in real GDP or poverty reduction that might result from trade reforms in India would not necessarily improve the food security and or nutritional status of

the poor. Similarly, Pérez, et al. (2008) conducted a study in Latin America. They observed that countries that rapidly liberalized trade in agricultural products in pursuit of the promised gains from trade liberalisation gained much less than expected.

Bezuneh and Yiheyis (2009), used an econometric panel analysis drawn from 37 countries to investigate whether trade liberalisation has improved food security in these selected countries. The national food security was measured using Per Capita Daily Dietary Energy Supply. According to their results, they found trade liberalisation exerted a negative short-run effect on food availability in the sampled countries. The delayed outcome though positive but not significant. Their fails to support the view that the medium to long run effect of trade liberalisation on food availability is favourable. The same authors also conducted a regional study in Africa using 11 African countries. Their study used a panel econometric model to analyse the episodes of trade liberalisation events in the 1980s and 1990s. Their findings reported that the effect of trade liberalisation on food security had been unfavourable to the 11 African countries. The countries include; Cameroun, Ghana, Benin, Kenya, Mali, Nigeria, Uganda, Mauritania, Gambia, Guinea-Bissau and Zambia.

Similarly, Abdullateef and Ijaiya (2010) conducted a country study in Nigeria. Their study used an econometric time series model, a before and after analysis and a computational general equilibrium. The total quantity of food requirement and food utilisation were proxies for food security. Their study observed that, in spite of the numerous policy measures to enhance food production, food demand has consistently outstripped supply with increasing number of people becoming more vulnerable. Their study also points out that despite the need to open up to trade to meet the excess demand for food, trade openness has the tendency to encourage exports of

food from net food importing countries, and this may further exacerbate the food insecurity situation in Nigeria.

Nyangito et al. (2006) studied trade-related reforms and food security in Kenya. Their study employed a before and after comparison of agricultural trade policy on household and national food consumption, malnutrition and self-sufficiency ratio for Kenya during 1992 to 2001. The trade reform characteristic of the study included quantitative restrictions, tariffs reduction and elimination of non-tariff barriers. Based on their findings, food security worsened coupled with rising malnutrition in the country after the adoption of the agricultural trade policies.

Musonda and Wanga (2006), used per capita food intake and the self-sufficiency index as a metric for food security. Quantitative controls and tariff reduction were to measure the extent of trade liberalisation in Tanzania. The data period for the study was 1981 to 2000. In the before and after analysis of the episodes of trade liberalisation on food security in Tanzania, the study concluded that food deficits have occurred in six out of the last fifteen years. Food production and food consumption had increased between the periods of 1980 -1992 and 1993-2000 but food production per capita had seen a decline by 13 percent. According to their study, some health and nutrition indicators worsened between the periods before and after 1992. They showed that malnutrition amongst children under five years increased by 4 percent and life expectancy dropped by 8 percent. This was further worsened by a decline in per capita daily calorie intake from 2146 kcal in 1980-90 to 1916 kcal in 1998-2000. The drop in per capita daily calorie intake indicates a worsening food insecurity.

Sharma and Morrissey (2006) argued that even Adam Smith, who was an ardent proponent of trade liberalisation, warned that, no country should completely liberalise because of the

problem of cheap imports. This may deprive the nationals of the home country employment and subsistence. Sharma and Morrissey (2006), argues that the aftermath of the trade liberalisation policy resulted in a loss of rural livelihood, rising unemployment and an increased rural-urban migration which further led to a decline in agricultural exports. Under the structural adjustment trade liberalisation programme, credit was tied with crop diversification. This led to shift from staple food crop production to cash crop production for export. This situation, according to Sharma and Morrissey (2006) resulted in a decline in domestic food crop production. Similarly, Clover (2003) discoursed that trade liberalisation is the primary cause of food insecurity in SSA as they emphasised that the region has over the years seen a reversal from being an exporter to a net importer of agricultural commodities.

Other studies conducted within this domain have reported ambiguous outcomes. Particularly, a review of the relevant literature by Madeley and Solagral (2001) indicates that the evidence is mixed. Some studies find evidence to support the view that trade liberalisation contributes to poverty reduction, augments prosperity and accelerates the development process of a country. Other studies report that “the fruit of liberalisation and globalisation are not reaching the table of the poor” and they emphasise “the ill effects of accelerated or incautious trade liberalisation” (Madeley & Solagral, 2001: p. 3 &5 as cited in Bezuneh & Yiheyis, 2014)

Thomas and Morrison (2006), used a mixed research approach to analyse the impact of trade liberalisation on price, production and trade flow in the agricultural sector of 15 developing countries. Their results indicated that, in the early years of a country’s development, trade reforms could be damaging to food security in the short to medium term. They attributed to the effects of price in the international market on domestic food price in case of a general price rise. Of the 15 countries selected for the study, seven of them saw an improvement in food

security over the period, whereas, the rest showed a mixed outcome at various duration of the study.

Oduro and Kwadzo (2007) in their study, Ghana and the Agreement on Agriculture observed a minimal impact of the Agreement on Agriculture on the nation's domestic agricultural policy. The study adopted the Agricultural Trade Policy Simulation Model (ATPSM) of the UNCTAD to examine the effect of tariff reductions on selected crops Ghana produces and exports. The study points out that if Ghana liberalised banana trade, it would see more gains compared to the liberalisation of other food crops. However, the model was quick to point out that under the liberalised regime, the country will experience an 8 percent decline in welfare. Hence, trade policies aimed at improving market access will not have significant improvement in welfare if the country produces very little for exports.

The study also finds that National Food security improved and later declined over the study period. That is, between 1992 and 1996 food security improved in the country. This was evidenced in a decline in food imports over the period, an increase in calorie availability of up to 26 percent, a decrease in underweight of children in five of the regions in Ghana and a reduction in poverty levels from 51.9 percent in 1991/92 to 39.5 percent in 1998/99. However, after 1996 the improvement in food security was reversed as the years weighed on. The study further highlighted a policy that encouraged a tariff reduction and its impact on export volumes of agricultural products as minimal.

Finally, they observed that because the European Union (EU) remains the leading destination for most of Ghana's agricultural exports, the country made some gains as the share of exports to the EU increased to 75 percent as of 1998 (Oduro & Kwadzo, 2007). However, Oduro and

Kwadzo (2007) observed that, though Ghana exports most of its crops to the EU, imports from the EU was rather small. The nation rather saw an increase in wheat imports from the USA and Canada plus an increase in rice imports from the East Asian countries. The study concludes that since the inception of the liberalisation reforms, Ghana has seen some gains in agriculture production, but much has not been seen in the improvement in the incidence of food poverty amongst food crop farmers.

Herath (2014) also employed times series estimation technique to investigate the effects of trade liberalisation on food security in China and Sri-Lanka for the period 1980-2009. The study observed trade liberalisation did not significantly have an influence on food security in China. The relationship between the two variables in China was found negative. The relationship between the trade liberalisation and food security in the case of Sri Lanka was weak. However, for the cases of both countries, real GDP level showed a strong positive relationship with food security during the period of study. And changes in imported food prices determined the level of food security Sri Lanka but was not a significant factor in the case of China.

McCorriston et al. (2013) using 34 relevant studies concluded that 13 of the studies suggested a positive outcome, 10 of the studies, suggested an adverse result and the remaining 11 showed no significant impact. The different effect may partly due to the different measure of food security, the estimation technique employed, the source of data for the study, the model used for the evaluation and the control variables in the model.

## 2.7 Conclusion

Evidently, the empirical literature on the nature of the relationship between trade liberalisation and food security is inconclusive; this apparent ambiguity in the empirical literature regarding the functional relationship between trade liberalisation and food security necessitates further research in the field to provide new evidence using recent data. This study, therefore, aims at providing further proof of the relationship between trade liberalisation and food security in SSA. The next chapter of the study provides a discussion of the methodology that would be employed in determining the relationship between trade liberalisation and food security in SSA.



## CHAPTER THREE

### METHODOLOGY

#### 3.1 Introduction

The chapter discusses the statistical techniques used in determining the relationship between trade liberalisation and food security in SSA. This chapter has five (5) sections. A description of relevant variables and sources of data for the study is discussed in the next section. A theoretical framework is presented in section 3.3. An empirical estimation model is shown in section 3.4. In Section 3.5, the estimation techniques are presented followed by some diagnostic tests on the model in section 3.6. The chapter concludes in section 3.7.

#### 3.2 Empirical Framework

To assess the effects of trade liberalisation on food security in SSA, a dynamic panel is estimated. As a robustness check, a panel data estimation technique is also performed for consistent and reliable estimates.

The study first adopts the panel data model to account for the temporal and country specific effects. Next, the study utilizes a dynamic system panel to correct for endogeneity in the model. This is as a result of a correlation between the unobserved heterogeneity term and the error term in the model fixed effects estimator. The lags of the dependent variable are included in the model to capture the lagged effects of the dependent variable. The panel fixed effects, and the dynamic panel models are specified as:

$$Y_{it} = x'_{it}\beta_1 + f_i + \varepsilon_{it} \quad 1$$

$$Y_{it} = \Phi Y_{it-j} + x'_{it}\beta_1 + f_i + \varepsilon_{it} \quad i=1\dots,N; t=1,\dots,T \quad 2$$

Equation 3.1 describes the panel fixed effects and equation 3.2 describes the dynamic panel estimation model. From the above equations,  $i$  indexes all countries under the study,  $t$  denotes the time period specified,  $\varepsilon$  denotes the idiosyncratic error term in the model,  $f_i$  captures the unobserved country specific effect,  $Y_{it}$  denotes the food security metric,  $Y_{it-j}$  denotes the lagged dependent variable (food security) and  $x'_{it}$  envelopes all the explanatory variables in the model. The lagged dependent variable is included as an internal instrument so as to eliminate the problem of endogeneity in the dynamic model after estimating the fixed effects model.

### 3.3 Empirical Model Specification

The empirical model presents a set of other explanatory variables that affect the level of food availability in a country. In line with previous studies, trade liberalisation is measured as a dummy variable. Thus, 0 closed to trade and one open to trade. Also, a set of control variables is included in the model because of their possible effects on the level of food security in a country. They include; GDP per capita, Land under cereal production, Cereal productivity, Total irrigated area, Level of political openness, Population, and Exchange rate.

Based on the description of the variables in session 3.4, the panel data estimator and dynamic panel data estimator is presented as:

$$LDES_{it} = \beta_0 + \beta_1 Tlibz_{it} + \beta_2 \sum_{i=0}^2 polsOpen_{it} + \beta_3 Lgdp_{it} + \beta_4 Llucp_{it} + \beta_5 Lpop_{it} + \beta_6 Lirri_{it} + \beta_7 Lcypc_{it} + \beta_8 Lexc_{it} + \varepsilon_{it} \dots \dots \dots 3$$

$$LDES_{it} = \Phi LDES_{it-j} + \beta_1 Tlibz_{it} + \beta_2 \sum_{i=0}^2 polsOpen_{it} + \beta_3 Lgdp_{it} + \beta_4 Llucp_{it} + \beta_5 Lpop_{it} + \beta_6 Lirri_{it} + \beta_7 Lcypc_{it} + \beta_8 Lexc_{it} + f_i + \varepsilon_{it} \dots \dots \dots 4$$

Where:

$LDES_{it}$  = Food security metric

$LDES_{it-j}$  = Lags of the food security metric

$TLibz_{it}$  = Trade liberalisation dummy [0=Closed, 1=Open]

$PolsOpen_{it}$  = Political openness [0=Autocratic state, 1=Anocratic state and 2=Democratic state]

$Lgdp_{it}$  = Log of GDP per capita in constant US dollars.

$Llucp_{it}$  = Log of land under cereal production

$Lpop_{it}$  = Log of population

$Lirri_{it}$  = Log of total irrigated land

$Lcypc_{it}$  = Log of cereal productivity

$Lexc_{it}$  = Log of exchange rate

### 3.4 Description of Variables and Data Sources

The choice of variables for the study is based on both empirical literature and theoretical economic theory. Food security represents the dependent variable which is measured in terms of the overall cereal availability in each country. The overall cereal availability in each country is converted to national dietary energy supply. That is the adequacy of the national food supply in calories terms. The study also includes the following explanatory variables; trade liberalisation, population, the degree of political openness, cereal productivity, GDP per capita, total irrigated lands and land under cereal production. These variables are discussed in the ensuing paragraphs. Also, the expected outcome is also presented. Data for the variables is sourced from the Food and Agriculture Organization Statistical Division, the World Development Indicators from the World Bank, Project IV, the United States Department of Agriculture and the United Nations Statistics for data on population.

*Food security:* For the purpose of this study, national cereal availability is used as a metric for food security in SSA. Cereals to be included in this study includes all cereals produced by SSA

countries as reported by FAO. Cereal is used in this study as an indicator of food security because according to Byrnes and Bumb (1998), cereal provides 60-70 percent of the average per capita caloric intake hence, they are sometimes treated as an indicator of food security. In consonance with related literature (Bezuneh & Yiheyis, 2014; Smith & Haddad, 2001), cereals produced by countries as food supply quantity is further calculated in terms of calories to represent the amount of food consumed by an individual. This has been denoted as Dietary Energy Supply, which is measured in Kilogram per capita per day. Data for the cereal availability is sourced from the FAO database. The database for cereal availability includes domestically grown cereals, imported cereals, exports of cereals, food aid supplied by the World Food Program and changes in national stocks.

*Trade liberalisation:* The dates within which SSA countries liberalised to trade after the adoption of the SAPs will be used to measure trade liberalisation. The dates follows a list that is drawn from a compilation of trade liberalisation episodes by Wacziarg and Welch (2008). In line with Bezuneh and Yiheyis (2012), episodes of trade liberalisation events compiled by Li (2003) was used in their study. However, this study will use the Wacziarg and Welch's list because it has greater coverage of developing countries (Wu & Li, 2008). The study expects either a positive or a negative outcome on food security.

*GDP per capita:* According to FAO, high growth rates of GDP per capita are a key factor in increasing food availability (Timmer, 2000). Therefore, a positive outcome on food security is expected. This measure reflects the total well-being of the population. GDP per capita is often measured in local currency units and in constant United States dollar terms. The study uses GDP per capita in constant dollar terms to serve as a reference point for GDPs across countries.

*Level of political openness:* Polity score is utilized in the study to measure the level of political openness in the selected countries. A categorical variable is defined for autocratic regimes (0), anocratic regimes (1) and democratic regimes (2). The justification for the inclusion of this variable in the study is because anocratic regime does not necessarily reflect either a democratic government or autocratic regime but rather, a transition from either an autocratic regime to a democratic regime and vice versa. The source of data for this measure is published in the Polity IV dataset. The evaluation of the political stability of each nation is based on the level of openness in its democratic elections. In line with a related literature, Zakaria and Xi (2014) observed a positive outcome on food security. The study, therefore, expects a positive result on food security for periods of democracy.

*Land under cereal production:* Bezuneh and Yiheyis (2014) used agricultural land as a proxy for land devoted to food production. In this study however, land under cereal production in SSA is used. The justification is that land under cereal production to include harvested area and cultivated area for cereal production (World Bank, 2012). This definition provides a direct measure for the study than agricultural lands. A positive relationship is expected on the food security metric.

*Cereal productivity:* Cereal yield per kilogram per hectare will be used to measure the level of cereal productivity in each country. A positive relationship is expected on food security in SSA. According to Khan et al. (2014) the adoption of green revolution packages, pesticides, and fertiliser is likely to increase the cereal yield of cereal crops grown in SSA. Consequently, ensuring food security. According to Jayne et al. (2010), the more productive a unit of land is in producing cereal, the more cereal availability one should expect.

*Population Growth:* The total population of each of the countries is used for the study. The values are logged to normalize the data to take care of extraneous variables. According to a report by the Population Action International<sup>7</sup> (PAI) in 2001, rapid population growth and high fertility rate in most developing countries is associated high food insecurity. Hence, a negative relationship is expected on the food security measure.

*Total area under irrigation:* Irrigated land refers to arable lands, solely provided with water for farming during off farming seasons (World Bank, 2012). Because cereals remain the primary staple food in SSA, if irrigation systems are developed for farmers, domestic cereal production is likely to grow within the region. Bagson and Kuuder (2013), asserted that in periods of off farming season, irrigation schemes improve the well-being of farmers through increases in food production which further enhances the household food security situation. Hence, the more arable lands are irrigated, the more productive the land will be for cereal cultivation holding all other factors constant.

*Exchange rate:* The study uses the official exchange rate measured in local currency unit per US dollar of each of the countries. This measure is useful to take care of the cross-country variations in the exchange rate. The volatility of the exchange rate in a country has a role in determining the level of food availability in a country through the appreciation and the depreciation of the currency. Gardner (1981) has reviewed evidence to suggest that the exchange rate was the most important variable in explaining real US farm food prices. The study expects either a positive or a negative outcome.

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<sup>7</sup> Population Action International is an International Non-Governmental Organization which uses research and advocacy to improve global access to family planning and reproductive health care. Sourced from: [www.pai.org](http://www.pai.org)

Table 1 reports the summary of the independent variables in the study. The source of data is also reported, and the expected signs on the dependent variable of each indicator are also reported.

**Table 3.1: Summary of Explanatory variables, their Expected signs and Data sources**

Variable	Expected sign	Data sources
GDP per capita (LCU/USD)	Positive	World Bank
Trade Liberalisation (dummy)	Positive / Negative	Wacziarg and Welch
Level of political openness	Positive	Systemic peace
Cereal cultivated land (Llucp)	Positive	USDA
Population (Lpop)	Negative	World Bank
Total irrigated land (Lirri)	Positive	USDA
Cereal productivity (Lcypc)	Positive	World Bank
Exchange rate in LCU/USD (Lexc)	Positive / Negative	World Bank

**Source:** Authors own tabulation.

### 3.5 Estimation technique

The study used a panel data estimation technique to estimate the effects of trade liberalisation on food security in SSA. This estimation method is used to account for temporal autocorrelation, reduce the level of potential spurious regression and to correct for heteroscedasticity. Panel data estimations are very suitable when one suspects that, the outcome variable depends on non-observable explanatory variables, but are correlated with the observed explanatory variables (Hsiao, 2003). If such omitted variables remain constant over time, panel data estimators permit one to consistently estimate the effect of the observed explanatory variables. An important motivation for using panel data is the control of unobserved

heterogeneity to avoid the problem of endogeneity bias (Hsiao, 2014). The reasoning is that countries have some unique characteristics that are known only to them. To use panel data models, the following assumptions must hold.

1. The model must be linear in parameters where  $E(\varepsilon_{it}) = 0$
2. Strict Exogeneity. This assumption is needed to rule out lagged dependent variables (Schmidheiny and Basel, 2015).
3. There is no problem of serial correlation and heteroscedasticity.

Although panel data estimates command the advantage of using both time and cross-sectional dimensions which improve the quality and quantity of the data. This estimator is flawed on the argument that it does not adequately address the problem of endogeneity in the model. Hence, prompting the need for a dynamic panel estimator.

The dynamic panel is best estimated when the General Method of Moments (GMM) estimation technique is used. One advantage of using the GMM is, it helps address the problem of “dynamic panel bias” – a phenomenon where the lagged dependent variable correlate with the error term. The dynamic panel models use internal instruments to deal with the problem of endogeneity in the model. Under the assumptions stated below, the GMM estimates produces consistent and efficient results (Hsiao, 2014).

1. A linear functional relationship exists amongst the variables.
2. A small period and a significant number of observations.
3. There exists country-specific serial correlation and heteroscedasticity in the stochastic error term.

4. Some of the independent variables are endogenous which can be used as internal instruments.
5. The Hausman specification test permits the fixed effects model (Roodman, 2009).

Two primary estimation procedure in using GMM include; the difference GMM by Arellano and Bond (1991) and the system GMM by Arellano and Bover (1995) and Blundell and Bond (2000). The Arellano and Bond (1991) difference GMM takes the first difference to eliminate the country heterogeneity term. By first differencing, instruments for the potential endogeneity term is constructed. The instrument generated is then used for the estimation. If the instrument is strong, then the problem of endogeneity is eliminated to produce consistent estimates.

From equation two the first difference of the dependent and the independent variable is presented as:

$$Y_{it} - Y_{it-1} = \Phi(Y_{it-1} - Y_{it-2}) + \beta_1(x'_{it} - x'_{it-1}) + (\varepsilon_{it} - \varepsilon_{it-1}) \quad 5$$

$$Y_{it} - Y_{it-1} = \Phi(Y_{it-1} - Y_{it-2}) + (\varepsilon_{it} - \varepsilon_{it-1}) \quad 6$$

$$\Delta Y_{it} = \Phi \Delta Y_{i,t-1} + \Delta \varepsilon_{it} \quad 7$$

The transformed model above removes the individual effects ( $f_i$ ) in the fixed effects model. For the differenced equation to hold, the model is performed under the assumption that the regressors are weakly exogenous, and there is no autocorrelation in the error term. One of the main problems of the difference estimator is serial correlation and weak instruments<sup>8</sup>. This may increase the variance of the coefficient and bias them in small samples. Due to the problem of weak instruments, Arellano and Bover (1995) and Blundell and Bond (2000) suggested a System GMM estimator that combines the level estimator and the first difference estimator for a consistent and efficient estimates (Roodman, 2009). For the instrument to hold under the

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<sup>8</sup> An instrument is said to be weak when there is a weak correlation between the endogenous variables and the instruments (Roodman, 2009).

System GMM, the heterogeneity term should be correlated with the independent variables; secondly, the lagged differences and the heterogeneity term should not be associated. The system GMM is preferred because efficiency in results is improved because both the level equation and the first difference equations (Roodman, 2006). To ascertain consistent and reliable estimates two primary test are performed. The Arellano-Bond test and the Sargan test. The Arellano-Bond test is conducted under the hypothesis that there is no autocorrelation between the error terms. The Sargan test is also conducted to test for over identifying restrictions.

### **3.6 Diagnostic tests**

To ensure the reliability of the estimation results, the following diagnostic tests are carried out to ascertain the appropriateness of the variables and the estimators used in the study.

#### **3.6.1 Test for time effects**

In order to check the appropriateness of the pooled regression model, time effects is checked for – that is, testing if the data is stable over time. If there are no time effects in the regression model, the pooled OLS estimator is used for inference. However, if there are time effects, the pooled model is rejected for an efficient estimator. The joint null hypothesis for time effects is;

- $H_0$ : There are no time effects in the pooled model.
- $H_1$ : There are time effects in the pooled model.

An acceptance of  $H_1$  means a rejection of the pooled model for either the Random effects or the fixed effects estimator.

### 3.6.2 Serial correlation and heteroscedasticity

In both the panel and dynamic panel data model, there is the problem of serial correlation and heteroscedasticity. Serial correlation is present in dynamic panel because of the lagged dependent variable as an explanatory variable in the model. From equation 2, when the lag of the dependent variable is taken, the serial correlation problem is observed.

$$Y_{i,t-1} = \Phi Y_{i,t-2} + x'_{i,t-1} \beta_1 + f_i + \varepsilon_{i,t-1} \quad 8$$

It is observed that the dependent variable and its lag are correlated with the heterogeneity term. The problem of heterogeneity is present in both panel and dynamic panel models because individual countries have peculiar characteristics known only to them. They include specific economic, social, environmental and geographical characteristics. Their presence in the model could lead to inconsistent and biased estimates.

### 3.6.3 Random Effect (RE) and Fixed effects (FE)

The correlation between the time-invariant country-specific error and the explanatory variables in the model raises two main estimation techniques in both panel and dynamic panel data estimators. They are the Random effects (RE) and the fixed effects (FE) model. The RE model assumes that the unobserved heterogeneity term does not correlate with the explanatory variables (Verbeek, 2008). That is, it also assumes that the variance does not change over time and that the individual specific effect is also constant.

$$\text{Thus, } Cov(f_i, x_{it}) = 0$$

The fixed effects model, on the other hand, allows the heterogeneity term to be correlated with the explanatory variables in the model. This is needed to control for omitted variables that vary between countries but are constant over time (Gujarati, 2003). The heterogeneity term included

in the model under the fixed effects could lead to the problem of endogeneity. The within transformation is used to eliminate the heterogeneity effect and the constant term. From equation 3.2 the resultant equation is stated in equation 9.

$$\Delta Y_{it} = \Phi \Delta Y_{i,t-j} + \Delta x'_{it} \beta_1 + \Delta \varepsilon_{it} \quad 9$$

The Hausman specification test is conducted to select the appropriate estimator of the model. That is either the RE or the FE estimator. The following hypothesis is presented for the selection of a suitable estimator under the Hausman specification test.

$$H_0: \quad RE = Y_{it} = \beta_0 + x'_{it} \beta_1 + f_i + \varepsilon_{it}$$

$$H_1: \quad FE = Y_{it} = \beta_0 + x'_{it} \beta_1 + \varepsilon_{it}$$

If the FE is accepted over the RE, the system GMM would be used to address the problem of endogeneity in the model for consistent and efficient estimates (Blundell & Bond, 2000).

### 3.6.4 Endogeneity test

The problem of endogeneity occurs an estimation when there is a correlation between the regressors and the error term. The problem might be as a result of reverse causality between the dependent variable and the regressors, or it might arise as a result of omitted variable bias. Equation 1 it likely to be prone to endogeneity. In the presence of endogeneity; the correlation between the heterogeneity term and the error term is non-zero. The Durbin-Wu-Hausman test for endogeneity is used to test for the presence of endogeneity in a model (Roodman 2009).

### 3.6.5 Stationarity (Unit Root) Test

Unit root test is regarded as a time series problem. The essence of conducting unit root test in panel data is to avoid the problem of spurious regression (Hsiao, 2014). The unit root is performed based on the hypothesis that all panels contain unit-roots. Hence, they are non-stationary. The Fisher test of unit root will be used because the data set is unbalanced. Some of the advantages of using the Fisher test is, it is possible to include a time trend or a drift term in the test as compared to the Im-Pesaran-Shin test (Choi, 2001).

### 3.6.6 Other diagnostic test

The Breusch – Pagan Lagrange Multiplier test statistic is used to test whether the variance is significantly different from zero. The Breusch–Pagan Lagrange Multiplier statistic, tests the following hypothesis stated below. Under the test hypothesis, a rejection of the Null-hypothesis means that the random effects estimator is appropriate in estimating the model than the pooled OLS estimator.

$H_0$ = Pooled OLS estimator is appropriate

$H_1$ =Random effects estimator is appropriate

The Sargan test of over-identification is also performed to test the validity of the internal instruments used in the model. The Arellano-Bond test for autocorrelation is also conducted to test for the presence of autocorrelation in the residuals. The Variance Inflation Factor test for multicollinearity is also carried out to ascertain the level of correlation amongst the independent variables.

### 3.7 Conclusion

In summary, the chapter discusses the theoretical basis of the panel and system GMM estimation technique and how it's to be applied to achieve the second objective of the study. It is apparent that certain estimation problems are likely to be encountered this include: serial correlation, heteroscedasticity, and endogeneity. These will be verified in chapter four of the study. The study performs the pooled OLS estimator, the Random effects estimator, the fixed effects estimator and the system GMM estimation technique to report consistent results. The focus of the discussion of the result is however, based on the system GMM estimator.



## CHAPTER FOUR

### ANALYSIS AND DISCUSSION OF RESULTS

#### 4.1 Introduction

The analysis of the data is presented in two parts to achieve the objectives of the study. The first part discusses trends of food security in SSA. The second part of the chapter provides an analysis of the estimated results of the study. Under this section, four main parts are defined. The first section provides descriptive statistics of the variables. The next section provides the empirical estimates, followed by a third section which presents the results of the diagnostic tests and the last section discusses the findings based on the appropriate estimator. StataCorp's statistical package software version 13 (STATA 13) is used for the estimations

#### 4.2 Trend Analysis of food security in SSA

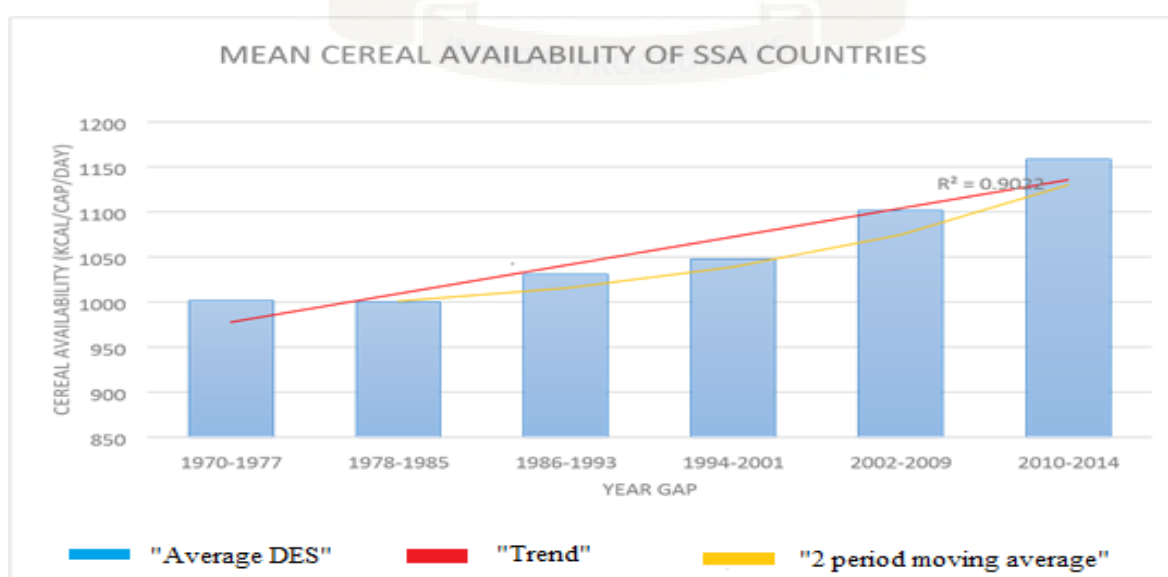
The growth in food security over the period 1970-2014 has been stable in spite of the episodes of hunger and food crises recorded in the region over the years. Figure 4.1 shows the trend of food security over the years. The trend is categorized into; (1) the pre- trade liberalisation era which is captured in 1970-1985; (2) the trade liberalisation era which captures the periods 1986-2001 and (3) the new trade reforms period which captures 2002-2014.

As shown in Figure 4.1 the pre-trade liberalization era was relatively stable over the period. Thus, the average cereals availability in the region between 1970 and 1985 was estimated around 1000.93 Kcal/cap/day.

The trade liberalisation era was associated with increases in food security in the region. The average food security between 1986-2001 increased from 1000.93 Kcal/cap/day to 1047.76 Kcal/cap/day during this period. As studied by Cleaver et al. (1995), some countries within SSA had achieved positive growth rates in food production per capita between 1986 and 1990. They estimated that food production grew at 3 percent per annum in these countries; Kenya, Benin, Nigeria, Botswana, Uganda, Togo, Mali, Niger, and Cote D'Ivoire (Cleaver et al., 1995). Similarly, According to UNECA (1995), growth yield in maize, Rice, millet, and sorghum in Burkina Faso grew by 4 percent between 1990 and 1991.

The period from 2002 - 2014 was associated with relative growth gains in food security in the region. Food security per capita per day increased to 1158.32. According to Ogundele (2011), the growth in food security with the region could be attributed to the role of globalisation through rising imports and commitment to increasing agricultural spending in SSA by 10 percent.

**Figure 4.1: Average DES(Kcal/cap/day) of SSA countries**



Source: Author's computation based on data obtained from FAO

Based on the availability of cereal data in the region for each of the countries, the following trends were observed. Similar to (Depetris et al., 2012), whereas some groups of countries showed an increasing trend, other groups showed a decreasing trend over same period whilst others showed no change.

#### 4.2.1 Constant trend cases of food security in SSA

From the figure 4.2, between 1970 and 1980, Tanzania and Cote D'Ivoire exhibited an increasing trend in food security that is from about 500 Kcal/cap/day to about 1000 Kcal/cap/day. After this steady rise, food security has remained relatively stable over the years in these two countries. For the case of Uganda, Niger, South Africa and Rwanda, the trend has remained relatively stable over the period. Senegal however, recorded a steady rise in food security from 1970-1990 followed by a steady decline over the period 1990 to 2010.

**Figure 4.1: Constant Trend of Selected SSA Countries.**



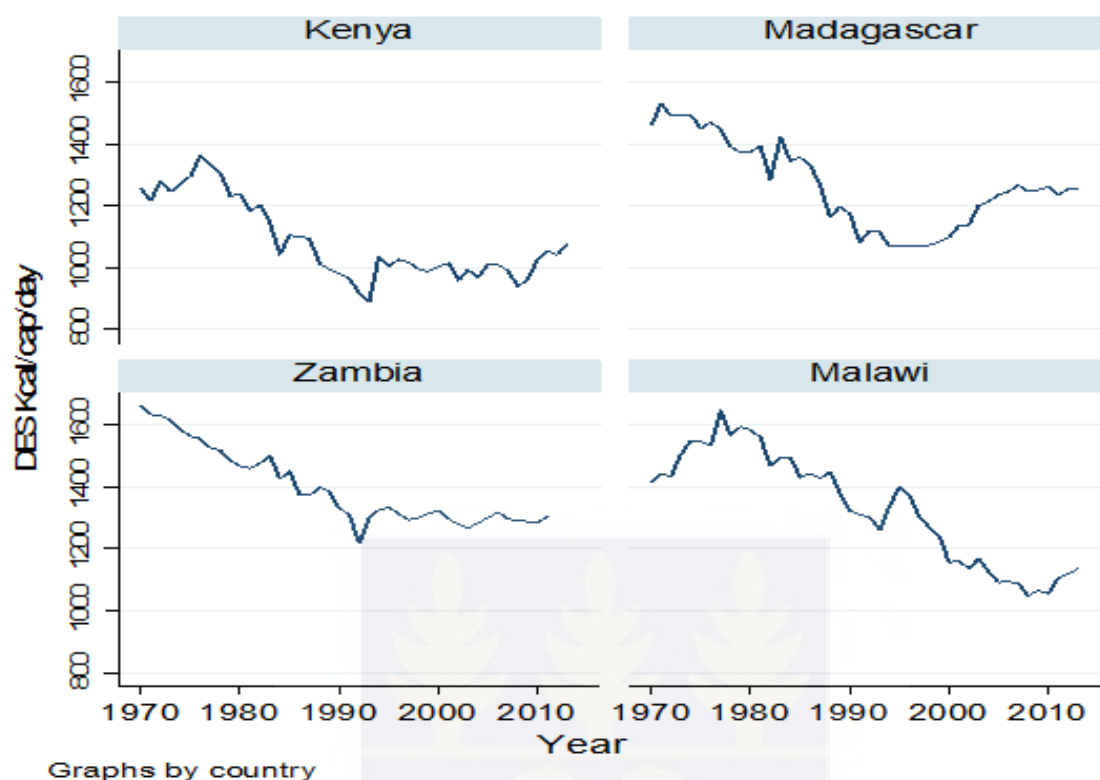
Source: Author's computation based on data obtained from FAO.

#### **4.2.2 Decreasing trend cases of food security in SSA.**

From Figure 4.3, Kenya, Madagascar, Malawi, and Zambia have all exhibited a decreasing trend in food security over the years under study. Over the period, Zambia and Malawi recorded the highest availability of cereals both of which occurred in the 1970s. According to a report by the United States Agency for International Development [USAID] (1999), the decline in food security in Malawi and Zambia may be attributed to two main factors. The first is excessive government debt, which is reflected in the country's balance of payment position resulted in a high import bill for the importation of food. Secondly, an unusual climatic condition affected the domestic production of cereal in the country (Mkumbwa, 2011).

Emongor (n.d) has stated that the decline in food security is linked to rapid urbanization leading to the clearing of arable lands meant for agriculture. Secondly, rapid population growth. Thirdly, high input price for cereal cultivation and lastly, low Gross national income per capita which affects the country's ability to import cereals to buffer domestic production (Diaz-Bonilla, 2015). Similarly, according to Ochieng et al. (2016), the declines in food security in Kenya have corresponded with the years of drought in the country and the dependence on rain-fed agriculture. In the case of Madagascar, the decline in food security over the period could be as a result of the political instability and economic uncertainty in the country. The results being characterised by a suspension of humanitarian assistance, harsh climatic factors in the Malagasy province. According to Mathys and Maalouf-Manasseh (2013) less arable land available for commercial farming and rural-urban migration are contributing factors.

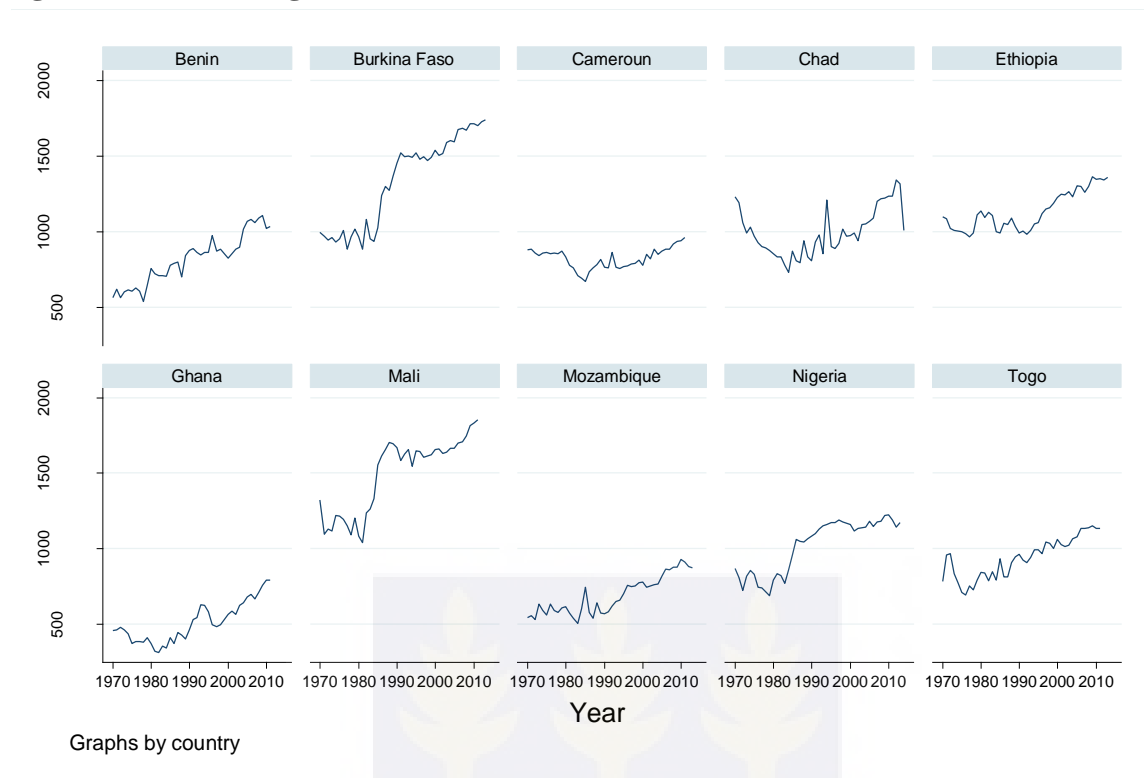
**Figure 4.2: Decreasing Trend of Selected SSA Countries**



Source: Author's computation based on data obtained from FAO.

#### **4.2.3 Increasing trend cases of food security in SSA**

From Figure 4.4 all 10 countries have demonstrated increasing availability of cereals over the entire duration of the study. These countries include Benin, Burkina Faso, Cameroun, Chad, Ethiopia, Ghana, Mali, Mozambique, Nigeria and Togo. Except Chad, Nigeria and Togo that have seen a decline in food security in the 1970s and a later, consistent rise from the 1980s.

**Figure 4.3: Increasing Trend of Selected SSA Countries.**

Source: Author's computation based on data obtained from FAO

### 4.3 Econometric analysis

#### 4.3.1 Descriptive statistics of variables

The descriptive statistics pertain to 21 SSA countries over the period 1970–2014. The mean, standard deviation, and the range of the dependent and independent variables are specified. Table 2 reports the descriptive statistics for the food security metric and all the independent variables in the model but political stability and trade liberalisation. A dummy variable is introduced for trade liberalisation. Where 1 represents an open economy and 0 represents a closed economy. A categorical variable is defined for the level of political openness in a country over the period. Where zero denotes autocratic regimes, one denotes anocratic regimes, and two signifies democratic regimes

Over the period 1970–2014, the average food availability in SSA is 1044.75 Kcal/cap/day. The range is between 219 kcal/cap/day and 1855 Kcal/cap/day. This range gives an indication of the relative disparity between countries in SSA. The mean real per capita income in the region is 629.15 dollars. The average land under cereal cultivation within the region is 262.85 km<sup>2</sup> and the average increase in irrigated land area is 1520.57 per km<sup>2</sup>. This could be attributed to the general increase demand for cereals in SSA. The level of cereal productivity on the average is 116.61 kg/km<sup>2</sup>. This could be attributed to commitments to investment in the agricultural sector in most SSA countries. The average population for the selected countries is 20.34 million. Nigeria being the most populated country and Togo being the least populated amongst the selected countries.

**Table 2: Summary statistics of the study.**

Variable	Units	Obs.	Mean	Std. dev	Min	Max
Food security	(’000s)Kcal/cap/day	903	1044.75	369.42	219	1855
GDP in millions	Million US dollars	945	629.15	838.03	49.47	7975.05
Total irrigated land area	Km <sup>2</sup>	882	1520.57	3115.22	0	16010
Land under cereal cultivation	Km <sup>2</sup>	924	262.85	330.27	0	1941
Cereal productivity	Kg/Km <sup>2</sup>	924	116.61	58.36	0	441.27
Population	Millions	945	20.34	24.86	2.12	177.48
Exchange rate	LCU per USD	945	304.32	408.0	.0001	2599.79

Source: Author’s calculation based on STATA (13) estimates.

#### 4.2.2 Empirical results

At this juncture, the study discusses the results of the system GMM dynamic panel estimator. The Fixed effects, the Random effect, and the pooled OLS models are used as robustness checks for a consistent, efficient and a meaningful inference. On the basis of the regression results shown in Table 3, the pooled OLS estimator reports significant estimates at 1 percent level for trade liberalisation, log of population, log of GDP, log of irrigated land area, log of land under cereal production and log of cereal productivity. The log of exchange rate and the degree of political openness is however, insignificant .

Trade liberalisation positively induces an increase in food security. The implication is that over the period, countries that opened up to trade saw an improvement in their food security situation than the periods they were closed to trade. The measure of the level of political openness and population growth negatively affects food security. However, the degree of political openness is insignificant in explaining the level of food security in the selected countries.

A test for time effects in the model confirms that the OLS estimator would yield biased estimates which may lead to inefficient conclusions. Hence, the Random effects model is adopted with the assumption of no individual heterogeneity. Under the Random effects model, trade liberalisation also causes food security to improve. The level political openness and total population growth is not significantly positive to food security. The log of GDP per capita and the log of exchange rate is also not significant in explaining the level of food security. To ascertain a robust measure of the estimates, a test for heteroscedasticity is conducted using the Breusch Pagan Lagrange Multiplier test. The results confirm the presence of heteroscedasticity in the model. Hence, the Fixed effects estimator is adopted. Under the Fixed effects model, the heterogeneity term is allowed to be correlated with the regressors in the model to correct the

problem of omitted variable bias. As observed in the pooled OLS and the Random effects estimators, trade liberalisation is significant and positively promotes improvement in food security at a 99 percent confidence interval. Population growth and degree of political openness showed a significant negative outcome. In consonance with the Random effects model, GDP and the exchange rate remain insignificant. However, the log of land under cereal cultivation, log of the population and the log of cereal productivity is significantly important at 1 percent significance level but for the log of irrigated land area which is significant at 10 percent.

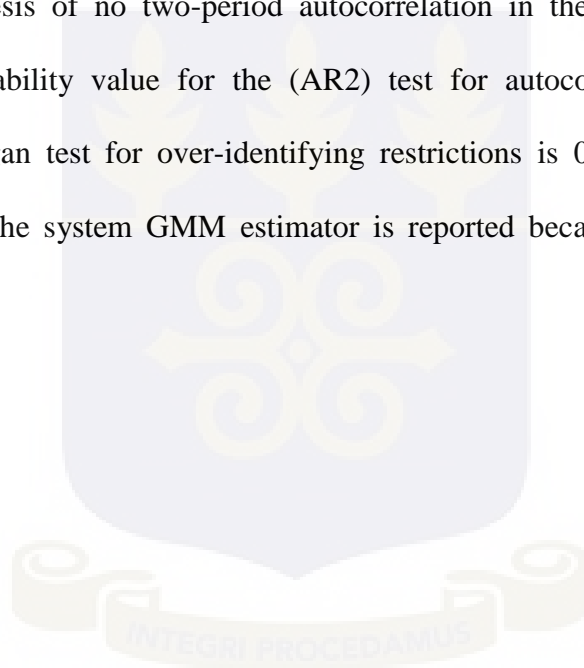
The choice of either the Random effects or the Fixed effects model is made possible by the Hausman test. The test is conducted under the null hypothesis that the Random effects model is appropriate and an alternative hypothesis that the Fixed Effect Model is appropriate. The results of the test in Table 5 confirm the rejection of the Null-hypothesis that the Random effects model is inappropriate to estimate the model. Hence, using the Fixed effects estimator for the estimation would yield consistent estimates.

However, the heterogeneity term in the Fixed effects model, possibly leads to the problem of endogeneity in the study. As a result, a test of endogeneity is conducted on all the variables but for trade liberalization and the level of political openness using the Durbin – Wu – Hausman test. As reported in Table 6, the test confirms the presence of endogeneity in the model, hence the need for a system GMM dynamic panel estimator.

The system GMM estimator is used because of its inherent endogeneity correction mechanism. According to Roodman (2009), because the system GMM combines both the level and the difference equation in the model, it yields consistent, efficient and reliable results for inference. The contemporaneous first difference is used as the instrument in the levels equation. As

observed from Table 3, the system GMM estimator produces smaller coefficients than the fixed effects, random effects, and the OLS estimators. The two periods lagged dependent variable in the system GMM is also reported in Table 3. From the table, the first lag coefficient of the food security metric is statistically significant at 1 percent. However, the second lag coefficient of the food security parameter is not statistically significant.

From the Table 3, the significant Wald Chi-squared for all the regressions shows that the explanatory variables are jointly significant. The Arellano-Bond test in first difference fails to reject the null hypothesis of no two-period autocorrelation in the residuals required for consistency. The probability value for the (AR2) test for autocorrelation is 0.342. The probability of the Sargan test for over-identifying restrictions is 0.252. By the estimates presented in Table 3, the system GMM estimator is reported because of consistency and efficiency.



**Table 3: Determinants of food security; GMM, FE, RE and OLS**

Dependent variable	System	Fixed	Random	
Food security (Dietary Energy Supply)	GMM	effects	effects	OLS
<b>Determinants</b>				
Log of food security (DES)_1	0.746*** (0.113)			
Log of food security (DES)_2	0.068 (0.100)			
Log of total irrigated land area	0.025** (0.012)	0.027* (0.014)	0.040*** (0.013)	0.110*** (0.008)
Log of cereal cultivated land	0.092*** (0.027)	0.358*** (0.017)	0.367*** (0.017)	0.534*** (0.018)
Log of GDP	0.014 (0.010)	0.006 (0.013)	0.012 (0.013)	0.033*** (0.011)
Log of cereal productivity	0.074*** (0.027)	0.306*** (0.021)	0.311*** (0.021)	0.386*** (0.027)
Log of exchange rate	0.005 (0.004)	-0.002 (0.003)	-0.001 (0.003)	0.004 (0.003)
Log of population	-0.133*** (0.038)	-0.249*** (0.033)	-0.299*** (0.031)	-0.653*** (0.021)
Degree of political openness (Autocracy)	-0.000 (0.004)	0.008 (0.005)	0.006 (0.005)	-0.012 (0.009)
Degree of political openness (Democracy)	-0.002 (0.005)	-0.000 (0.006)	-0.000 (0.006)	-0.017 (0.010)
Trade liberalisation (Open economy)	0.007* (0.004)	0.021*** (0.006)	0.024*** (0.006)	0.025*** (0.009)
Constant	0.620*** (0.155)	1.535*** (0.196)	1.779*** (0.184)	2.869*** (0.109)
Observations	779	779	779	779
R-squared		0.482		0.770
Wald Chi2 (Prob > Chi)	0.000			
Arellano-Bond AR2 (Pr > Z)	0.342			
Sargan test of over-identification (Pr > Z)	0.252			
Number of country	21	21	21	21

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Source: Author's computation using STATA (13)

### 4.2.3 Breusch Pagan Lagrange Multiplier Test

The Breusch–Pagan Lagrange Multiplier test is conducted to test for the presence of heteroscedasticity in the model. The resultant  $\text{Prob} > \chi^2 = 0.0000$  confirms the existence of individual heterogeneity in the model. Table 4 reports the statistic of the Breusch-Pagan Lagrange Multiplier test. As a result of the problem of heteroscedasticity in the model, the robust command is used in the OLS estimation to correct the problem

**Table 4: Breusch –Pagan Lagrange Multiplier Test**

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Ho: Constant variance (Homoscedasticity)
Chi2bar (1) = 6049.22
Prob > Chi2 = 0.0000

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Source: Authors computation using STATA (13)

### 4.2.4 Multicollinearity test

The test of multicollinearity is performed as a diagnostic check because when there is a near perfect or perfect relationship among the explanatory variables in the model, the regression model cannot be uniquely computed. This may render the model unstable and may inflate the standard errors of the estimates. The Variance Inflation Factor (VIF) is computed for multicollinearity in the model. The rule of thumb under this computation states that when the VIF computed is greater than 10 further investigations may be requested to correct the problem. Table 5 shows the results of the VIF test for multicollinearity. From Table 5, the mean value of  $\text{VIF} = 2.38$ . This is less than 10. Hence, there is no serious problem of multicollinearity amongst the explanatory variables in the model.

**Table 5: VIF test for Multicollinearity**

Variable	VIF	1/VIF
1. Trade liberalisation	1.91	0.523335
Level of political openness		
0 (Period of autocratic regime)	1.78	0.562962
2 (Period of democratic regime)	1.43	0.698258
Lgdp	1.44	0.692479
Lirri	2.50	0.400485
Llucp	4.16	0.240274
Lcypc	2.49	0.401187
Lexc	1.25	0.802851
Lpop	4.47	0.223695
Mean VIF	2.38	

#### 4.2.6 Hausman test

The Hausman test is performed to choose between the Random Effects estimator and the Fixed Effects Estimator. The test is performed on the assumption that the two covariance matrices used in the test be based on a standard estimate of disturbance variance. Table 5 shows the results of the Hausman test.

**Table 6: Hausman Test for Random Effects Verses Fixed Effects**


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Test:	Ho:	difference in coefficients not systematic	
	chi2 (8)	=	$(b-B)'[(V_b-V_B)^{-1}](b-B)$
		=	22.70
	Prob > chi2	=	0.0069

---

Source: Authors Computation Using STATA (13)

From the above estimated results, the P-value is less than the conventional 0.05. This confirms the appropriateness of choosing the fixed effects model over the random effects model.

#### 4.2.7 Test for endogeneity

The study employs the Durbin-Wu-Hausman (DWH) test to validate the presence of endogeneity among some of the variables in the model. The results of the DWH test confirms that total irrigated land, land under cereal cultivation, cereal productivity, population and exchange rate are all endogenous. However, the log GDP per capita was not endogenous using the Durbin-Wu-Hausman test. (see table 7). An implication is that they should be instrumented with appropriate instruments. In this case, the assumption of Exogeneity in panel data will not hold under the system GMM. This implies that the system GMM approach would yield consistent and efficient estimates given that it will address the problem of endogeneity in the model.

**Table 7: Durbin-Wu-Hausman Test for Endogeneity**

Null Hypothesis	Durbin (Chi)		Wu - Hausman (F)	
	Statistic	P-value	Statistic	P-value
Lgdp	1.46658	0.2259	1.45992	0.2273
Lirri	346.088	0.0000	617.969	0.0000
Llucp	148.062	0.0000	180.930	0.0000
Lcypc	121.348	0.0000	142.632	0.0000
Lpop	322.821	0.0000	547.024	0.0000
Lexc	94.8548	0.0000	107.313	0.0000

*Note: The residuals of the variables are predicted and tested for significance after regressing them on all the other exogenous variables.*

H<sub>0</sub>: Variables are exogenous

H<sub>1</sub>: Variables are not exogenous

Source: Author's computation using STATA (13)

#### 4.2.8 Stationarity (Unit Root) Test

A test of stationarity is conducted to ascertain the stationarity or otherwise of the panel data set. The Fisher test assumes that the data is generated by an Autoregressive (1) process. The Fisher test is conducted by performing a unit root test separately on each variable and then combine all the variables to obtain a panel unit root test. A drift term is specified because the mean values are non-zero. Under the Fisher test, the null hypothesis reports that the variables have no unit roots. According to Choi (2001), because the number of panels is finite, the inverse chi-squared test yields a powerful and an appropriate testing result for panel unit root. The study, therefore rejects the Null hypothesis that all panels contain unit root on the basis of the inverse chi-squared p-value and the inverse normal p-value. It is concluded that at least one

panel is stationary hence there is no tendency for the problem of spurious regression. Table 8 reports the test for stationarity for all the variables.

**Table 8: Fisher–Type Stationarity (Unit Root) Test**

Variable	Inverse chi-squared		Inverse Normal		Inverse Logit	
	Statistic	P-value	Statistic	P-Value	Statistic	P-value
L (DES)	139.9921	0.0000	-7.2966	0.0000	-8.0972	0.0000
Lgdp	145.0685	0.0000	-7.6866	0.0000	-8.3653	0.0000
Lirri	244.9327	0.0000	-7.3181	0.0000	-12.1593	0.0000
Llucp	110.7963	0.0000	-5.9844	0.0000	-6.2833	0.0000
Lcypc	253.7459	0.0000	-11.8281	0.0000	-15.1428	0.0000
Lpop	308.1066	0.0000	-2.8863	0.0019	-6.7661	0.0000
Lexc	66.2520	0.0099	-2.0217	0.0216	-1.7678	0.0399

H<sub>0</sub>: All panels contain unit roots                      H<sub>1</sub>: At least one panel is stationary

Source: Author's computation using STATA (13)

### 4.3 Discussion of results

The main findings of the effects of trade liberalisation on food security and the other significant explanatory variables are discussed below.

*Trade liberalisation:* In conformity with other relevant studies, trade liberalisation is positively related to food security. A Comparison of the results from the system GMM, the fixed effects estimator, the random effects estimator and the pooled OLS estimator shows that the system GMM estimator yields robust estimates for inference. A positive outcome is seen as trade liberalisation causes improvement in food security over the period. The coefficient of trade

liberalisation on the food security metric is significant at 10 percent level of significance. For the purposes of an efficient and a consistent estimator, the system GMM coefficient is considered over the other robustness check estimators. This outcome is consistent with earlier similar empirical works. (Vamvakidis, 1999; Madeley 2001; Shapouri & Trueblood, 2001; Imad & Karim, 2003; Bouet et al., 2005; Chang & Sumner, 2006; Opolot et al., 2006; Dorosh et al., 2009; Ivica, 2013; Zakaria & Xi, 2014). This result suggests that for SSA, trade liberalisation remains a critical component in improving food security and ending malnutrition and hunger.

*Log of population growth:* In line with the a priori expectation, the relationship between population growth and food security is negative. The implication is that growth in the population is a catalyst for food insecurity in the region as the only continent experiencing the highest incidence of hunger and malnutrition (FAO, 2015). The results of the system GMM estimate presented in Table 3 indicate that food security will decline by 1.3 percent for a one percent increase in the population in the region. According to a report by Population Action International in 2001, population growth leads to a rise in demand for food which exacerbates the rise in demand for arable land use and water in SSA. To further emphasize the confirmation of this result, Bremner (2012), concludes that population growth in SSA will significantly affect the food needs of the people in SSA if the current reproductive choices of the youth are not checked. An implication is that uncontrolled levels of population growth in SSA are further likely to exacerbate the incidence of food insecurity in the region.

*Log of land under cereal cultivation:* Land under cereal cultivation retains a positive and significant coefficient as expected at 1 percent level of significance. This suggests that the more lands are cultivated with cereals, the greater the availability of food. The coefficient of land

under cereal cultivation implies that a proportionate improvement in land under cereal production will lead to about a 0.9 percent increase in food security in SSA. An implication to ending food insecurity in the region is smallholder farming accounts for most jobs created in the rural regions of SSA (Timmer, 2010). Hence, an increase in the cultivable area meant for cereal production can help boost the national food supply without necessarily relying on imports. Evidently, countries like Kenya and Ethiopia have succeeded in reducing hunger and food insecurity through donor support in expanded cropland area for farming (Timmer, 2010). This outcome also confirms the findings of Bezuneh and Yiheyis (2014) that agricultural land plays a significant role in improving food security in SSA.

*Log of Cereal productivity:* The coefficient of cereal productivity causes food security positively by 0.7 percent. This means that the more productive cereal lands are in the sub-region, the more food secured the sub-region becomes. The productivity of the cereal lands relates to how land is made productive for agricultural purposes. This coefficient is, however, significant at 1 percent under the system GMM. According to Timmer (2010), the best way to prevent food crises, in the long run, is to invest in “agricultural productivity and policies on behalf of stable food production and prices” rather than “trying to cope afterwards with the food crisis impact on the poor.” The implication is that policy should be targeted at making food available at all times rather than coping after a food security emergency situation arises. Bremner (2012) further reinforced that improving agriculture on small farms is critical to reducing hunger. Similarly, Conceição et al. (2016) accented that, to ensure food security in SSA, it is important that farmers in SSA increase agricultural productivity through rapid increases in land productivity.

*Log of total irrigated land area:* The positive estimated coefficient of total irrigated land on food security in SSA, means that as more and more arable agricultural lands are irrigated for cereal cultivation in the region, food security will increase by 0.25 percent for every unit increase in the total irrigated land area in the region. The coefficient of the estimated result is statistically significant at 5 percent level of significance. The positive causation of increasing food security as a result of increasing irrigated land area is consistent with literature and other empirical studies conducted in this regard. (Sahn et al., 1992; Conceição et al., 2016; Liu et al., 2016; Srinivasan, 2016).

Although the log of GDP was not significant in explaining the level of food security in the region. It had a positive effect on food security in the region. Similarly, the coefficient of the exchange rate was not significant in explaining the level of food security in the selected countries. The implication is that there is no evidence to support the relationship between exchange rate and food security in the region. The relationship between a politically democratic country and food security reported a positive outcome, but not significant in explaining the level of food security in the region.

#### **4.4 Conclusion**

This chapter of the study analyses the panel dataset of 21 countries to ascertain the relationship between trade liberalisation and food security in the Sub-Saharan African region. The results have been discussed alongside the diagnostic test. Before the system GMM results were reported, a test of unit root was conducted to test for stationarity in the data set. The Fisher unit root test ascertained stationarity in the data set. In analysing the relationship between trade liberalisation and food security the pooled OLS estimator was first conducted.

The results indicate significant figures for Log of land under cereal cultivation, cereal productivity, Log of population, log of irrigated land area, log of GDP and trade liberalisation but not the log of exchange rate, and the level of political openness. A test for time effects confirms the presence of time increasing variables. Hence, the random effects estimator is used for a robust study. However, because of the presence of heteroscedasticity, the fixed effects model is also estimated. A choice between the Random effects estimator and the Fixed effects estimator is made possible by the Hausman test. The results confirmed the choice of the fixed effects over the random effects. The suspicion of the presence of endogeneity in the fixed effect model means the fixed effects model would not report consistent and reliable estimates. Hence, the Durbin-Wu-Hausman test of endogeneity is performed to validate the presence of endogenous variables in the model. The results suggest the existence of endogenous variables in the model which includes irrigated land area, population, exchange rate, cereal productivity and land under cereal cultivation. In order to correct the problem of endogeneity for robust estimates, the system GMM dynamic panel estimator is used because of its inherent endogeneity correction mechanism. The results of the system GMM model suggest that trade liberalisation causes food security positively at a 10 percent level of significance. Although, the effect is positive and significant, one is tempted to argue to support the assertion that given certain factors such loss of rural livelihoods in SSA countries as a result of trade liberalisation can warrant a change in the finding. This however, confirms a similar argument that the expected gains from full trade liberalisation in the Latin American countries had not been realised.

## CHAPTER FIVE

### SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

#### 5.1 Introduction

This chapter presents the summary, conclusion and policy recommendations based on the finding of the study. Some limitations of the study are identified to aid in future studies on the subject matter.

#### 5.2 Summary and Conclusions

The incidence of hunger and food insecurity in SSA countries has been an issue of global, regional, national, institutional and individual researchers concern over the years. It is a common concern amongst SSA countries that trade liberalisation policies have not significantly improved the food availability situation in the region. This may have prompted some empirical studies on the subject matter. Some studies have evidenced that the advent of trade liberalisation policies has led to the improvement of food security in the region. Other empirical studies conducted, have shown an adverse effect on food security as a result of trade liberalisation policies. Despite the contradictory evidence on the subject matter, the purpose of the study is aimed at filling the lacuna in literature. This has necessitated the need for this study with the principal aim of examining the effects of trade liberalisation on food security in SSA.

The study uses an unbalanced panel data for food security in twenty - one (21) SSA countries for the duration 1970-2014 to investigate the effects of trade liberalisation on food security. Other control variables included in the study are total irrigated land, the level of political openness, population, GDP per capita in constant US dollars, cereal productivity, land under cereal cultivation and exchange rate.

The study first presents the trends and patterns of food security in the region based on the income per capita grouping in SSA. Subsequently, a pattern of food security is presented for selected countries. It was observed that 10 out of the 21 countries selected showed increasing trends in food security over the years, 7 of the selected countries exhibited a constant trend, whereas, 4 out of the selected countries exhibited decreasing trend over the years. Cote D'Ivoire, Niger, Rwanda, South Africa and Senegal have all shown a constant trend in food security over the years under study. Countries that showed decreasing trend include; Zambia, Kenya, Malawi, and Madagascar. Whereas, Benin, Burkina Faso, Cameroun, Chad, Ethiopia, Ghana, Mali, Mozambique, Nigeria and Togo demonstrated an increasing trend of food security.

In order to achieve the second and third objectives of the study, a system GMM estimation technique is specified to examine the effects of trade liberalisation on food security in SSA for the period under study. Based on the results from the system GMM estimator, the study concludes that there was 0.8 percent increases food security in periods where a country opened up to trade than periods in which a country closed to trade. Secondly, it was evidenced that population growth negatively affects food security in the region. Whereas, increased availability of cereal lands and agricultural productivity increased food security in the region.

### **5.3 Policy Recommendations**

The findings suggest that food security improved in periods the selected countries opened up to trade than periods they closed to trade. However, the study observes that increases in irrigated land area and increases in cereal productive lands increased the level of food security in the region. An implication is that liberalising trade in a manner that would also improve productivity in cereals by local farmers would help alleviate food insecurity in the region. This

could be done through the support of donor agencies and development partners in the areas of irrigation farming and investment in technological agriculture in the region.

Furthermore, policies such as improving land distribution through local land reforms, expanding the level of domestic food production and investments in agricultural productivity could be pursued by donor and Aid agencies, regional and local governments and development partners to further enhance the food availability in SSA.

Finally, policies should be targeted at reducing the growth level of population in SSA. This could be achieved through adequate knowledge in reproductive health and family planning, Education and women empowerment.

#### **5.4 Limitations of the Study and Areas for Further Research**

The multidimensional definition of food security creates a limitation for the study as it focuses on just one dimension of the measure of food security. This assumption has its limitation and warrants the exploration of the other three dimensions of food security for further research.

Similarly, the study focuses on cereals as a measure for food security which might not present a good picture if other food crops are doing well in each country other than cereals. The study recommends, future studies on the subject matter to include climate change as a moderating factor to food security.

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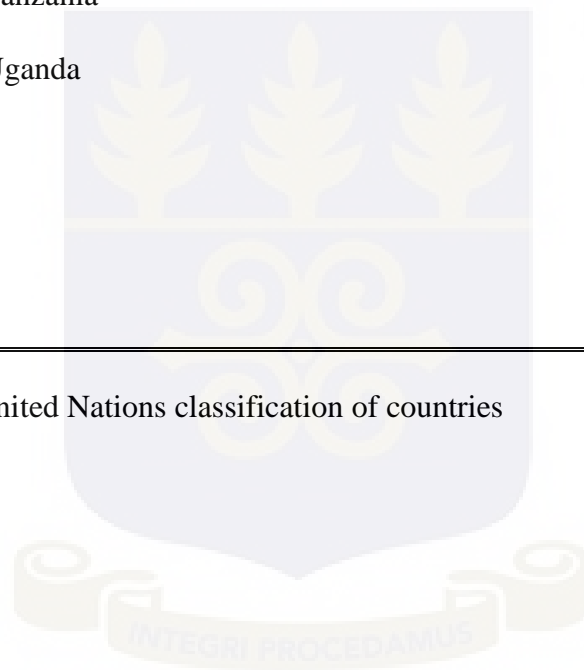


## APPENDIX

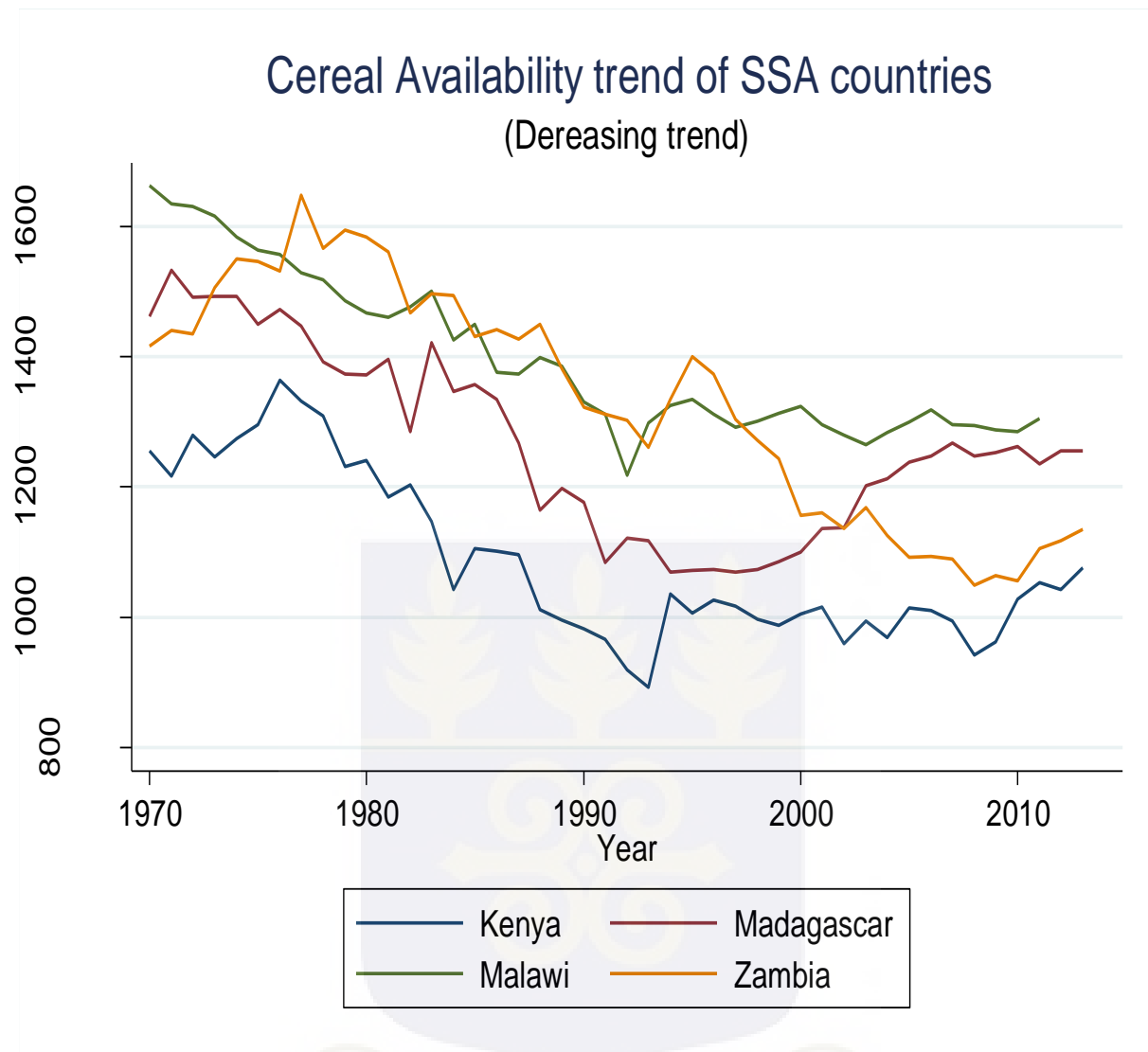
### Appendix I: List of the 21 countries in the study by region

West Africa	East Africa	Central Africa	South Africa
Benin	Ethiopia	Cameroun	Madagascar
Burkina Faso	Kenya	Chad	Mozambique
Cote D'Ivoire	Malawi		South Africa
Ghana	Rwanda		Zambia
Mali	Tanzania		
Niger	Uganda		
Nigeria			
Senegal			
Togo			

Source: Based on the United Nations classification of countries

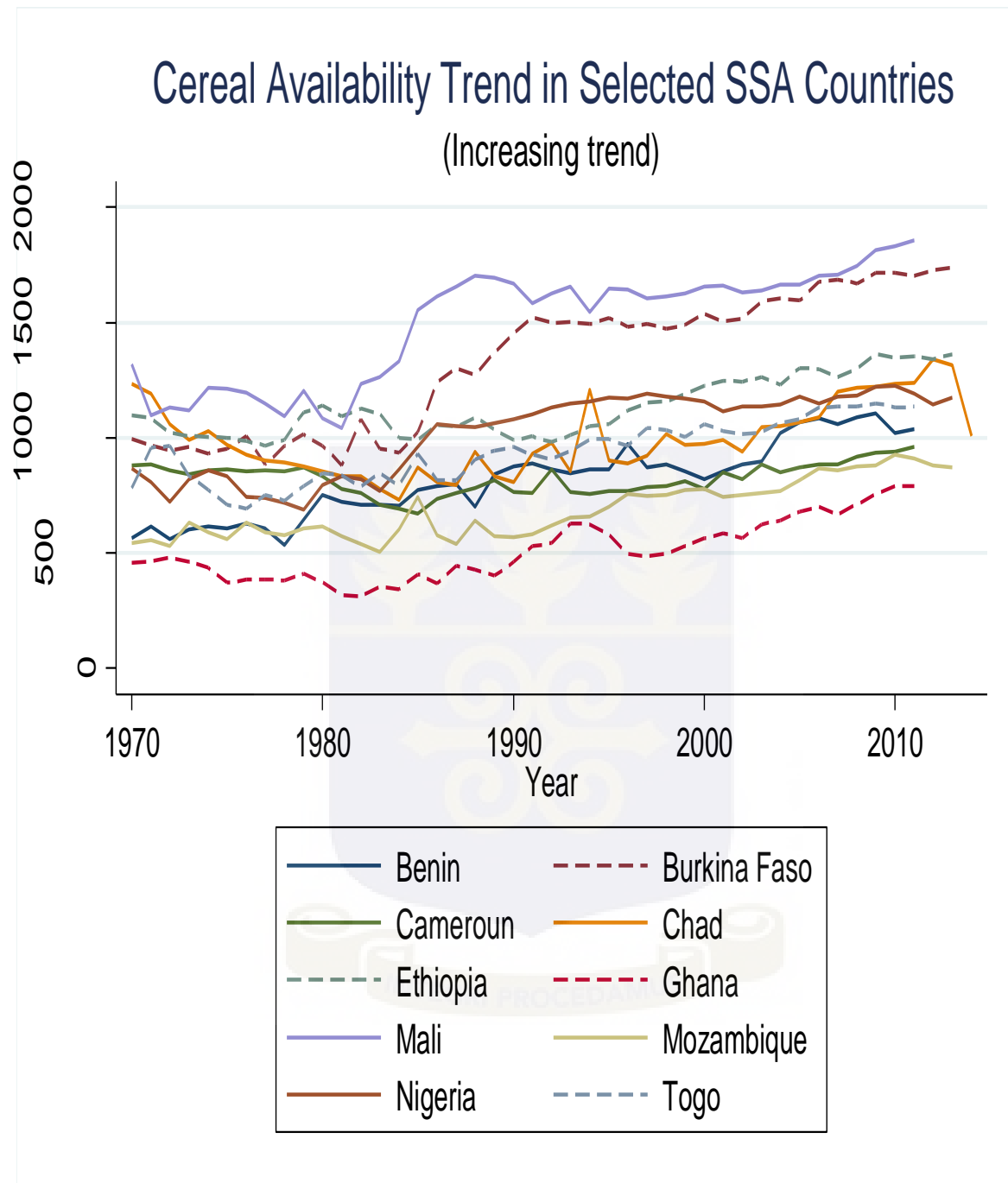


**Appendix II: Decreasing trend of food security of selected SSA countries**



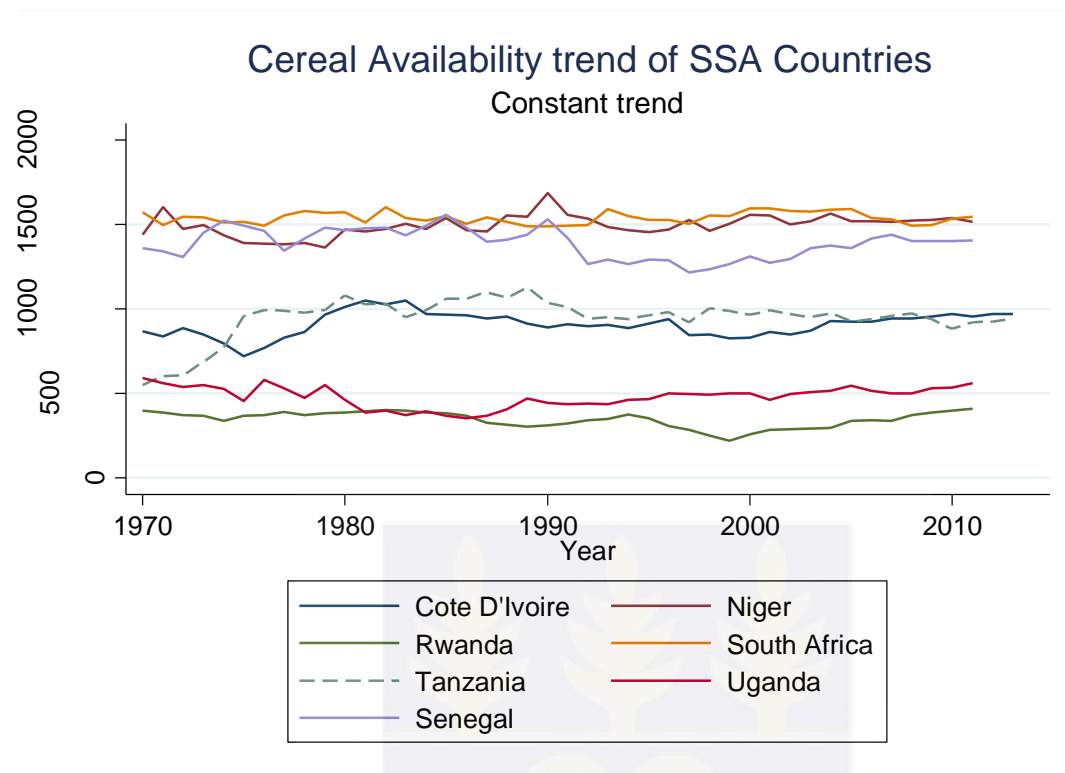
Source: Author's computation based on data obtained from FAO

**Appendix III: Increasing trend of food security of selected countries in SSA**

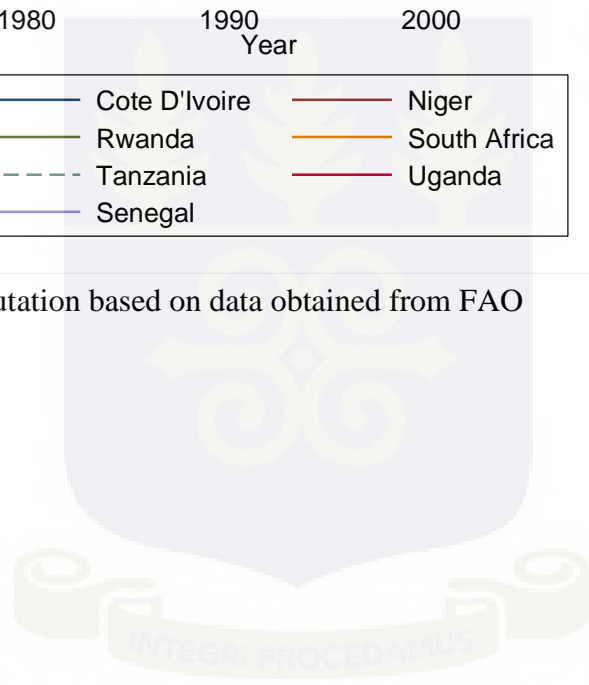


Source: Author's computation based on data obtained from FAO

**Appendix IV: Constant trend of food security of selected SSA countries**



Source: Author's computation based on data obtained from FAO



### Appendix V: Hausman test

. hausman fe

	Coefficients			sqrt(diag(V_b-V_B)) S.E.
	(b) fe	(B) .	(b-B) Difference	
1.tradelib~y	.0212664	.0238508	-.0025844	.0004568
0bn.polsOpen	.0075745	.0057364	.0018381	.0003998
2.polsOpen	-.000268	-.0003607	.0000927	.
Lgdp	.0062805	.012162	-.0058815	.0023492
Lirri	.0267809	.0399409	-.01316	.0045454
Llucp	.3580123	.3671862	-.009174	.0024184
Lcytc	.3063052	.3113662	-.005061	.0010428
Lexc	-.0022367	-.0005067	-.00173	.0010086
Lpop	-.2491463	-.2991586	.0500123	.0115199

b = consistent under Ho and Ha; obtained from xtreg  
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V\_b-V\_B)^(-1)](b-B)  
 = 22.70  
 Prob>chi2 = 0.0069  
 (V\_b-V\_B is not positive definite)

Source: Author's computation using (STATA 13)

### Appendix VI: Breusch Pagan Test of Heterogeneity

Breusch and Pagan Lagrangian multiplier test for random effects

Lfoodsecurity[country,t] = Xb + u[country] + e[country,t]

Estimated results:

	Var	sd = sqrt(Var)
Lfoodse~y	.0331269	.1820079
e	.0020073	.044803
u	.0071291	.0844339

Test: Var(u) = 0

chibar2(01) = 6049.22  
 Prob > chibar2 = 0.0000

Source: Author's computation using (STATA 13)

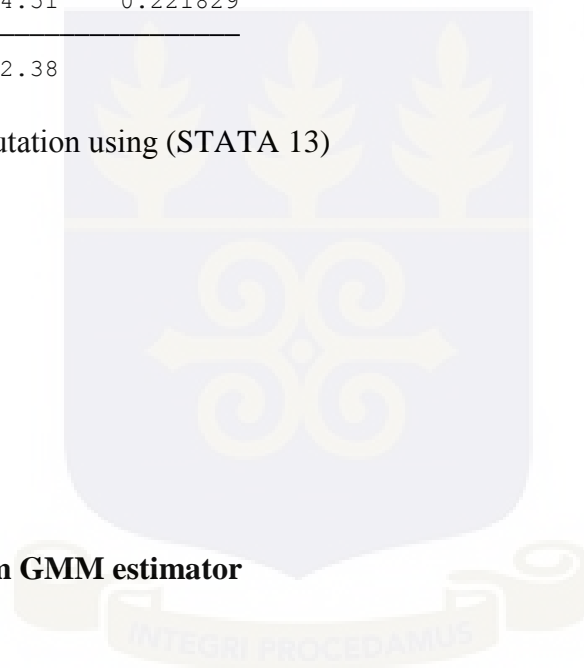
**Appendix VII: VIF test of Multicollinearity**

. estat vif

Variable	VIF	1/VIF
1.tradelib~y	1.93	0.518998
polsOpen		
0	1.69	0.590653
2	1.42	0.702518
Lgdp	1.47	0.678160
Lirri	2.55	0.392636
Llucp	4.17	0.239994
Lcypc	2.46	0.406120
Lexc	1.23	0.810834
Lpop	4.51	0.221829
Mean VIF	2.38	

Source: Author's computation using (STATA 13)

**Appendix VIII: System GMM estimator**



Dynamic panel-data estimation, one-step system GMM

```

Group variable: country                Number of obs    =    779
Time variable : Year                  Number of groups =    21
Number of instruments = 215           Obs per group: min =    29
Wald chi2(13) = 3808.45                avg =    37.10
Prob > chi2 = 0.000                    max =    40
    
```

Lfoodsecurity	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
Lfoodsecurity						
L1.	.7458036	.1128069	6.61	0.000	.5247061	.9669011
L2.	.0678743	.0997715	0.68	0.496	-.1276743	.2634228
Lirri	.0245476	.0122883	2.00	0.046	.0004629	.0486323
Llucp	.0920263	.0269478	3.41	0.001	.0392097	.144843
Lgdp	.0142658	.009846	1.45	0.147	-.005032	.0335637
Lcypc	.0743996	.0267255	2.78	0.005	.0220186	.1267807
Lexc	.005283	.0038563	1.37	0.171	-.0022752	.0128412
Lpop	-.1334541	.0375351	-3.56	0.000	-.2070216	-.0598867
polsOpen						
0.Autoc_St~e	-.0001525	.0038773	-0.04	0.969	-.0077519	.0074469
1.Anoc_State	0	(empty)				
2.Demo_State	-.0018499	.0051282	-0.36	0.718	-.0119011	.0082012
tradelibera~y						
0	0	(empty)				
1	.0072334	.0042129	1.72	0.086	-.0010236	.0154905
_cons	.6204823	.1547206	4.01	0.000	.3172354	.9237292

Instruments for first differences equation

Standard

D.(0b.tradeliberalisationdummy 1.tradeliberalisationdummy 0.polsOpen  
1b.polsOpen 2.polsOpen Lgdp)

GMM-type (missing=0, separate instruments for each period unless collapsed)

L(1/44).(Lcypc Llucp Lpop Lirri Lexc) collapsed

Instruments for levels equation

Standard

0b.tradeliberalisationdummy 1.tradeliberalisationdummy 0.polsOpen  
1b.polsOpen 2.polsOpen Lgdp

\_cons

GMM-type (missing=0, separate instruments for each period unless collapsed)

D.(Lcypc Llucp Lpop Lirri Lexc) collapsed

```

Arellano-Bond test for AR(1) in first differences: z = -3.55 Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences: z = -0.95 Pr > z = 0.342
    
```

```

Sargan test of overid. restrictions: chi2(201) = 214.00 Prob > chi2 = 0.252
(Not robust, but not weakened by many instruments.)
    
```

Sargan test of overid. restrictions: chi2(201) = 214.00 Prob > chi2 = 0.252  
(Not robust, but not weakened by many instruments.)

Difference-in-Sargan tests of exogeneity of instrument subsets:

GMM instruments for levels  
 Sargan test excluding group: chi2(196) = 199.71 Prob > chi2 = 0.413  
 Difference (null H = exogenous): chi2(5) = 14.29 Prob > chi2 = 0.014  
 iv(0b.tradeliberalisationdummy 1.tradeliberalisationdummy 0.polsOpen 1b.polsOp  
 > en 2.polsOpen Lgdp)  
 Sargan test excluding group: chi2(197) = 213.56 Prob > chi2 = 0.199  
 Difference (null H = exogenous): chi2(4) = 0.43 Prob > chi2 = 0.980

Source: Author's computation using (STATA 13)

### Appendix ix: Results for the Random effects estimator

```
. xtreg $ylist $xlist, re, if esample==1
```

```
Random-effects GLS regression           Number of obs   =       779
Group variable: country                 Number of groups =        21

R-sq:  within = 0.4805                   Obs per group:  min =        29
        between = 0.6683                   avg =       37.1
        overall = 0.6396                   max =        40

                                Wald chi2(9)       =       732.86
corr(u_i, X) = 0 (assumed)             Prob > chi2     =       0.0000
```

Lfoodsecurity	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
1.tradelibe~y	.0238508	.0062745	3.80	0.000	.0115531	.0361486
polsOpen						
0.Autoc_St~e	.0057364	.0052387	1.10	0.274	-.0045312	.0160041
2.Demo_State	-.0003607	.0058945	-0.06	0.951	-.0119138	.0111924
Lgdp	.012162	.0127545	0.95	0.340	-.0128363	.0371604
Lirri	.0399409	.0132222	3.02	0.003	.0140259	.0658559
Llucp	.3671862	.0170267	21.57	0.000	.3338145	.400558
Lcypc	.3113662	.021232	14.66	0.000	.2697523	.3529801
Lexc	-.0005067	.0031643	-0.16	0.873	-.0067087	.0056952
Lpop	-.2991586	.030915	-9.68	0.000	-.3597509	-.2385663
_cons	1.779345	.1836901	9.69	0.000	1.419319	2.139371
sigma_u	.08443387					
sigma_e	.04480302					
rho	.78029495	(fraction of variance due to u_i)				

**Appendix x: Results for the Fixed effects estimator**

. xtreg \$ylist \$xlist, fe, if esample==1

```

Fixed-effects (within) regression          Number of obs   =       779
Group variable: country                   Number of groups =       21

R-sq:  within = 0.4821                    Obs per group:  min =       29
        between = 0.5876                  avg =      37.1
        overall = 0.5723                  max =       40

                                           F(9,749)       =      77.47
corr(u_i, Xb) = 0.2765                    Prob > F       =      0.0000
    
```

Lfoodsecurity	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
1.tradelibe~y	.0212664	.0062911	3.38	0.001	.0089162	.0336166
polsOpen						
0.Autoc_St~e	.0075745	.0052539	1.44	0.150	-.0027397	.0178886
2.Demo_State	-.000268	.0058447	-0.05	0.963	-.011742	.0112059
Lgdp	.0062805	.012969	0.48	0.628	-.0191795	.0317405
Lirri	.0267809	.0139817	1.92	0.056	-.000667	.0542288
Llucp	.3580123	.0171976	20.82	0.000	.324251	.3917735
Lcypc	.3063052	.0212576	14.41	0.000	.2645737	.3480367
Lexc	-.0022367	.0033212	-0.67	0.501	-.0087566	.0042831
Lpop	-.2491463	.0329916	-7.55	0.000	-.3139133	-.1843793
_cons	1.534814	.1964314	7.81	0.000	1.149192	1.920435
-----						
sigma_u	.12022047					
sigma_e	.04480302					
rho	.87805118	(fraction of variance due to u_i)				

F test that all u\_i=0: F(20, 749) = 110.21 Prob > F = 0.0000