UNIVERSITY OF CAPE COAST

THE EFFECT OF TRADE LIBERALISATIONS ON FOOD SECURITY IN GHANA

CLETUS BUGAPEH

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BY

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Thesis submitted to the Department of Economic Studies of the School of Economics, College of Humanities and Legal Studies, University of Cape Coast, in partial fulfillment of the requirement for the award of Master of Philosophy degree in Economics

JULY 2018

DECLARATION

Candidate's Declaration

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

Candidate's signature……..

Date…….

Name: Cletus Bugapeh

Supervisors' Declaration

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

Principal Supervisor's Signature: …….

Date……

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Co-supervisor's Signature…….

Date……

Name: Dr. Emmanuel Ekow Asmah

ABSTRACT

The study examines the relationship between food security and trade liberalization in the context of Ghana using time series data from 1986 to 2016. The sum of imports and export over GDP is used as the key variable to measure the trade liberalization of the economy. Other than the key variable of trade liberalization, the study employs five variables namely food production index, consumer price index, real GDP, arable land, and reserve of foreign exchange to assess their effect on food availability which add to improve food security. The ARDL approach and the ECM were used to estimate the long run and short run effects of trade liberalization on food security respectively. The Granger causality test was also conducted to find the causal relationship between trade liberalization and food security. The findings indicated that trade liberalization positively affects food security both in the long run and short run. It also found a unidirectional causality from trade liberalization to food security implying that trade liberalization causes food security but food security does not cause trade liberalization. Moreover, with the exception of consumer price index and real GDP in the long run which have negative effect on food security, the other variables indicated a positive effect on food security in both the long run and short run. It is therefore, recommended that the Ministry of Trade and Industry should promote trade agricultural products especially food in order to improve the food security of the nation since more food can be made available through trade.

KEYWORDS

Auto-Regressive Distributed Lag (ARDL)

Error correction model

Food and Agricultural Organisation

Food Security

Trade Liberalisation

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DEDICATION

In memory of my late wife.

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LIST OF ACCRONYMS

ADF Augmented Dickey-Fuller

AFTA Asian Free Trade Area

AIC Akaike Information Criterion

ARDL Autoregressive Distributed Lag

ASEAN Association of South East Asian Nations

CPI Consumer Price Index

CUSUM Cumulative Sum of Recursive Residuals

CUSUMSQ Cumulative Sum of Square Recursive Residuals

DF Dickey-Fuller

DW Durbin-Watson

ECM Error Correction Model

ECOWAS Economic Community of West African States

ECT Error Correction Term

ERP Economic Recovery Programme

FAO Food and Agricultural Organization

FDI Foreign Direct Investment

GDP Gross Domestic Product

GLSS Ghana Living Standard Survey

HQ Hannan-Quinn Information criterion

IAASTS International Assessment of Agricultural Knowledge, Science and Technology for Development

IMF International Monetary Fund

LARL	Log of Arable Land
LCPI	Log of Consumer Price Index
LFPI	Log Food Production Index
LGPC	Log of Real Gross Domestic Product
LPDES	Log of Per Capita Dietary Energy Supply
LRES	Log of Amount of Foreign Reserves
LTLIB	Log of Trade Liberalization
MFN	Most Favoured Nation
MoFA	Ministry of Food and Agriculture
OECD	Organization of Economic Co-operation and Development
OLS	Ordinary Least Square
PP	Phillips-Perron
SAP	Structural Adjustment Programme
SBC	Schwartz-Bayesian Criterion
SIC	Schwarz Information Criterion
WDI	World Development Indicators

CHAPTER ONE

INTRODUCTION

Background of the Study

Is trade liberalisation a threat or an opportunity for food security? Longstanding debates over this question still remain unresolved. This is understandable when one considers that the agricultural sector serves a range of vital functions in society. It provides food, which is essential for human survival, and it provides a livelihood for approximately 30 percent of the world's active workforce. At the same time, agricultural exports are a significant source of revenue for many countries including Ghana, and imports are crucial for food security in most countries. Agriculture also has deep ecological connections as well as important cultural dimensions. For these various reasons, there has long been concern about the ways in which trade liberalization might improve or hinder society's ability to balance different social and economic goals as they relate to agriculture and food security (FAO, 2015).

The term Food Security was first introduced in the mid-1970s in the midst of a global crisis that saw rapidly rising grain prices and heightened concern about the scale of world hunger (FAO, 2015; Shaw, 2007). The Food and Agricultural Organization defined food security as a situation that exist when all people at all time have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy lifestyle (FAO, 2001). When the supply of food in the country is able to cover the food demands of its population then this situation is known as food security. The

country in this regard can thus be classified as a food secured nation. On the other hand, when people do not have adequate physical, social or economic access to food thus food insecurity exists.

Food securities consist of four dimensions: food availability- sufficient quantities of food available on a consistent basis; accessibility- having sufficient resources to obtain appropriate foods for a nutritious diet; utilization- appropriate use based on knowledge of basic nutrition and care, as well as adequate water and sanitation; and stability- regular supply of food quantities at all times. Of the four dimensions, this research work basically concentrates on food availability. That is food available for human consumption at the national level regardless of its source, domestic and imported. According to reports in the 1960s, food availability in Ghana in terms of domestic production had been falling with a decline in the food self-sufficiency ratio from 83 percent in 1961 – 1966 to 71 percent in 1973 – 1980, coupled with fourfold increase in food imports in a decade prior to 1982. The 1983 drought brought widespread shortages in food stuff and export crop production reached an all-time low.

The advent of the Economic Recovery Programme (ERP) in 1984 identified the agricultural sector as a hub that could rescue Ghana from the many challenges including inadequacy of food production. Accordingly, since that time, the government has invested significant funds in the rehabilitation of projects aimed at increasing food production. Following this to 1991, the government announced that one goal of the Medium Term Agricultural Development Programme 1991 -2000 was to attain food self-sufficiency and security by the

year 2000. Government also took much effort to encourage farmers to switch to production of staples but this did not yield much result as total food production fell by an average of 2.7 percent per year between 1971 – 1973 and 1981 – 1983. By the close of 1983, Ghana was sufficient in only one staple crop – plantain. Food imports rose from 43000 tons in 1973 to 152000 tons in 1981. In 2017, government launched a flagship programme – Planting for Food and Jobs which is aimed at producing enough food to feed the nation, export the surpluses, reduce excessive food import bill and generate employment for Ghanaians. The focus of the programme is to create jobs for the teeming unemployed youth in agriculture and allied sectors. The policy rallies the civic responsibility of all citizens to plant a seed of any kind during the farming season to green Ghana. It is encouraging Ghanaians to grow grain crops and vegetables in open spaces including backyard gardens in urban areas. In that regard, private and public institutions are encouraged to set up their own farms. Institutions like breweries, food processors, schools, colleges and prisons are all encouraged to establish their own farms. By the close of the first year of the program, it was estimated to have created 745,000 jobs but its contribution to domestic food production was not yet known.

Following the trade liberalisation policy in 1986 by the complete removal of all restrictions on trade, it was hoped that Ghana would be able to secure enough food imports to augment local production in order to achieve food security. This has been justified by economic theory's expected role of increasing efficiency particularly in resource allocation and output growth by improving transparency in incentives, thereby promoting economic growth and poverty

alleviation and improving food availability for local consumption (Dithmer & Awudu, 2017; FAO, 2003;). At the global level, international trade can therefore, link production and consumption of food and may thus play an important role in securing enhanced food security as it permits global production to take place in those regions most suited to it and enable food to flow from countries with abundant supplies to ones with insufficient supplies (Dithmer & Awudu, 2017). A country increasing openness to trade may then lead to an increase in the amount of food available to the population and make available greater variety of food contributing to increased food security.

However, after the recognition of trade as an important policy for food security at the World Food Summit in 1996, speaking in favor of fair and market oriental world trade system (Dithmer & Awudu, 2017; World Food Summit, 1996), the debates following this about the appropriate role of international trade in delivering the food needs of the world has remained an elusive concept in academic research. The relationship between international trade and food security is not always straight forward and country case studies are not as well uniform. What is true with trade liberalization for one country will not necessarily be so for another country. To consider, trade barriers can limit the availability of food in countries experiencing deficits leading to price spikes thereby reducing access to food. On the other hand, lower food prices that result from subsidy support to farmers may only benefit urban consumers in imparting countries and hurt famers' income in those same countries.

Beyond the World Trade Organization (WTO), tensions over the appropriate role for trade in food security policy have also been front and centre in a number of other policy contexts in the past decade. Trade feature as a key factor but in different ways in two key reports in agriculture and development in 2008-World Bank's World Development Report 2008, and the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTS) report (FAO, 2015; World Bank, 1995). Trade was also a divisive issue in the 2007-2008 food crises as wide spread export restrictions in a number of countries were seen by some to have contributed to price spikes (Sharma, 2001; FAO, 2015).

There appears to be no clear consensus in the literature e about the impact of trade liberalization on food security. Most of the empirical analyses on the subject are country case studies with a significant portion of them involves comparing food security indicators before and after trade liberalization events (before and after approach) without statistical validation of the underlying hypothesis (Bezuneh & Yiheyis, 2014). Direct evidence predicted on country specific econometric studies is rather thin which furnishes the motivation for the work.

Per the results of this study, the research work therefore, makes an attempt on solving the following questions. What is the net impact of the further liberalization of food and agricultural trade, considering the widely differing situations in Ghana and other developing countries? How can the overall economic gains from trade benefit those who are most likely to be suffering from

food insecurity? Do gains "trickle down" to enhance economic access to food for the poor? How can food and agricultural production and trade be restrained from the over-exploitation of natural resources that may jeopardize domestic food security in the long term? It is hope that this research work will provide some fundamental diagnostics as to how to address these issues of national concern.

Statement of the Problem

In spite of the huge progress in world agriculture and economic development during the last few decades, food security still remains a major problem in many countries. As indicated by FAO, with more than 800m people still suffering from chronic undernourishment and additional population pressure, the eradication of hunger continuous to be a global challenge (FAO, 2013). The World Bank estimates that global food price spikes in 2008 pushed addition 44 million people below the poverty line, most of them in developing countries. In 2010, an estimated 925 million people were affected by undernourishment globally (FAO, 2015) an increase from the 848million estimated in 2007. According to FAO, 98 percent of the world undernourished lived in developing countries with an average undernourishment rate of 14.9 percent.

Despite a marked growth in global food production in the past half-century, more than one in seven people today still do not have access to basic dietary requirements and sufficient protein and energy input (Luan et al 2013). South Asia and Sub-Saharan Africa are the regions most affected by unreliable food access and undernourishment (Luan et al. 2013), with 30 percent of world hunger concentrated in the latter region alone (FAO, 2013).

Ghana embarked on full scale trade liberalization since the launching of the Economic Recovery Programme in 1983 and subsequently the Structural Adjustment Programme in 1985. Incidentally, in recent times Ghana has been experiencing food insecurity. The question to address is whether there is any relationship between trade liberalization and food security in Ghana.

According to the 2016 Global Food Security Index, Ghana is ranked 76 with a percentage point of 47.9 out of 113 countries globally in terms of food security. Ireland and the United States occupied the first and second positions with percentage points of 85.6 and 84.6 respectively and Burundi at the bottom list with 25.1 percentage points given it the least secured country in terms of food security. In Ghana, a report prepared by Ministry of Food and Agriculture (MoFA) in 2015 discussed that about 5 percent of Ghana's population (1.2 million people) are food insecure (Darfour & Rosentrater 2016). The World Food Programme (WFP) in 2009 reported that approximately 453,000 people in Ghana are food insecure with 34 percent in the Upper West region, 15 percent in the Upper East, and 10 percent in the Northern region (WFP, 2009, Darfour & Rosentrater 2016). Reports indicate that about 2 million people are vulnerable to become food insecure nation-wide, which means any unexpected natural or man-made shock will greatly affect the pattern of their food consumption (Darfour & Rosentrater 2016). People vulnerable to food insecurity totaling 1.5 million live in the rural and urban areas of the following seven regions of Ghana: Brong-Ahafo (11%), Ashanti (10%), Eastern (8%), Volta Region (7%) etc. The remaining 0.5

million people are found in the three Northern regions (Darfour & Rosentrater, 2016).

One of the basic issues when dealing with food security is the food self-sufficiency of a certain region or country. Self-sufficiency is the ability of a region to sustain its own requirement for food and is therefore dependent on two factors: production and consumption (FAO, 2001). Fluctuations in the self-sufficiency ratio (SSR) are used to characterize the stability of a country's capacity to sustain its own population. A study conducted by Luan et al (2013) between 1961 and 2007 indicated that the food self-sufficiency ratio for most African countries including Ghana have been falling throughout the study period.

Food insecurity can bring a lot of challenges to a developing country like Ghana. According to the World Bank report in 2006, food insecurity have direct consequences for health and human development and more general for learning, individual productivity and economic development. ActionAid, a non-governmental organization (NGO), in 2018 estimates that food insecurity cost developing countries economics around $450 billion in lost GDP each year. For these reasons and others that in 2014, FAO emphasized the need to place food security at the top of the political and international research agenda and to create an enabling environment for improving food security through adequate investments and better policies. Many countries, developed as well as underdeveloped ones, have taken substantial policy reforms aimed at achieving this goal. This study therefore, seeks to analyze the food security situation in Ghana considering trade liberalization and other macroeconomic variables.

Of utmost justification is the fact that earlier studies adopted the ordinary least square due to the fact that it gives the responsiveness of the dependent variable of a unit change in the independent variables. This study attempts adopting the Error Correction Model (ECM). This is due to the fact that this model deals with the problem of non-stationary time series and spurious correlation which are prominent among the variables.

Objectives of the Study

The main objective of this study is to examine the effect of trade liberalization on food security in Ghana from 1986 to 2016. The research therefore, specifically has the following objectives

- Estimate the long run relationship between trade liberalization and food security in Ghana.
- Estimate the short run relationship between trade liberalization and food security in Ghana.
- Identify the direction of causality between trade liberalization and national food security.

Research Hypotheses

This research work sought to test the following hypotheses.

H_N. There is no long run relationship between trade liberalization and food security in Ghana.

H_A. There is a positive long run relationship between trade liberalisation and food security in Ghana

H_N. There is no short run relationship between trade liberalization and food security in Ghana.

H_A. There is a positive short run relationship between trade liberalization and food security in Ghana

H_N. There is no causal relationship between trade liberalization and food security.

H_A. There is a unidirectional causal relationship between trade liberalization and food security.

Significance of the Study

It is an undisputable fact that achieving food security will bring enormous benefits to Ghana and improve the life of every Ghanaian. Food is the most basic of all human wants but achieving food security has remained a global challenge for many years now. According to the United Nations Department of Statistics, Ghana's population is estimated to be 51 million by 2050 and the demand for food will be more than double. This calls for new and innovative ways to double current production into the future to be able to handcuff any risk of food shortage. This study is therefore timely and it ought to bring out useful information that constitutes a significant addition to existing knowledge on the impact of trade liberalization on food security in Ghana.

A new report from the World food program suggests that for every one percentage increase in food insecurity, an additional 1.9 percent of people are compelled to migrate. The study will make suggestions for changing this phenomenon by improving food security. This is important because studies have further shown that lack of food is correlated with a substantial deterioration of

democratic institutions in low-income countries, as well as a rise in communal violence, belligerence, riots, human rights abuses and civil conflict among others. Food being the most elementary of all human wants; it has also gained a legal dimension after the establishment of FAO in 1945. This study will therefore benefit Ghana's agricultural sector as it stands to suggest ways of increasing food protection in order to lower the Country's risk of food insecurity as depicted by George Bush "it is important for our nation to build… to grow food stuffs, to feed our people. Can you imagine a nation that was unable to grow enough food to feed the people? It would be a nation that would be subject to international pressure. It would be a nation at risk" (Bush, 2001; FAO, 2015).

Examining the relationship between trade liberalization and food security is therefore crucial for a developing country like Ghana. This research therefore represents an attempt to establish whether identifiable relationship exists between trade liberalization and food security in Ghana. By knowing the nature of relationship, it will help policy makers in the review and making of new trade policies. Finally, the cointegration analysis as well as the error correction model will help in explaining whether a long run or short run relationship exist between trade liberalization and food security in Ghana.

Scope of the study

This study investigates the impact of trade liberalization on food security in Ghana using time series data for the period 1986 to 2016. The period 1986 to 2016 was the time of complete liberalization of trade with the abolishing of all quantitative controls on both imports and exports.

It includes theoretical and empirical discussions on trade liberalization and food security. The study employs the Autoregressive Distributed Lag Model otherwise known as the bound testing approach to cointegration developed by Pesaran and Pesaran (1997); Pesaran, Shin and Smith (2001). The study employs the following variables; per capita dietary energy supply, food production index, consumer price index, real gross domestic product, arable land, trade openness as a measure of trade liberalization and amount of foreign reserves.

Organisation of the Study

This study is divided into six chapters. Chapter one deals with background of the study, problem statement, objectives of the study, hypothesis to be tested, and significance of the study, scope of the study and organization of the study. Chapter two deals with an over view of the agricultural sector and the variables of study. Chapter three is devoted to the review of related literature which is both theoretical and empirical on the relationship between trade liberalization and food security with the view to identifying all it possible influences. This certainly leads to the formulation of appropriate model for analysis. Chapter four deals with methodology which formulates empirical model and econometric estimation technique. This deals with the data and techniques adopted in carrying out the study. In chapter five, the econometric results are presented and a discussion is made of the time series characteristics of our datasets. Finally, chapter six gives summary of findings, policy implications, conclusions and recommendations of the study.

CHAPTER TWO

AN OVER VIEW OF THE STUDY VARIABLES AND THE AGRICULTURAL SECTOR IN GHANA

Introduction

This chapter is divided into two parts. The first part deals with historical trend of the study variables. The main objective in doing this is to find out how the variables have fared throughout the study period. The second part takes an overview of the agricultural sector in Ghana. The rational is to look at the characteristics of the sector and its potential to deliver the food requirements of the nation.

Historical Trend Analysis of the Study Variables

This section takes a look at the variables of interest over the period 1986 to 2016. As mentioned earlier, food security is represented by per capita daily dietary energy supply and is dependent on food production index, consumer price index, real gross domestic product, arable land as percentage of total land area, trade openness and foreign reserves.

Annual trend of Per capita daily dietary energy supply (PDES) in Ghana

The measurement of dietary energy supply is typically the most standard measure of food supply over time. From figure 1 below it can be seen that average food supply in Ghana has been growing steadily over the study period with minimal fluctuations over certain years. The worst period recorded was in 1990 when average food supply dropped to 1729. The growth rate of PDES started picking up after the 1990 but with some fluctuations as indicted on figure 1

below. This is quite clear since the economy was yet recovering from the global food crises in the early 1980s. Beyond this period, PDES has seen a favorable growth trend over the study period with supply close to double in recent years. The improving supply of food in Ghana is shown in the data visualization in Figure 1.

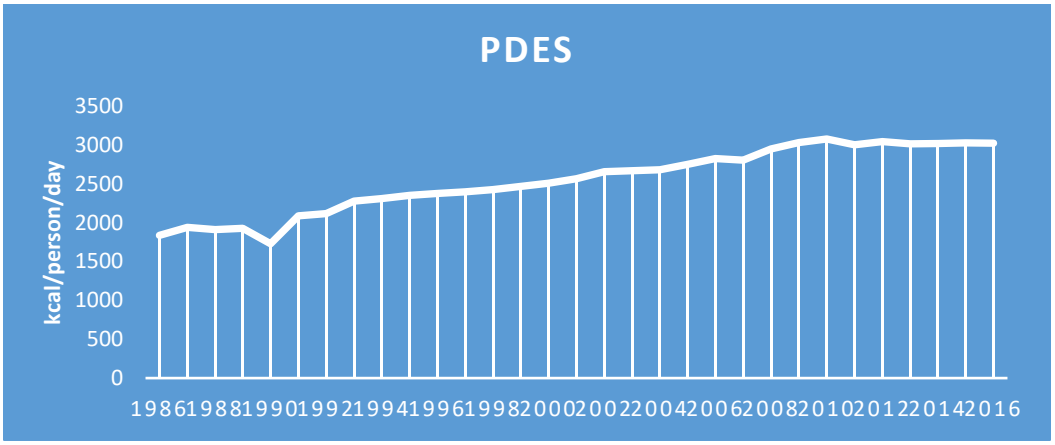


Figure 1: Annual Trend of Per Person Dietary Energy Supply in Ghana
Source: Author (2018)

Despite these positive trends as indicated above, poverty and hunger are still issues to content with especially in the rural communities. According to the FAO as indicated on the table 1, rural extreme poor as a percentage of total extreme poor was 25.6 percent as at the year 2007.

Table 1 .*Poverty and hunger index*

Rural poor as a percent of total poor population,2007	*.857*
Rural hungry as a percent of total hungry population, 2007	*.881*
Rural extreme poor as a percent of total extreme poor population,2007	*25.6*
Undernourished people on total population (%) (2004-2006)	*8.0%*
Dietary Energy Supply (DES) (kcal/person/day)	*1990-92: 2,040* *1995-97: 2,390* *2000-02: 2,550* *2004-06: 2,740*
Annual Growth of Dietary Energy Supply (DES)	*1990-92,3.2 1995-97: 2,390%* *1995-97, 2000-02: 1.2%* *2000-02, 2004-06: 1.7%*

Source: adopted from FAO food balance sheet (2017)

Food production index

The main food crops are corn, yams, cassava and other root crops. Despite government efforts to encourage farmers to switch to production of staples, total food production fell by an average of 2.7 percent per year between 1971–73 and 1981–83. By 1983 Ghana was self-sufficient in only one staple food crop—plantains. Food imports rose from 43,000 tons in 1973 to 152,000 tons in 1981. There were various reasons for the declined performance, including growing urbanization and a shift in consumer preference from starchy home-grown staples to rice and corn. However, farmers also had to deal with shortages of production inputs, difficulties in transporting produce to market, and competition from imported foods that were underpriced because of the vastly overvalued cedi. Weather also played a major part, particularly in 1983, when drought cut cereal production from 518,000 tons in 1982 to only 450,000 tons. Food imports in 1982–83 amounted to 115,000 tons, with the 1983–84 shortfall estimated at 370,000 tons.

There was a spectacular improvement beginning in 1984, mainly because of recovery from the prior year's drought. By 1988 the agricultural sector had vastly expanded, with food crops responsible for the bulk of the increase. Drought conditions returned in 1990, bringing massive falls in the production of all food crops apart from rice, but better weather and improved production brought prices down in 1991.

In August 1990, the government moved to liberalize the agricultural sector, announcing the end of minimum crop prices. The measure's impact was difficult to gauge because higher production meant more food was available at better prices anyway. The government's medium-term plan, outlined in 1990, sought to raise average crop yields and to increase food security, with special attention to improved producer incentives and storage facilities.

Livestock production was limited by the incidence of tsetse fly in Ghana's forested regions and by low grazing vegetation elsewhere and it was of major importance only in the relatively arid north and was not earmarked for special treatment. In 1989 there were an estimated 1.2 million cattle, 2.2 million sheep, 2 million goats, 550,000 pigs and 8 million chickens in Ghana. The overall annual trend of Ghana’s food production index is given on the figure below.

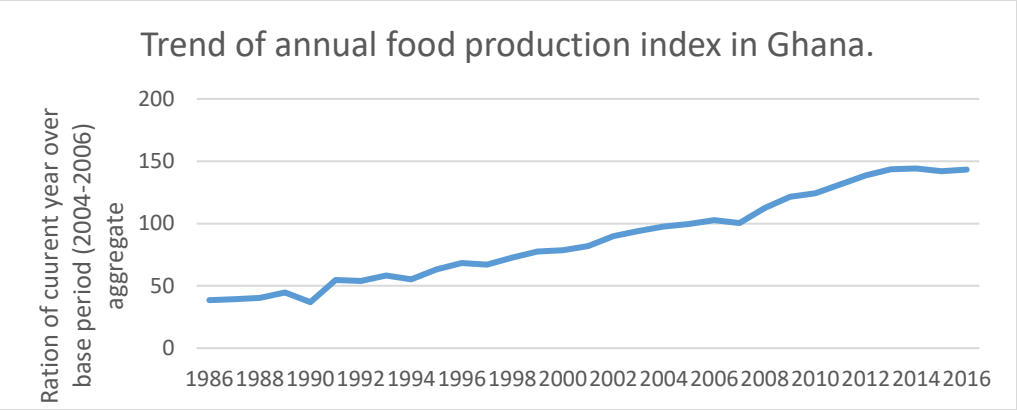


Figure 2: Annual trend of food production index in Ghana
Source: Author (2017)

Annual Consumer Price Index Trend in Ghana

Studies have shown that there is a strong negative trend between an increase in the consumer price index and economic growth and welfare in Ghana and this will consequently affect the food supply of the nation. Consumer price index reflects changes in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used. Data are period averages. This study uses the consumer price index as a proxy for inflation. Within the study period-1986 to 2016 periods of high inflation growth were associated with deteriorating standard of living as it serves as a tax on people income to acquire their necessary diets. From the statistical data obtained and has been visualized below, Ghana recorded the highest consumer prices in varying years as shown below. According to some economist inflation rates of 10 percent or more would seriously have a negative impact on other macroeconomic variables and this would surely trickle to food availability. Apart from the years 1992, 2007, 2011 and 2012, inflation rates in Ghana were far above 10 percent with worst

occurrences above 20 to 50 percent. It is acknowledged that the severity of this problem was as a result of insufficient growth of output and natural constraints faced by the economy. Theoretical models have proved that inflation is one of the major determinants of food availability as countries with low inflation levels are seen to have adequate food supply than countries with high inflations rates. The figure below gives the annual trend of the consumer price index of Ghana.

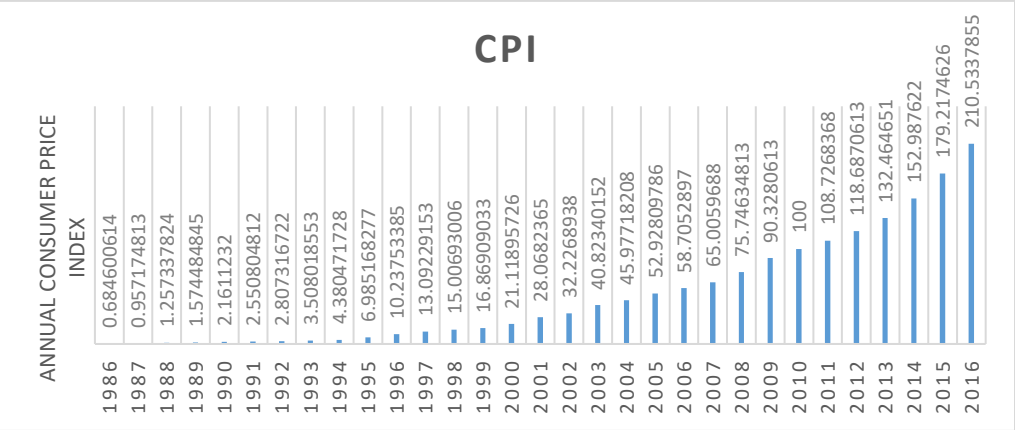


Figure 3: Annual Consumer Price Index Trends in Ghana
Source: Author (2017)

Annual Real Gross Domestic Product in Ghana

Ghana's economic performance has been quite strong over the past three decades during which the country pursued market led economic policies and programmes with minimal involvement of government in direct economic activities. The recovery of the country's economy from recession in the early 1980s on the back of the economic reform and structural adjustment programme, and the sustained growth since then has earned the country a lot of commendations in terms of economic achievement. It can be seen from the figure below that Ghana's real gross domestic product has followed an upward trajectory

increase over the period of this study. Recent progress has however, been much attributed to the commercial oil production which was commenced in 2011. Though fluctuation cannot be ruled out entirely, overall, year by year increase in the real gross domestic product has been consistent and fairly good during this study period. Figure 4 below gives the annual trend of the year by year real gross domestic product.

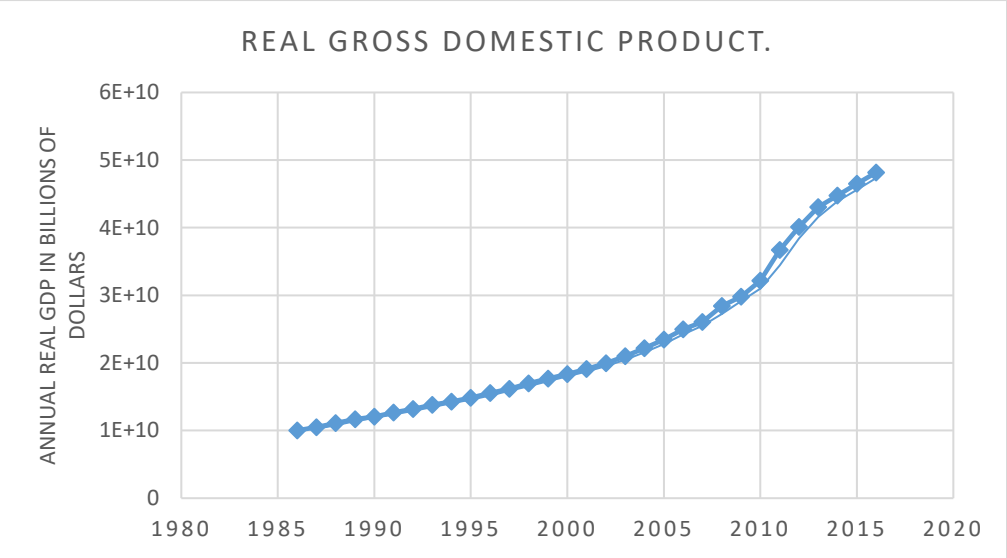


Figure 4: Annual Trend of Real Gross Domestic Product in Ghana
Source: Author (2017)

Arable land as a percentage of agricultural land

The most obvious land cover change in Ghana is the major increase in agricultural land in all regions of the country. However, the largest increases can be seen in the northeast, east-central, and southwestern regions of Ghana. This rate of agricultural expansion is unprecedented in the country's history, overrunning many of the other land cover types, including Ghana's savannas, woodlands, and forests. From 1975 to 2000, agricultural lands expanded from 13

to 28 percent of Ghana's total area. In just the years from 2000 to 2013, agriculture land continued to expand rapidly, reaching 32 percent of Ghana's land area. This expansion has significance beyond the simple area numbers. Agricultural lands often represent a radical transformation from a diverse variety of vegetation types and natural habitats to crop-dominated landscapes. In Ghana, savannas experienced a large loss, from about 51 to 40 percent of the total land area from 1975 to 2013. The figure 5 shows the annual trend of arable land growth in Ghana.

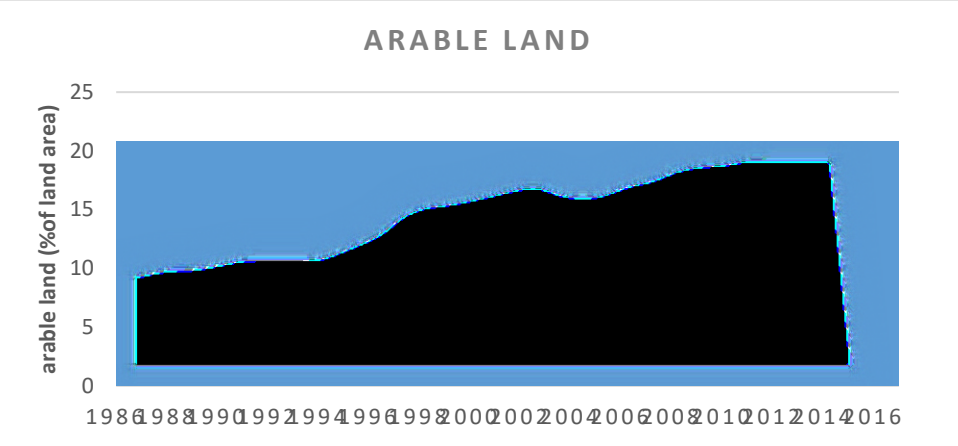


Figure 5: Annual trend of arable land in Ghana
Source: Author (2017)

From figure 5 above, it can therefore be seen that arable land in Ghana has been growing though with minimal fluctuations during the early 2000s.

Episodes of Trade Liberalisation in Ghana

Until the inception of the Economic Recovery Programme in 1983, Ghana had operated alternating intermittent episodes of a fairly liberal trade regime. The first was between 1950 and 1961 as a member of the sterling zone, with virtually no restrictions on payments to and from member countries but imposed restrictions on payments to non-member countries. Interruption of the

liberalization process was basically the result of fiscal indiscipline and depletion of the country's foreign exchange reserves. The country's second experience of a liberal import regime was between 1967 and 1971. Under this regime, the domestic currency was devalued by about 43 percent and import duties on some selected items were reduced. Again, the process of liberalisation was interrupted with a resort to control measures in 1972 following the deterioration of the country's balance of payments position and depletion of its foreign exchange reserves due to fiscal indiscipline and huge import bills (Jebuni et al, 1994).

Trade liberalization has been an integral part of the structural adjustment programmes which began in 1983 and can be categorized into three phases: the period of attempted liberalization or transition to import liberalization; the period of import liberalization; and the period of liberalized trade regime.

The period of attempted liberalisation or transition to import liberalization covers the years 1983–1986. This period is characterized by the introduction of a system of bonuses and surcharges, and their later replacement by frequent nominal devaluations. Import tariff rates were adjusted downward, but the range of rates with the import licensing system and import programming were maintained. Aside from these, the period witnessed a decline in export tax rates that was greater than the decline in import tariff s. The period of import liberalization per se ran from 1986 to 1989. This period was characterized by the introduction of a formal dual exchange rate system, which was later unified into a single exchange rate system based on auctioning and a further liberalisation of the exchange rate. Other features of this phase of the liberalisation process include a

redefining of the import licensing categories, a reduction of the import tax schedule and a reduction in the sales taxes on imported goods by 10 percentage points. The foreign exchange retention scheme was liberalised in 1987, while the cocoa export tax rate (made up of the ratio of cocoa duties to cocoa export earnings) was reduced (Jebuni et al, 1994).

A liberalised trade regime has been in place since 1989. This period has been characterised by a replacement of retail auctioning with wholesale auctioning in the foreign exchange market in 1990, abolition of the import licensing system, decline in import tax rates on raw materials and capital goods, and reduction in sales tax on imported basic consumer goods. Over this same period, protective duty rates were introduced for specific goods in 1990 and 1994, and the export retention scheme was phased out. The Most Favoured Nation (MFN) tariff s apply on most imports, except those from the Economic Commission of West African States (ECOWAS) member countries, which have attracted duty-free rates since 1996.

Under the ECOWAS trade liberalization scheme established in 1990, Ghana initially provided preferential tariff reductions of 20 percent on imports of a few goods from some countries that had been granted community status. Products from member states that qualified for preferential treatment attracted rates of 8, 16 and 20 percent while similar items from other countries attracted duty rates of 10, 20 and 25 percent respectively.

However, since 1996 most imports from member countries have attracted duty free rates. Ghana provides duty-free preferences on a range of unprocessed

agricultural products and several industrial products imported from enterprises sited within member countries, and that are eligible to receive such preferential treatment. Eligibility is based on whether the imports meet the ECOWAS rules of origin and have obtained at least, 60 percent of their raw materials from within the Community. Beyond year 2000, Ghana has opened its borders more to global trade and this trend has been growing over the years as shown from the figure 6 below.

One way by which trade liberalisation affects food availability in Ghana is through international price transmission. Price transmission elasticity shows the extent to which changes in world prices are transmitted onto domestic markets. (Thompson & Bohl,1999) argue that price transmission elasticity can indeed be interpreted as a measure of the degree of market insulation, or the extent to which border policies are transmitted onto the domestic market. Price transmission is affected by trade liberalisation and by trade policies.

For developing countries like Ghana, global agricultural trade liberalization affects food security through world price levels and export earnings. A recent FAO study projected that long run real world food prices would rise by about 12 percent and that developing countries 'exports would increase by about 30 percent. Though Ghana is doing well in terms of its openness to global trade, the opportunities derived from this are not conclusive. Much of the Ghanaian diet is still dependent on foreign produce as indicated on the table above.

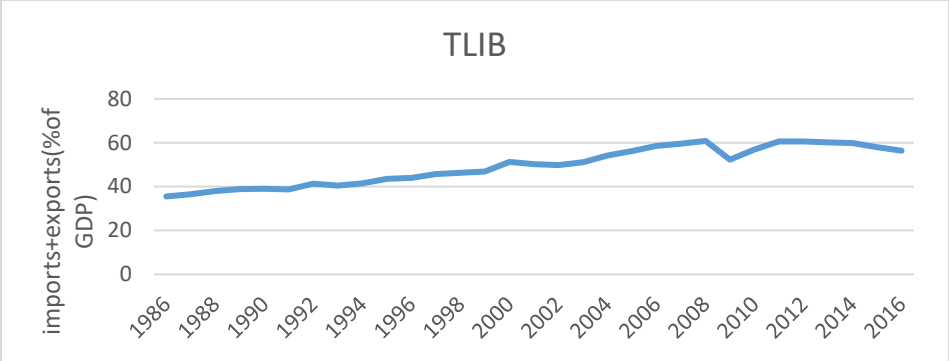


Figure 6: Trend of Ghana's openness to international trade
Source: Author (2017)

The Table 2 below also gives the trade indicators for Ghana for year 2015 which are quite significant considering the state of the country as a developing one. Overall, the country agricultural share of total merchandise exports has far exceeded that of imports as shown on the table below.

Table 2: *Trade Indicators of Ghana as at 2015*

Imports of major agricultural commodities (2015)	*Quantity (tonnes)*	*Value (current US$)*
Palm Oil	53,651,909	158,921,580.39
Rice Broken	537,485,689.77	876,604,626.89
Wheat	416,761,171	479,352.74
Exports of major agricultural commodities (2015)		
Cocoa Beans	605,795	10,146,591,471
Sugar, refined	1,705.07	1,590.44
Cocoa Butter	3,181,316.68	817,082.84
Merchandise imports (current US$) (2015)		5,660,063,386.41
Merchandise exports (current US$) (2015)		13,557,084,176.36
Share of agriculture imports on total merchandise (%) (2015)	18.30%%	
Share of agriculture exports on total merchandise (%) (2015)	74.85%%	

Source: Adopted from FAO (2017)

Annual Trend of Ghana's Foreign Reserves

A country like Ghana has to pay for its imports. The countries which are exporting to Ghana will not accept Ghana's currency. They will demand in a currency which is acceptable to them. In order to pay for these imports you need to maintain internationally accepted currency in some form readily to meet imports, to meet other term commitments such as repayment of foreign currency loans etc.

Generally speaking, foreign exchange reserves consist of any foreign currency held by a centralized monetary authority, like the Bank of Ghana. Foreign exchange reserves include foreign banknotes, bank deposits, bonds, treasury bills and other government securities. Colloquially, the term can also encompass gold reserves or IMF funds. Foreign reserve assets serve a variety of purposes, but are primarily used to promote favourable international trade deals such as to cover imports as considered in this study. The figure 7 below shows the amount of foreign reserves held by the Bank of Ghana in annual terms.

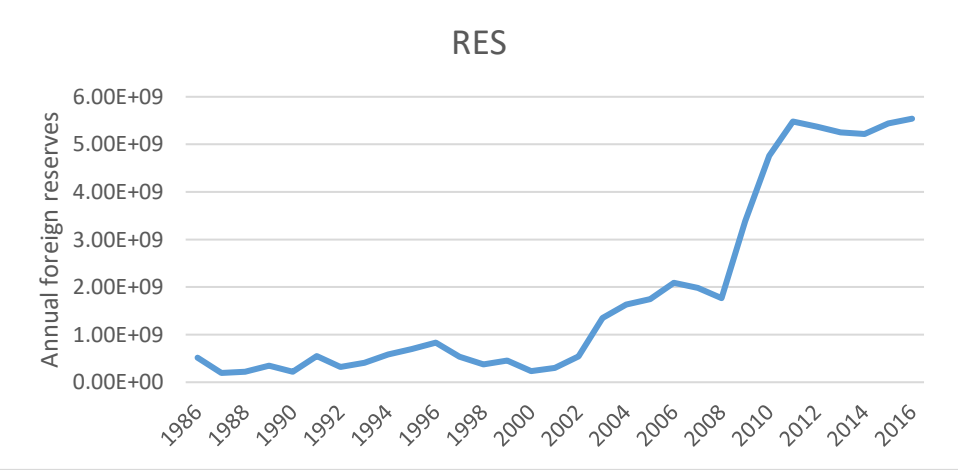


Figure 7: Annual Foreign Reserves Held by the Central Bank
Source: Author (2017)

An Overview of Ghana's Agricultural Sector

During the last few decades, Ghana has achieved an impressive economic growth record and to some level brought down poverty and hunger (Ghana Statistical Service, 2009). This growth however, did not lead to a reduction in unemployment, inequality and underemployment among others. Agriculture continues to be an important economic sector. It is the largest source of employment and livelihood, the leading export earner and an important contributor to GDP according to statistical data. Agriculture however, remains saddle with a lot of challenges that are inherent in its structure and its location within the wider economy MoFA (2007) reported that agriculture was dominantly practiced on smallholder level using simple technology in producing about 80 percent of the total agricultural output in Ghana. According to the report, about 2.74 million households own a farm or are keeping livestock. In reference to the 2000 census, 50.6 percent (4.2 million people) of the labor force, were directly involved in agriculture. From the census, about 90 percent of most farm lands were not up to 2 ha in size and mostly oil palm, rubber, coconut, maize, rice and pineapples farms are very large. Generally, agriculture in Ghana is rainfall dependent, although in 2002 an estimated 6,000 farm enterprises across Ghana used some means of irrigation. Reports indicate that, the average farm land irrigated in 2002 was around 11,000 ha with an estimated potential area for irrigation of 500,000 ha. Generally, 51 percent of Ghana's cereal needs are locally produced, 60 percent of fish requirements are locally produced, 50 percent of meat are locally produced, and less than 30 percent of agro-based industries' raw

materials are locally produced (Figure 8). The economy of Ghana is controlled by the service, industry and the agriculture sector with agriculture accounting for 23 percent of the national Gross Domestic Product (GDP) in 2012 (FAO & FAPDA, 2015). Agriculture is still one of the largest share contributor to the GDP. Since 2000, there has been a total of between 35.8 percent and 37 percent contribution to the GDP from agriculture. Agricultural growth increased from around 4 percent in 2000 to 6 percent in 2005, with the greatest growth contribution from the cocoa industry.

According to the report by FFG (2014), there has been consistency in growth and poverty reduction over the past 2 decades making Ghana a successful African country. The annual GDP in 2014 has grown consistently over the past decade, and this yearly growth is perceived to exist for years to come. Poverty reduction, especially in the southern Ghana has been driven by agricultural growth, and agriculture sector employs the largest number of people, and these people are predominantly smallholder farmers that produce food and cash crops. Over the past 10 years, Ghana's overall poverty reduction rate has been from 52 percent to 28 percent. Despite Ghana's progress in agriculture, Ghana still imports about 70 percent and 15 percent respectively of rice and maize consumed. The rise in incomes and increasing urban growth rate is expected to increase the demand of both crops.

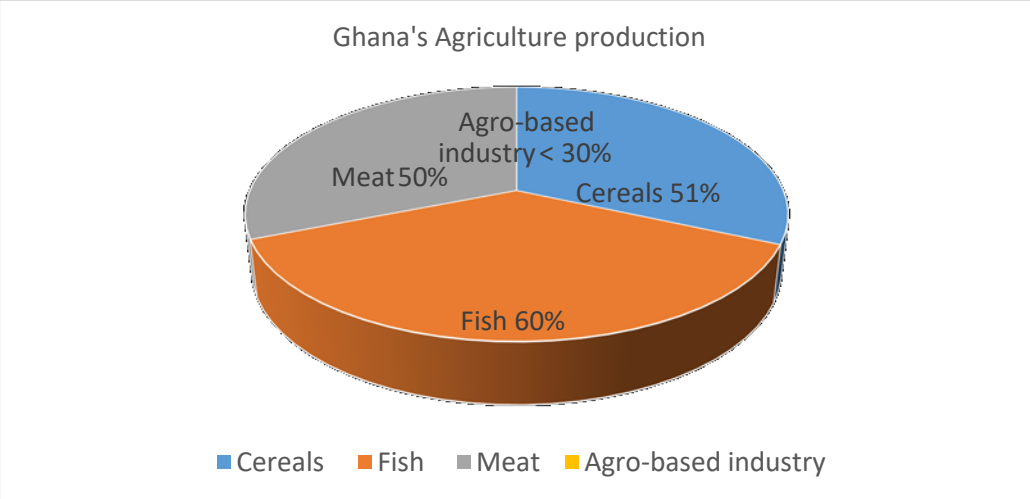


Figure 8: Productivity of the Agricultural Sector in Some Products
Source: MoFA (2012)

Agricultural Sector Constraints

There are aggregated factors hindering agricultural growth and these factors are discouraging farmers from investing and producing. Some of these factors are limited access to finance, changes in technology and existence of poor infrastructure among others. Diversity in Ghana's agro-ecology pattern has compounded these challenges. Ghana's Ministry of Food and Agriculture in 2007 listed some constraints in the agriculture sector.

Human resource and managerial skills: The largest constituent of the human resource of the agricultural sector is the over 60 per cent of the population, including farmers, traders and processors that make a living from the sector. Agriculture is also a critical sector for women. About half (48.7%) of the total female population is self –employed in agriculture, with the majority being engaged in food production There is an aging farmer population yet the sector is unable to attract the youth. High illiteracy among producers means a constant need for facilitating their access to information on new approaches, opportunities and policies. High incidence of poverty among farmers limits their ability to respond to opportunities either because of lack of capacity or because of their risk-aversion strategies. Changes in global trade environment are widening the gap between the skills needs of the private agribusiness and the skills of existing manpower of service providers. Livestock specialists, e.g. veterinarians, breeders, and meat scientists are especially limited in the country (MOFA, 20O7).

Knowledge about new crop varieties and changes in farming methods are limited to the old folk. Productivity is much dependent on these factors and the absence of them largely explains the dwindling performance of the sector over the years. Educating small scale farmers on management skills need to compliment the policies which are geared towards small scale farmers' development.

Sustainable Natural Resource Management: Ghana's agriculture is natural resource-based, with extensive crop and livestock production systems, hunting, rain-fed agriculture, and fish from natural water bodies. Traditional practices such as bush burning, and the improper use of technologies such as

irrigation and agro-chemicals do not engender sustainability of resource use. For example, 69 percent of the total land surface of Ghana is considered prone to severe erosion coming at a cost of 2 percent of GDP. Although the problem is in all the agro-ecological zones, the savannah regions are affected the most.

Land degradation, desertification and soil erosion hit hardest at the local level and those most affected are the poor women and men who depend on natural resources for their survival. 'Women's work', particularly work performed by poor women, is strongly affected by environmental degradation. Communal ownership of land and absence of demarcated grazing lands result in over-grazing and conflicts between livestock keeping and crop farming. The practice of bush burning for crop production is a source of loss of fodder for livestock during the critical dry season period.

Unfortunately, most farmers in Ghana are not aware of the linkage between inappropriate tillage and water management practices on one hand, and environmental degradation on the other. With an estimated 64 per cent of the natural wealth of Ghana locked up in crop lands, there is the need for more focused attention to address poor agricultural land management. The prudent management of agrochemicals and drainage is crucial in sustaining the natural resource base (MoFA, 2007).

Technology development and dissemination: Low productivity in agriculture can be due to poor conditions of soils, irregular pattern of rainfall, disease and pest outbreaks, lack of access to good varieties of planting materials and seeds. Lack of access to good market incentives and relevant inputs, limited access to

processing technologies, transports, handling and storing of commodities of crop, fish, and livestock are challenging factors. There is also limited knowledge in post-harvest management, most especially of perishable produce, resulting in high post-harvest losses of about 20 to 50 percent for fruits, vegetables, roots and tubers, and about 20 to 30 percent for cereals and legumes. The women have been using traditional processing technologies, which have low yields, strenuous, and not be of good product quality (MoFA, 2015). Without the application of technology and adoption of modern methods of farming, the development of a good Ghanaian agricultural base will forever remain a mirage.

Infrastructure: Movement of agricultural commodities is a challenge as road and transport infrastructures are inadequate and poor. This constraint particularly has retarded agriculture growth and development in some high potential areas. Most feeder roads connecting farms to villages are very poor compelling farmers to carry their produce on their heads from farms to markets. Poor road infrastructure also has a toil on cost of important inputs such as fertilizer. Most markets have limited infrastructures such as suitable commodity specific storage facilities, toilet facility, good and hygienic environment, accessibility by car or truck and limited space (MoFA, 2015). Infrastructural development is key to agricultural progress in its entirety. High valued agricultural products have in many times perished right from harvest without getting to the market due to bad storage systems. The empirical literature indicates that public infrastructure investment provides a significant return to agriculture and augments productivity growth. There is a positive relationship between public infrastructure and

productivity growth in livestock and crop production in many of the empirical literature. This therefore, suggest that any decline in public infrastructure investment can partly explain the observed decline in the productivity growth of Ghana's agriculture.

Market access: Lack of access to the market, limited marketing skills and limited processing skills are major constrain in the agriculture value chain. Poor infrastructural development is the biggest culprit in this regard. Most farmers do not have an easy time conveying their products to major trading centres for a good price. The poor roads to farming areas lead to limited access to the bigger markets, which can offer better price for their crops. Other farmers have to resort to the use of middle men in marketing their agricultural produce which is also unfavorable to them. Prices of farm produce are therefore, very low especially during harvest time when there is a glut and this serves as disincentive to the farmers.

Food insecurity: Ghana faces eminent food insecurity as the average yield has not been growing. In almost two decades the importation of commercial food, and food aid have reached about 4.7 percent of food needs. Food production and availability per year is dependent on rainfall during and between growing seasons, and the level of production. This creates food insecurity at household levels, making community areas poor and chronically distressed. Ghana is generally food secure, but there are pockets of food insecurity existing in all regions as a result of acute limited resources and limited alternative livelihood chances for most people

to meet their dietary needs. Adverse weather conditions, and bush fires have had severe impact on smallholder farm enterprises (MoFA, 2015).

Farm Finance: The principal source of funding for farming activities is from the farmers' own savings. Other sources are private money lenders, relatives and a limited percentage from the banks. The role of existing financial institutions and other sources of acquiring credit are minimal especially in the rural areas. The limited number of credit facilities is due to the cumbersome procedures and the lack of collateral demanded by the banks and the mistrust generated by the failure of some farmers to pay back loans early. Few farmers in the Ghana, therefore, benefit from credit facilities as most of the farmers cannot meet the requirements for obtaining loans. There is a strong desire among farmers to have access to credit facilities from sources other than money lenders as the interest rate charged by money lenders are extremely high. Indeed, the minimal use of farmers' associations in the country makes it difficult for farmers to mobilize credit.

Irrigation development and management: Dry lands less than one percent are using irrigation, and improper management of the present systems further limits their effectiveness. There are public irrigation systems that operate at approximately one third of their designed capacity. This has caused low yield and low cropping intensity because of lack of good operation and maintenance of irrigation facilities. Formal irrigation development is highly supply-driven and its over-reliance has limited the areas under irrigation.

Climate change: Ghana's agriculture is highly vulnerable to the increased frequency, severity and unpredictability of extreme weather-related events caused

by climate change such as hurricanes, droughts, floods, and rising sea levels among others. Studies have further observed that, on a global scale, various models predict a moderate impact in the next two decades indicating that, all regions will experience increased temperatures and changes in rainfall patterns that will affect agricultural production as well as food and nutrition security

Energy: The cost and demand for energy (fossil fuel, electricity) in all sectors of the economy is growing rapidly (growth in demand for electricity estimated at 7% per annum), with dire consequences for agricultural production and processing. There is widespread use of energy inefficient agricultural machinery and equipment. Potential of alternative energy sources (renewable energy) in the sector is largely unexplored due to inadequate research and knowledge. In the case of electric power, the single-phase electricity supply system in rural areas is not suitable for agro-processing and related industries, which should be equipped by three-phase powered machines.

Access to Land: Available agricultural land is declining due to population pressure and urbanization. This is increasingly limiting access to land and causing changes in the spatial distribution of crops such as the shift in cocoa production from the Ashanti, Eastern and Brong Ahafo Regions to the Western Region and replacement of yam by cassava in the transitional zone. Insecurity of tenure is widespread, largely because of customary land tenure systems in which there are no legal titles. Boundaries are unclear, and communal ownership invests rights in all but gives responsibility for management to none. Insecurity of land rights

could limit investment, and is a threat to livelihoods of migrant populations in farming communities and sustainable use of land through intensification.

Conclusion

The chapter took a look at the various variables that are included in the study and looked at their trend from 1986 to 2016 which is the study period. As expected of most time series data none of the variable exhibited a linear trend but fluctuated with varying degrees throughout the study period. The second part of the chapter looked at the agricultural sector in Ghana and the constraints facing it. A number of challenges were identified to be hindering the growth of the sector.

CHAPTER THREE

LITERATURE REVIEW

Introduction

This chapter discusses the emergence of the core issues in the literature. In doing so, the study discussed the background to the problem that has to do with the relationship between trade liberalization and food security in Ghana. The chapter is organized into six main parts. The first one deals with the conceptual definitions of food security, the second looks at the theoretical approaches to food security and the third also deals theoretical arguments of trade liberalisation on food security. The fourth one takes a look at some few international trade theories, the fifth one deals with theoretical correlation between trade liberalisation and food access and the last one looks at the empirical literature between trade liberalization and food security.

Evolution and Conceptual Definitions of Food Security

Concepts of food security have evolved in the last thirty years to reflect changes in official policy thinking (Clay, 2002; FAO, 2003; Heidhues et al., 2004). The FAO (1983) and the World Bank's (1986) definitions have reflected these changes, complemented by the work of academics, for example Amartya Sen's (1981) theory of famine The World Food Summit's widely accepted 1996 definition has now encompasses four dimensions: food availability, access, utilization, and stability (FAO, 2013): "Food security 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"

(World Food Summit, 1996). The term 'security' itself has also undergone constant evolution. Historically, the concept of security has been defined primarily in military terms; it was restricted to the issues related to armed conflicts, the major threat to human safety. Today, however, climate unpredictability, water scarcity, spreading hunger, and failing states are the new threats to survival (Brown, 1975), and as such, increasingly considered security issues as well.

The term first originated in the mid-1970s, when the World Food Conference in 1974 defined food security in terms of food supply - assuring the availability and price stability of basic foodstuffs at the international and national level: "Availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices". In 1983, FAO analysis focused on food access, leading to a definition based on the balance between the demand and supply side of the food security equation: "Ensuring that all people at all times have both physical and economic access to the basic food that they need" (FAO, 1983). The definition was revised to include the individual and household level, in addition to the regional and national level of aggregation, in food security analysis. In 1986, the highly influential World Bank Report on Poverty and Hunger (World Bank, 1986) focused on temporal dynamics of food insecurity (Clay, 2002). The report introduced the distinction between chronic food insecurity, associated with problems of continuing or structural poverty and low incomes, and transitory food insecurity, which involved periods of intensified

pressure caused by natural disasters, economic collapse or conflict. This was complemented by Sen's theory of famine (1981) which highlighted the effect of personal entitlements on food access i.e. production, labour, trade and transfer based resources. The widely accepted World Food Summit (1996) definition reinforces the multidimensional nature of food security and includes food access, availability, food use and stability. It has enabled policy responses focused on the promotion and recovery of livelihood options. Initially made popular by academics such as Chambers and Conway (1992), livelihood approaches are now fundamental to international organizations' development programmes. They are increasingly applied in emergency contexts and include the concepts of vulnerability, risk coping and risk management. The inability to manage any risk associated with food unavailability gave rise to a different definition by other researchers.

Food insecurity exists when members of a household have an inadequate diet for part or all of the year or face the possibility of an inadequate diet in the future (Phillips & Taylor, 1990). This therefore means that access to food is a major requirement in the food security equation as noted by Jonsson and Toole. "Access to food, adequate in quantity and quality, to fulfill all nutritional requirements for all household members throughout the year" (Jonsson & Toole, 1991). Other works incorporates experience interceptions in its description of food insecurity and states that food insecurity is experienced by households and individuals when there is uncertainty about future food availability and access, insufficiency of the amount and kinds of foods (quality) required for a healthy

lifestyle, or the need to use socially unacceptable ways to acquire food. This definition integrates the notion of perceptions of food insecurity and of ‘‘feelings of deprivation’’ in individuals, which may trigger response behaviors that can deepen current poverty or lead to the transmission of poverty to the next generation in the longer term. Some of these behaviors carry important nutritional risks, thus undermining health and productivity, especially for the most nutritionally vulnerable household members, such as pregnant and lactating women and young children, who have high nutrient requirements

More recently, the ethical and human rights dimension of food security has come into focus. The Right to Food is not a new concept, and was first recognized in the UN Declaration of Human Rights in 1948. In 1996, the formal adoption of the Right to Adequate Food marked a milestone achievement by World Food Summit delegates. It pointed the way towards the possibility of a rights based approach to food security. Currently, most countries have the right to food enshrined in their constitution and FAO estimates that the right to food could be judicial in some 54 countries (McClain-Nhlapo, 2004). In 2004, a set of voluntary guidelines supporting the progressive realization of the right to adequate food in the context of national food security were elaborated by an Intergovernmental Working Group under the auspices of the FAO Council.

As we can see from the above definitions, earlier definitions of food security lay much more emphases on fulfilling physiological needs. And as global living standard advances, the definition of food security improved. New concepts, including “affordability” and “nutrition”, were added to ensure people around the

world can obtain safe and nutritious food. In 2009, Food and Agriculture Organization of the United Nations (FAO) redefined food security and assessed it across four internationally designated dimensions: Physical Availability of Food, Economic and Physical Access to Food, Food Utilization, and Stability of the other three dimensions over time.

Achieving food security requires that the aggregate availability of physical supplies of food is sufficient, that households have adequate access to those food supplies through their own production, through the market or through other sources, and that the utilization of those food supplies is appropriate to meet the specific dietary needs of individuals.

Theoretical approaches to food security

Food Availability (Classical approach)

The classical approach gives emphasis on the availability and supply of sufficient and nutritious food to fulfil the dietary requirements of an active life of the individual. Availability refers to supply of food from all sources such as local production, import, existence of food stock and food aid. Thus, availability determines the supply side of the concept which is related to the physical existence of enough food for all and hence it is the first condition to achieve food security. According to FAO (2001) global food supplies are more than sufficient to provide all individuals with required calories needed for active and healthy life provided that food was distributed equally. However, this abundant food is not distributed equally. So about 870 million people (15% of world population) are living undernourished having less calorie intake than required (FAO, 2013). Thus

sufficient supply of food at the international or national level cannot assure the micro level food security i.e. availability of food does not necessarily imply access to food by all. During mid-1960s Asian Green Revolution successfully increased domestic food (cereal) production, yet household nutrition status did not improve much and many people suffer from starvation. Since unavailability of food is one of the constraints in improving nutritional status, all factors related to food chain from production to consumption is integral part of malnutrition. Broadly, constraint to accessibility to the available food is one of the main causes of the people starvation. Therefore, for nutrition it is crucial to ensure the accessibility to the available food.

Accessibility (Entitlement approach)

Inadequate supply of food is not always the cause of starvation, inability to physical and economic access to food can be the constraint for having sufficient food. In 1983, FAO incorporates the 'accessibility' dimension to the idea of food security with the inspiration of trailblazer work of Sen (1981) of 'entitlement'. The entitlement approach supports the view that 'hunger is caused by a lack of income, not of food supply' (Sen & Drèze, 1989; Sen, 1981). Despite an ample supply of food, Sen shows that starvation and malnutrition arise due to lack of entitlement. According to this approach, "The food security problem is seen as a problem both of supply and of lack of effective demand amongst the poor. A range of socioeconomic factors (household income, and economic assets, prices, demographic factors and socio cultural factors) are sought that determine access to food" (Yaro, 2004).

FAO (2001) alo analyzed lack of physical and economic accessibility to food on the basis of policy issues like income, expenditure, market structure and prices. Access depends on income level of household, purchasing power, existence of transport and market infrastructure and food distribution systems of a country (FAO, 2015).Poor infrastructure can increase the input price and also the transportation cost to domestic or global market. Moreover, inadequate infrastructure creates regional poverty since people live in an isolated area do not have access to market hence inhibit economic activities. In addition, lack of infrastructure is obstacle to receive better health facilities and education; consequently people in isolated area are more vulnerable to malnutrition and food insecurity. Therefore, even though sufficient production of food, food insecurity will persist if people do not have the income to purchase it or if the price is very high.

Utilisation

Nutritional status of individual is determined by the food utilisation. Utilisation refers to the proper use of food. Nutrition does not depend only upon the quantity of food we consume to get calorie but also on the micro nutrient of food and dietary diversity. FAO (2013) defines utilisation aspect as the safe and healthy food, access to clean water, health and sanitation. Utilisation includes the existence of appropriate food processing and storage practices, adequate knowledge and application of nutrition and child care and adequate health and sanitation services (FAO, 2015). Access to food or elimination of starvation cannot guarantee good status of health since balance and diverse food is the

principal requirement for it (Pellegrini & Tasciotti, 2014). Therefore, nutritional education is vital for ensuring the food value in the developing countries. Adequate knowledge on nutrition, food preparation and diversification of diet can help to have balance food practice. Overall, feeding practice, dietary diversity, and intra household distribution of food refers to the utilization criterion.

Stability

Even if the above three criterions are fulfilled, periodic inadequate access to food can make people food insecure and thereby raising the risk of malnutrition. Stability depends on domestic food production, income, market structure, government and private transfer policy. Adverse weather, price fluctuation, political and economic factors like unemployment, fluctuation of food price can be responsible for sporadically inadequate access to food. Factors related to risk and uncertainty is described as 'stability of the other three dimensions over time' (FAO, 2008). This aspect indicates that individual food security can change over time. Time related food insecure depends upon the duration; usually they are transient and chronic. Transitory food insecurity refers to a sudden fall in the ability to produce or access food to maintain a balance nutritional position (FAO, 2008). This type of food insecure happen because of sudden and unexpected shocks such as natural or human induced disaster that affect food supply, price or household income. Usually this is temporary in nature. When temporary shocks occur repeatedly it would decline the household living standard and eventually resulting into chronic food insecurity. Chronic food insecure occurs when people are not able to meet their minimum food requirements over a sustained period of

time (FAO, 2008) or when it is persistent. This type of food insecure is mostly due to poverty and insufficient access (physically and economically) to productive resources over a sustained period of time (FAO, 2008). Seasonal food insecurity is a situation that lies between chronic and transitory food insecurity. Seasonal food insecurity is usually predictable and follows a known incident hence has some similarities to chronic food insecurity. However, the time span is limited for seasonal food insecurity, hence viewed as transitory food insecurity. This type of insecurity is connected with the seasonal variation of climate, cropping patterns, work opportunities and market fluctuations.

Theoretical Arguments of Trade Liberalisation on Food Security

Trade liberalization is expected to influence food security through a multiplicity of channels with differing effects. Some of the salient channels and arguments at the theoretical level are summarised below.

Economic growth: Trade liberalization is expected to foster economic growth, reduce poverty, and thereby improve food security through induced changes in the relative prices of traded and non-traded goods that result in more efficient resource allocation based on current comparatives advantage. However, in the event of adverse changes in income distribution against the poor due, for example, to induced changes in the structure of production, the poor may, in the short run, experience increased income risks, worsening their food security condition, even in the face of higher aggregate income.

Cheaper imports and a fall in domestic prices: Where domestic food price are higher than its world counterpart because of tariffs and other trade barriers, trade

liberalization in a small, importing country would lower domestic food prices to the world level and thereby raise the quantity of food consumed. However, the competition from cheaper imports and the fall in domestic food prices would exert a disincentive effect on domestic production and could adversely affect the food security status of the poor whose main source of employment and income is food production. With multilateral liberalization, a removal of farm and export subsidies in exporting countries could cause a rise in world food prices, potentially offsetting the above-mentioned domestic price effect associated with tariff reduction by the importing country.

Reducing uncertainty and variability of food supply: Opening up the economy reduces the variability of staple foods supply by helping offset adverse domestic supply shocks such as droughts. On the other hand, in the presence of less stable and less predictable world markets (than trade under protection), liberalising the trade regime could worsen the variability of staple food supply.

It is clear from the foregoing that whether trade liberalisation improves food security is theoretically ambiguous. The nature and magnitude of the food security effect of liberalisation depends on a number of factors including but not limited to the following: the extent of adaptability of the poor (in terms of location and skill and the constraints they face) to changing economic conditions; the degree of exposure of the country to food imports; the presence of favorable initial conditions and accompanying measures, such as adequate regulatory and export capacity, non-trade domestic policies and infrastructure; and the time horizon (short-term versus medium to long term) considered. The relationship

between trade liberalization and food security is, therefore, an empirical question. It has been a subject of numerous empirical investigations, mostly case studies, using different food security indicators.

International Trade Theories

International trade is one of the most important economic activities and now a day's almost all the countries in the world involve in it. There are several factors behind the involvement of international trade: (1) To expand the market of a country's commodity; (2) To obtain foreign exchange for finance domestic development; (3) The differences in supply and demand across the country for a particular product; (4) The difference in relative cost in producing a particular product; (5) Differences in natural resources endowment between countries (Krugman & Obstfeld, 2003). Moreover, according to Salvatore (2001) international trade provides benefit for the countries specialize in producing the goods and services –production of goods and services become more efficient. A country's development will more connected with the development of other countries. International trade is one of the major benefactors to ensure the access to food upon which a country's food security as well as nutrition depends (Kerr, 2011).

The Theory of Absolute Advantage

According to the absolute advantage theory by Adam Smith, absolute advantage is the basis for international trade between two countries. In general, absolute advantage theory states that if a country is more efficient (has an absolute advantage) in producing a commodity 'A' compared with other

countries, but is less efficient (having absolute disadvantage) to produce commodity 'B'; then, both of them can gain profit by specializing in the producing and exporting the commodity that has an absolute advantage and trade with a commodity that has an absolute disadvantage. Through this process, resources in both countries can be used in the most efficient way and the production of both commodities will increase. The increase in output will measure profit of specialization of production for the two countries to trade (Salvatore, 2001)

The Theory of Comparative Advantage

Most economists today generally support freer trade over protection, including trade in food and agriculture. The concept of comparative advantage, drawn from the classical trade theory outlined by David Ricardo in 1817, is often given as a rationale for this view. According to the theory, there will be gains from trade even if a country does not have an absolute advantage in any particular good. The key is that all countries are comparatively better at producing some goods than they are at producing other goods, and that these comparative advantages at the domestic level are what matters for realizing gains from trade (Prasch, 1996; Schumacher, 2013). The theory posits that because each country faces different opportunity costs to produce different goods – due to variations in endowments of land, labour, climate, capital, and technology – every country has comparative advantage in at least some goods. If all countries specialize in the goods for which they have comparative advantage and then engage in trade with other countries that are doing the same, according to the theory, world welfare

should increase. Specialization in this way spurs efficiency gains that should lead to a rise in overall world production of goods. These predicted gains can be demonstrated mathematically, and it is widely assumed by those adopting this narrative that countries that trade do so because they are made better off than is the case without trade. The theory has been updated and refined by others since it was first articulated to account for the modern context, and has remained a dominant rationale for trade liberalization by many countries including Ghana.

The theory of comparative advantage is often referenced by those who argue that trade liberalization enhances food security (Zorya *et al*., 2015). The idea is that efficiency gains from specialization and trade should improve both food availability and food access. Common steps to the argument (illustrated in table 3) are as follows:

Removal of trade barriers encourages market competition and specialization based on comparative advantage (as determined by natural endowments with respect to land, labour, technology, and climate). Efficiency of food production is enhanced as crops are grown in countries that have the least opportunity costs in producing them.

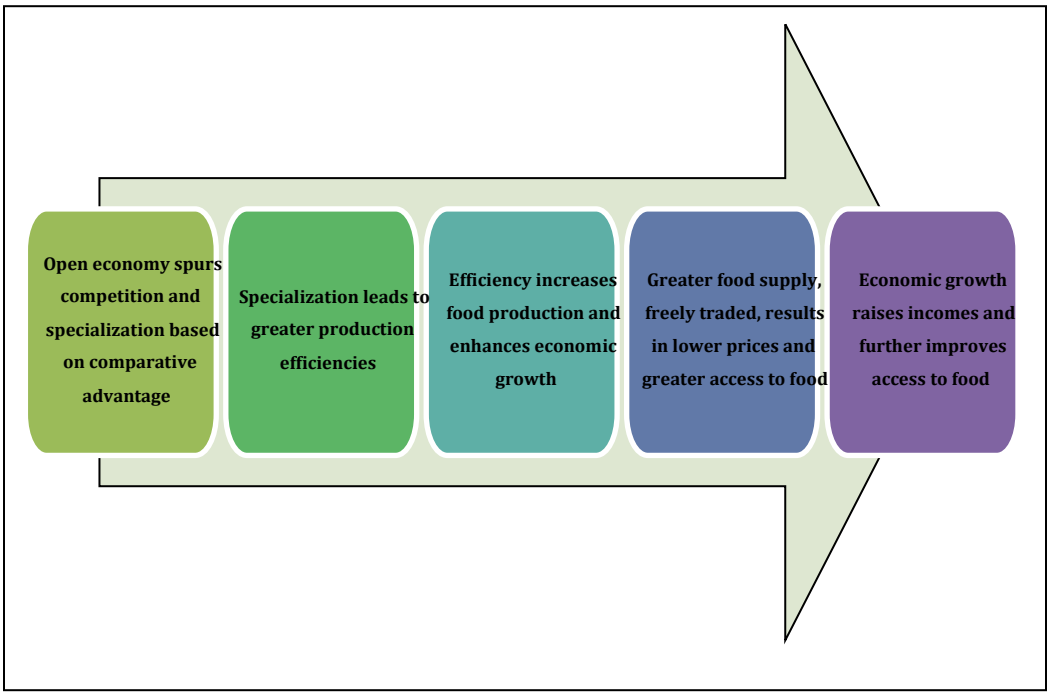
More efficient agricultural production results in greater food supply on a global scale (from efficiency gains), as well as higher economic growth and job creation (spurred by efficiency gains in sectors with a comparative advantage) within countries, enabling technological development to further enhance production.

A greater supply of food, freely traded, should result in more availability and lower food prices in all countries, as dictated by the forces of supply and demand, resulting in greater access to a wider variety of food, improving food security.

Economic growth resulting from more efficient economic activity raises incomes and creates jobs, also improving access to food and enhancing food security.

Illustrating the steps to this argument, Pascal Lamy, former head of the WTO, noted after the recent food crisis: “Clearly, international trade was not the source of the food crises. If anything, international trade has reduced the price of food over the years through greater competition, and enhanced consumer purchasing power. International trade has also brought about undisputable efficiency gains in agricultural production” (Lamy, 2011).

Table 3: *Pro-trade perspective on comparative advantage, trade, and food security*



Source: (Based on FAO (2003) and Lamy (2013).

From the above analysis we can therefore conclude that free trade promotes a mutually beneficial division of labour among nations. Free and open trade allows each nation to expand its production and consumption possibilities, raising the world's living standard. Protectionism on the other hand, prevents the forces of comparative advantage from to maximum advantage.

Heckscher-Ohlin (H-O) Theorem

Another important theory of international trade is the Factor Endowment theory by Eli Heckscher and Bertil Ohlin or well-known Heckscher-Ohlin (H-O) theorem. This theory was developed from the Ricardian model. Similar to Ricardian model, it illustrates trade between two countries that produce two goods. In addition to Ricardian model it assumes two factors of production-

labour and capital. The theory states that each country will specialize in production and export the commodity which uses relatively intensive factors of production available in the country and import the commodity which use relatively scarce and expensive factor of production (Salvatore 2001). This theory assert that in labour abundant countries the relative price of labour intensive product to capital intensive product is lower than in capital-abundant countries (FAO, 2003). Furthermore, according to factor price equalization theorem of Heckscher-Ohlin, international trade tend to equalize prices of homogeneous factors of production in both countries that engage in trade either in relative or absolute terms.

In essence, the theory of Heckscher-Ohlin trade explains that international trade takes place based on the comparative advantage of each state. This theory also highlights the effects of international trade on price or income level of each factor of production. The Heckscher-Ohlin (H-O) model serves the most recognized basis for the pattern of international trade with different factor endowment. Commonly developing countries are regarded as labour abundant country and producer of agricultural commodities since agricultural goods are labour intensive goods. Thus, very often it is argued on the basis of H-O theory that developing countries are net exporters of agricultural goods while the developed countries are net importer. However, world trade pattern shows that developed countries hold the lion share of world agricultural trade. Thus, considering trade pattern it can be argued that agricultural goods are not labour intensive rather developed countries controls the power of product differentiation

by holding abundant arable land, natural resources and improved technologies. Hence, at the present time developed countries are the principal food producer of the world since they have the advantages over factors of production and the technology of production. As a result of higher productivity, food price is relatively lower in developed countries. The price difference induced them to export food where it is short and this "expertise to arbitrage will at the end moderate food price" (Kerr, 2011)

Theoretical Correlation between Trade Liberalization and Access to Food

It is always difficult to demonstrate the existence of precise relationships between international trade and food security status. This is partly because of the complex "multi factorial etiology" of food security (Fleuret & Fleuret, 1980) and partly because of the highly variable and diverse outcomes of increased integration to international trade. The debate over this correlation lies at the very root of the economy and the exact effect depends upon the economic features of the particular country. Fleuret and Fleuret (1980) identified the core reasons of consumption related malnutrition; inadequate food production causes by shortage of land, labour, capital or any one of these. Some people do not have access to food or the appropriate kind(s) of food provided that production is adequate. Cultural factors such as diet preferences, intra household distribution cause unhealthy diet pattern even with sufficient food production. In spite of having enough food production and overall income levels, certain categories of the population are constrained by other social and economic factors to make consumption decisions that are inconsistent with good nutrition. Sen (1981)

emphasises on the lack of entitlement to food as a main reason of malnutrition. The problem of entitlement is not related with inadequate production of food; rather some people cannot afford enough food or the appropriate kind(s) of food due to deprivation of a source of income.

The classical development theories argue that free trade benefits economic growth and thus growth negatively affect hunger and malnutrition by creating scope of income and access to food. This view maintains that protection on trade reduce world welfare since liberalized or less restrictions on trade enhance more efficient use of resources. Thus trade plays an important role in raising production and income and helps to get rid of the vicious circle of poverty. This will also help to create a 'vicious circle of raising productivity' (FAO, 2005). Additionally; trade opens the door to flow produced goods from surplus to deficit areas. Open trade also increases overall incomes through the benefits to exporters and importers. These are the main channels through which trade can assure better food security. During 1990s depletion of tariff and exchange rate movement increase the food imports in many African countries as explain in FAO (2005) report. Some countries import more because of the reduction of food production at that time. Yet, import of food does not assure that good nutrition. Thus the critics argue that free trade model gives benefit to powerful, hamper the multilateral trade negotiation process. So trade liberalization ultimately hamper food security as scale intervention and size concentration throw the marginalise farmers out of the system, creates unemployment and poverty Chile & Talukder, 2014).

According to this view trade liberalization protect the smaller part of the society at the expense of the many.

In the trade-food accessibility relation, first linkage occurs at the border (FAO, 2005). When a country reduces its tariff as a liberalize policy this will lower the market price of imports at the country's border. The transmission of price from border to local market to producer, consumer and house hold depends on country's infrastructure and geographical factors. Price changes in domestic market change the relative price. In response to change in price households alter their consumption habit, change their working hour even their job.

Household's long term investment in human capital can be affected. In the long run free trade boost up the productivity, investment in market institutions, infrastructure, technology and human capital and all these are better policy for achieve a long term growth (FAO, 2005). Critics, on the other hand, claim that open trade adversely affects growth, especially in the short run. Liberalized trade in developing countries interrupt market, reduce the incentive for local production and make poor people more vulnerable to international shocks. Chile and Talukder (2014) claim that scale intervention and size concentration due to increased trade throw the marginalize farmer out of the system, creates unemployment and poverty.

Empirical Review of Trade Liberalisation and Food Security

Turmoil on global food markets since 2007 has prompted greater use of trade-relevant policy measures, such as export bans, price controls, and public-stockholding schemes by a number of countries as a means to enhance domestic

food security. Many countries in Asia, Africa, and the Gulf region also announced plans to become more self-sufficient in food in order to reduce their reliance on global markets for their food supply. Trade advocates have actively argued against these types of policies, which they see as harming, rather than enhancing food security. Instead, they argue that more trade, supported by more open trade policies, is required to enhance food security. Those who view trade as beneficial for food security typically draw on economic ideas and promote the idea of "food self-reliance" – i.e. engaging in trade as a means by which to ensure food security (FAO, 2003).

One of the empirical evidence why trade liberalization enhances food security is that it acts as a transmission belt, moving food from surplus to deficit regions. This argument builds on the theory of comparative advantage but emphasizes the balancing role that trade can play in distributing food more evenly on a global scale (OECD, 2013).

In a survey of impact assessments on the effects of liberalization from 39 countries conducted largely by NGOs and related institutions, Madeley (2000) concluded that liberalization measures under World Bank/IMF sponsored structural adjustment programs and under the World Trade Organization's Agreement on Agriculture were making the poor more vulnerable to food insecurity, adversely affecting small-scale farmers who faced, among others and depending on the country studied, competition from cheap imports, increased landlessness, higher farm input prices relative to the prices they received for their produce, and a reduction in government supports provided.

Another survey by Madeley and Solagral (2001) of studies inclusive of perspectives from multilateral agencies, such as UN agencies, IMF, World Bank and national governments indicates that the evidence is mixed. Some of these studies find evidence to support the view that trade liberalization contributes to poverty reduction, augments prosperity and accelerates the development process of a country, while others report that trade liberalization has caused many farmers to leave farming and countries to become increasingly dependent on food imports.

Similarly, a synthesis of findings by Thomas and Morrison (2006) of 15 country case studies launched by FAO in 2003 and conducted by national consultants shows that the food security outcomes of liberalization varied by country and the food security indicator used. The empirical examination included quantitative and qualitative analysis of the impact of policy reforms on prices, production, and trade flows in the agricultural sector and on target variables, such as real incomes of farmers. By this indicator, seven of the study countries reportedly experienced an improvement in food security, while the outcomes for the rest were negative or ambiguous.

Bezuneh and Yiheyis (2012) have examined the food security in national level with special reference to the trade liberalization. The researchers have conceptualized food security as food availability for human consumption at the national level both from domestic production, commercial imports and food aid. Bezuneh and Yiheyis have made efforts to empirically investigate the effect of trade liberalization on food security. In their study, they have employed multiple-regression model to capture impacts of trade liberalization on food security. The

dependent variable of the regression model is referred as the food availability. Food availability is represented by per capita daily dietary energy supply and is derived from food balance sheets using country-level data on domestically produced and imported foods including food aid available for human consumption minus nonfood use. In their study, the researchers have employed trade liberalization dummy variables with three lags to capture time effect of trade liberalization. Bezuneh and Yiheyis (2012) hypothesized a positive association between food security and trade liberalization with favorable impact of increased supply of food and decreased food prices.

As well as, a before/after study of agricultural trade policy and food security in the Caribbean indicates that policy reforms introduced in the 1980s and 1990s were associated with increased food insecurity and loss of rural livelihoods for several countries in the region, as traditional export crops lost access to markets, domestic food was crowded out by cheaper imports, and as consumption patterns and diets changed and health problems worsened (Ford & Rawlins, 2007).

Also, another study by Abdullateef and Ijaiya (2010) on agriculture trade liberalization and food security in Nigeria established that the trade policy during the 1986 to 2003 did not impact on the development of the agriculture sector and major policy efforts did not address the fundamental problem of food production. It is 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. The results obtained in their study suggest that the capacity to develop appropriate apparatus for equitable food

production and distribution in the face of globalization is weak. This is evident from the experiences obtained from the two regimes of before and after trade liberalization.

World Bank Report (2001) reviews the evidence as to whether globalization supports poverty reduction and concludes that whilst a category of "new globalizers" are benefiting from greater integration into the world economy, a significant group are becoming more marginalized. The degree of openness to trade has been proposed as one potential reason for this divergence.

Diaz-Bonilla and Lucio (2000) on the other hand, find a positive correlation between trade openness and economic growth and increased food availability. Sachs & Warner (1995) suggest that openness explains in part, the different export performance of Asia, Africa and Latin American Countries (LAC) in processed and high value added agricultural goods. However, they also noted that diverse performances can be attributed to a broad range of factors, including for example: differentiated population dynamics, climate patterns, degrees of technical development and domestic policy sets.

Examples of studies using the Computable General Equilibrium model include a study of India's experience by Panda and Ganesh-Kumar (2009) and that of China by Chen and Duncan (2008). The former reported 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. In the case of China, trade reforms adopted to accede WTO are found to worsen food insecurity in the sense of reduced income (viewed from a partial equilibrium

perspective in the context of agriculture) and in terms of self-sufficiency when analyzed from an economy-wide perspective.

Thomas and Morrison (2006) examined the effect of ASEAN Free Trade Agreement (AFTA) on food security of its member countries by employing multiple regression analysis in panel data to disentangle the impacts of trade liberalization on food security with use of regional trade agreement dummy variable. The finding of the study supports that AFTA has influenced positively on food security of its member nations. After the formation of AFTA, the level of per-capita daily dietary energy supply of the member countries has been increased moderately over time.

More importantly, another multi-country study by Shapouri and Trueblood (2001), under scenarios of rising food prices and impact of full agricultural trade liberalization on foreign exchange earnings, indicates that global market liberalization would have a small but positive impact in reducing the food gaps in the study sample which included 67 low-income, food-deficit economies.

A multi-equation econometric model estimated for two distinct trade regimes (regulated/restricted versus more open trade regime) in Nigeria finds that trade reforms may have induced reliance on food imports, failing to address the fundamental problem of food production in that country. Likewise, Bezuneh and Yiheyis (2012), in a panel data econometric analysis of liberalization episodes in the 1980s and 1990s in 11 African countries, reported the typical effect of liberalization on food security, as measured by per capita daily energy supply, to have been unfavorable.

Clearly, the evidence on the nature of the relationship between trade liberalisation and food security is mixed and inconclusive; and this conclusion is also reached by a comprehensive and an in-depth review and synthesis of 34 relevant studies by McCorriston *et al*. (2013). They found 13 studies suggesting a positive outcome, 10 negative, and the remaining 11 mixed. As the authors observe, this may have arisen partly from the different types of food security measures utilised, since some of the indicators could move in opposite directions. Another major difference is the estimation methods employed, each with its own merits and shortcomings. Results based on the before-after approach do not typically control for other changes that might have occurred during the process of liberalisation, unjustifiably ascribing observed differences in food security indicators solely to a given policy reform. Estimates of Computable General Equilibrium models crucially hinge on assumptions made about how the policy reform is expected to influence the response variable of interest, while problems such as coefficient instability in the presence of structural breaks arising from large policy changes become an issue for econometric results.

In view of the paucity of a single country econometric evidence and the inconclusiveness of the empirical evidence in general, this study investigates the said relationship by taking stock of the experience of Ghana as a single country where trade liberalisation occurred in 1986. The empirical literature examined so far did not find a single study specifically addressing the Ghanaian experience of the said relationship. Earlier studies have been on the determinants of food security of which trade liberalisation has never been a variable in any of the

studies. This study will include trade liberalisation as a study variable. Studies closer to this topic were conducted by FAO in the form of surveys without any econometric validation of their findings. This empirical analysis will therefore be conducted by employing a mix of estimation methods with a statistical validation of observed differences and by specifying and estimating an econometric model while being cognizant of its redeeming features, such as allowing statistical validation of hypothesised effects while controlling for other relevant factors.

In conclusion, while the inclusion of variables which are peculiar to Ghana's food security is distinctively admirable in this study, a little departure from the panel approaches to the use of time series data on Ghana alone will aid to reveal the unique characteristics of the country. Large group statistical designs in the form of panel analysis do not typically provide this information because repeated assessments are not usually taken and the behavior of individuals in the groups are not scrutinised. In most cases, group means are reported.

CHAPTER FOUR

METHODOLOGY

Introduction

The main purpose of this chapter is to present the methodological framework suitable for carrying out the research exercise. Issues or topics that come under this section are methods and tools employed in the study. It clearly presents the detail form of the theoretical and empirical description of the model, variables in the model, data types and sources, estimation techniques as well as tools for data analysis.

Research Design

Consistent with the objectives of the study, quantitative research design was employed to investigate the relationship between Food Security (the dependent variable) and trade liberalisation (the independent variable) in Ghana. As compared to qualitative design, the major strength of research design is how it takes full advantage of replicability, objectivity, and generalisability of findings. Therefore, this design ensures that the researcher set aside his experiences, discretions or perceptions and biases to ensure objectivity in the conduct of the study and deductions that are drawn. Interestingly, quantitative research designs are either descriptive, where subjects usually measured once or experimental, subjects measured before and after a treatment. More specifically, since the objectives of the study is explanatory in nature (that is, examine the effect of trade liberalisation on food security in Ghana) the study adopted the explanatory research under the quantitative approach.

Theoretical Model Specification

The theoretical foundation of this study is built on the Food and Agricultural Organization (FAO) framework for analyzing food security and Amartya Sen's Food Availability Decline (FAD) theory. As stated earlier, out of the four dimensions of food security, this study will concentrate on the availability aspect at the national level. Food availability is when all people have sufficient quantities available on a consistent basis. According to FAO, food availability is determined by production and trade (FAO, 2008).

There are two faces to food availability. First, in the 1970s it was believed that food availability was the only indicator of food security. The Food Availability Decline (FAD) theory as propounded by Amartya Sen states that people are food insecure because of insufficient food supply and this was the main theory used to explain food insecurity. The association of food security as food availability was thought to have caused an oversimplification of food security indicators, typically measured in daily calories per person available (Barret, 2010). Second, it is now recognized that food security is also a problem about distribution and not production alone. However, we have to acknowledge that an adequate supply of food still needs to be available to reach food security. Adequate food production and trade are necessary to ensure appropriate food availability.

In his famous "essay on the principle of population" Malthus (1798) brought to attention the importance of having enough amounts of food to feed the global population. Here, he stated that the ratio at which food was produced and

consumed were different, implying that at some point there would not be enough food for all humans. Sen's FAD theory is based on that premise. FAD states that people starve because of insufficient supply of food. In simple terms FAD argues that anything that disrupts food production can cause starvation since it might cause a food supply decline below the subsistence needs of the population of a nation. Though the FAD theory has received some criticism in the past, it is still relevant today for embarking any empirical studies on food security. This is because food availability is still necessary to prevent food insecurity. After the world food crisis of the 1970s this concern became more present. Food availability addresses the question "is there enough food to feed everyone?" According to classic economic theory, scarcity occurs because there are limited resources available and they cannot meet unlimited wants. A good is scarce if people cannot freely get all they want, so that the good commands a positive price. Scarcity poses three basic economic questions: What will be produced? How will production occur? And who will use the goods produced?

To address these questions several organisations have developed quantitative models that project global food supply and demand into the future. According to FAO, the relationship between trade liberalisation and food security status can be conceptualised at a fairly general level, depicted in the figure below as a two stage relationship where a set of causal factors impact on a series of intermediate indicators, which in turn determine the final outcome in terms of changes in food security status.

Table 4. A simple analytical framework for linking trade liberalization and food security

Causal factors	Intermediate effects	Outcomes
Trade liberalization	Prices	Food security
Other factors	Quantities	
External shocks	Trade volumes	Income/welfare

Source (adopted from FAO, 2003)

In our study therefore, we adopt trade liberalisation as our policy variable and include other factors such as food production index, consumer price index, real gross domestic product, arable land area and amount of foreign reserves to determine their overall impact on food security in Ghana.

Empirical Modeling of the Theory.

Based on the theoretical foundations and the literature as seen in the works of Bezuneh and Yiheyis (2014) and Afrin (2014) among others, the following empirical model was estimated where dietary energy supply expressed in kilo calories per person per day (PDES) was employed as the dependent variable and a number of explanatory variables such as food production index (FPI), consumer price index (CPI), real gross domestic product (RGDP), arable land area (ARL), trade openness (TLIB) as a measure of trade liberalization and amount of foreign reserves (RES). The empirical model is derived from the general Cobb Douglas production function which is estimated below.

$$Y(L,K) = AL^{\beta 1}K^{\beta 2},\ A > 0,\ 0 < \beta_1,\ 0 < \beta_2 \qquad (1)$$

$$Y(L,K) = AL^{a_1}K^{a_2},\qquad A>0,\quad 0 < a1 < 1,\ 0 < a_2 < 1$$

Where Y is output and L and K are labour and capital respectively. β_1 and β_2 are output elasticities in the inputs and A is the efficiency parameter.

In the Cobb-Douglas production function $Y = AL^{a_1}K^{a_2}$, there is a nonlinear relationship between the inputs L and K and the output Y, and the two input interact. To estimate the parameters a_1, a_2, and A, the nonlinear Cobb Douglas must be linearized by taking the natural log of both sides of $Y = AL^{a_1}K^{a_2}$ which gives $\ln(Y) = \ln(A) + a_1 \ln(L) + a_2 \ln(K)$ (2)

In a similar way as explained in equation 1 above, the model for food security can be modeled in a similar way and be made to include many variables as follows:

$PDES=\beta_0 FPI^{\beta 1} CPI^{\beta 2} RGDP^{\beta 3} ARL^{\beta 4} TLIB^{\beta 5} RES^{\beta 6}$ (3)

From equation (3), we can see that there is a nonlinear relationship between food security and the factors that determined it. To enable us estimate the coefficients of the model, we take the natural log of equation (3) to linearise it. This is done as follows:

$\ln(PDES) = \ln(\beta_0) + \beta_1 ln(FPI) + \beta_2 \ln(CPI) + \beta_3 \ln(RGDP) + \beta_4 \ln(ARL) + \beta_5 \ln(TLIB) + \beta_6 \ln(RES)$ (4)

Since we are dealing with time series data, the functional form of equation one above can be transformed into an econometric model and also be made to capture the time series properties of the data by including a time parameter. This equation is written below as:

$lnPDES_t = \beta_0 + \beta_1 lnFPI_t + \beta_2 ln\, CPI_t + \beta_3 lnRGDP_t + \beta_4 lnARL_t + \beta_5 lnTLIB_t + \beta_6 lnRES_t + \varepsilon_t$ (5)

The ln denotes natural logarithm, PDES, CPI, RGDP, ARL, TLIB, and RES have been defined already. The coefficients β_1, β_2, β_3, β_4, β_5, β_6 are the elasticities of the

respective variables, β_0 is the drift component, t denotes the time and ε is the error term. The following are expected from the estimated output: $\beta_{1>0}$, $\beta_2 <0$, $\beta_3>0$, $\beta_4 > 0$, $\beta_5 > 0$ $\beta_6 > 0$. The choice of the functional form is based on the following reasons.

It was detected that most of the variable have a right skew (mean > median) so taking the log would make the distribution of the transformed variable appear more symmetric (more normal). It must be noted that this is also essential in getting away with outliers in order to reduce their influence in the data.

Log transformation is also appropriate in dealing with the problem of heteroscedasticity especially where the variance of the regression residuals are increasing with the regression predictions.

For interpretation of the coefficients, we also decided on this functional form. In economics, we are sometimes interested on how a percentage change in x affects the percentage change in y. This is called elasticity. By this therefore, we can say that a percentage change in any of our independent variables affects food security by a certain percentage.

Definition and measurement of variables

Per Capita Daily Dietary Energy Supply (PDES) in Kilo Calories per Person per Day.

PDES refers to the food available for human consumption during the course of the reference period, expressed in terms of energy (kcal/person/day). The estimate is derived from the Food Balance Sheets compiled on the basis of data on the production and trade (Imports and Exports) of food commodities.

Using these data and the available information on stock changes, losses between the levels at which production is recorded and the household (waste**)** and types of utilization (Seed, Feed, Food, inputs for Processing derived products and other uses) and supply/utilization account is prepared for each commodity in weight terms.

The food component, which is usually derived as a balancing item, refers to the total amount of the commodity available for human consumption during the year. The PDES is obtained by aggregating the food component of all commodities after conversion into energy values and expressed in kilo calories per person per day. The computational formula is given below:

$$PDES = \sum_{i=1}^{N} NFD(Ee) \qquad (6)$$

Where NFD = net food disposable, i = rice, corn, camote, cassava, etc. (tubers, root crops, cereals) and Ee = energy content.

Data for this variable was however, not computed by the author but rather, taken from FAOSTAT, a database of the Food and Agricultural Organization. PDES is by far the approximate for food security because it measures average food that is available for human consumption at the national level.

Food Production Index (FPI)

Food production index; this covers food crops that are considered edible and that contains nutrients. We noted here that, though coffee and tea are edible but they do not have any nutritive value and are therefore excluded. FPI measures the production of food crops commodities in a particular year relative to the base year. The current base year as used by FAO is 2004-2006. The base year is not a

single year but an average of three consecutive years to reflect the fluctuation nature of agricultural production. This index captures crops that are actually produced and harvested for a particular crop during the reference period. It includes those harvested but damaged, stolen, given away, consumed, given as harvesters' and threshers' share and those reserved but exclude those produce but not harvested due to low price, lack of demand and force majeure or unexpected events (FAO 2015, Oppong, 2016).

In construction this index according to FAO, data on crops produced are collected and is stored in metric tons. The gross value of the output is then calculated by multiplying the producer price which is the national currency unit by the output. The producer price includes the cost incurred by the farmer and the profit. The value of the intermediate output is taken out after which the value index is then found. This index is given as the ratio of the current value over the base period aggregate value. The adopted formula for calculating this index is given below:

$$FPI = \frac{\text{production in the current year}}{\text{production in the base year}} X100 \qquad (7)$$

The data for this variable was however, taken from FAO food balance sheet but not one computed by the author. Its inclusion is very significant because it measures on a ground scale the productivity of the Ghanaian agricultural sector in making food available. Higher index is associated with more food availability and lower index associated with less food availability. Following the work of Amartya Sen theory of food insecurity (Food Availability Decline), he stated that people

are generally food insecure when there are not enough quantities available for the general population. This therefore falls in line with the objectives of the study.

Consumer Price Index (CPI)

The Consumer Price Index (CPI) measures changes over time in the general price level of goods and services that households acquire for the purpose of consumption, with reference to the price level in 2002, the base year, which has an index of 100. The CPI measures inflation which reflects the annual percentage change in the cost to the average consumer of acquiring a fixed basket of goods and services that may be fixed or changed at specified intervals, such as yearly. Inflation rate is a reflection of macroeconomic instability. A high rate of inflation is generally harmful to growth because it raises the cost of borrowing and thus lowers the rate of capital investment. However, at low levels of inflation, the likelihood of such a trade-off between inflation and growth is minimal. The consumer price index is used here as a proxy for inflation to capture macroeconomic instability which will adversely affect food security. This is because a percentage change (increase) in inflation will affect the purchasing power of the Ghanaian cedi which is used to purchase goods and service. Data on this variable was taken from the database of the WDI. Since the rate of inflation possess a tax on the resources of the consumer, it is expected to affect food security negatively in this study.

Real Gross Domestic Product (RGDP)

Real GDP or inflation adjusted GDP indicates the real change of income of a country. It is a measure of the value of economic output adjusted for price

changes. This study uses the GDP at constant price to capture the availability of resources in the country. Real GDP data are collected from WDI database. Data are in constant 2005 U.S. dollars

Arable land area (ARL)

The study considers arable land area as a percentage of the total land area of the country. According to FAO arable land is land under temporary crops, temporary meadows for mowing or for pastures, land under market or kitchen gardens and land under temporary fallow. Double cropped areas are counted once when measuring arable land. Land abandoned as a result of shifting cultivation is not part of arable land. In Ghana, holding of land is one of the determinants of accessibility to food. At the household level, possession of land is an important factor in child nutrition according to statistical data. Thus land area growth has been a significant factor for agricultural growth in addition to high yielding varieties. But the population of Ghana is growing and agricultural land is likely to be burden in the future. Data on arable land for this study is collected from the world development indicators and is measured in hectors.

Trade openness (TLIB)

Trade openness refers to the degree to which nationals and foreigners can transact trade without artificial (that is, governmentally imposed) costs, including delays and uncertainty. Trade openness is often hypothesized to raise growth through several channels from the literature such as, greater access to a variety of inputs for production, access to advanced technology from abroad, possibilities of catch-up, and access to broader markets that raise the efficiency of domestic

production through increased specialization. Various measures of openness have been proposed and tested, with no single best measure emerging. This study will make use of the sum of exports and imports of goods and services a as ratio to GDP to measure of openness.

Amount of Foreign Reserves (RES)

Foreign reserves comprise special drawing rights, reserves of the country held by the IMF, and holdings of foreign exchange under the control of monetary authorities. Gold holdings are not included in the reserve. Ghana depends on import of different foods such as rice, wheat, pulses, edible oil, spices etc. Reserve of foreign currency is important for financing the import of food from global markets. It is also important for importation of machinery, technical knowhow for agriculture and industrial set up. Higher reserve means larger capacity of import. Data for this variable was collected from World Bank WDI database.

Data sources

The study made use of secondary data. The data collected was on annual basis and covers the period 1986 to 2016. The choice of the data period was informed by a number of factors which included among others the fact that it was in 1986 that international trade was completely liberalized with the removal of quantitative restrictions on trade. It is therefore, not out of place that any study design to analyze trade liberalization should start from this period. Quite apart, it was also extremely difficult to obtain data beyond the study period on some of the variables. Considering the estimation technique, it is also noted that the

Autoregressive Distributed Lag approach is efficient in small samples. The data time space is therefore, compatible with the estimation technique. The series for RES, ARL, RGDP, CPI and TLIB were drawn from the World Development Indicators of the World Bank Group while that of PDES and FPI were also drawn from the Food Balance Sheet of the Food and Agricultural Organization of the United Nations.

Estimation techniques

To investigate the short run as well as the long run relationship dynamic relationship among trade liberalization and food security in Ghana, the Autoregressive Distributed Lag (ARDL) to Cointegration and Error Correction Model (ECM) were applied. The testing procedure involves the following steps. The study first investigated the time series properties of the data by using the Augmented Dicky-Fuller (ADF) and the Philip-Peron tests. The unit root test was used to check the stationarity properties of the data series. The second process involves testing for cointegration by making use of Autoregressive Distributed Lag framework. Once cointegration is established, we used the ARDL to estimate the long run results and the ECM to get the short run results. Causality testing was also done to find out the causal relationship between trade liberalization and food security. This objective was achieved by the use of the Granger Causality Test.

Unit Root Test

To mention Tang (2006), in the presence of $I(2)$ variables the computed F-statistic provided by Pasaran et al. (2001) are no longer valid. As a result of this, we investigate the order of integration before conducting the ARDL Cointegration

test. The idea is to make sure that the series are not I(2) in order to avoid spurious results. This is because the bound test is based on the assumption that variables are I(0) or I(1). It is very important to test for the time series properties of the variable when dealing with time series data. Time series data are rarely stationary in level forms. Regression involving non stationary time series often lead to the problem of spurious regression. This occur when the regression results reveal a high and significant relationship among the variables when in actual sense there is no such relationship. To add to this, Stock and Watson (1988) have also shown that the usual test statistic (t, F, DW, and R square) will not possess standard distributions if some of the variables in the model have unit roots and thus nonstationary. A time series variable is nonstationary if its moments (mean, variance and autocovariances) are independent of time.

The study made use of a variety of unit root tests. This is done to ensure reliable results of the test for stationarity due to the inherent weakness specific to the various tests. The study therefore, used both the Augmented Dicky- Fuller (ADF) test and Philip-Perron (PP) test. These tests are similar except that they differ with respect to the way they correct for autocorrelation in the residuals. The PP nonparametric test generalizes the ADF procedure, allowing for less restrictive assumptions for the time series in question. The null hypothesis to be tested is that the variable under investigation has a unit root against the stationarity alternative hypothesis. In each case the lag length is chosen using the Akaike Information Criteria (AIC) and Swartz Information Criteria (SBC) for both the ADF and PP test. The sensitivity of the ADF to lag selection renders the PP test an important

additional tool for making inferences about unit root. The basic formulation of the ADF is specified below.

$$\Delta X_t = \alpha + \delta_t + \rho X_{t-1} + \sum_{i=1}^{p} \lambda i \Delta X_{t-1} + \varepsilon_t \qquad (8)$$

Where Xt represents the series at time t, Δ is the first difference operator, α, λ, δ and ρ are parameters to be estimated, ε is the stochastic error term.

Therefore, the ADF and PP test the null hypothesis that a series has a unit root (nonstationary) against the alternative hypothesis of no unit root (stationary). That is to say:

$H_0 : \rho = 0$ (the series is non-stationary)

$Ho : \rho \neq 0$ (the series is stationary)

If the tau values or t statistic is more negative than the critical values, we reject the null hypothesis and conclude that the series is stationary. Conversely, if the tau statistic is less negative than the critical values, if fail to reject the null hypothesis and conclude that the series is non stationary. The critical values for the series can be found in Mackinnon et al (1996).

The ARDL Approach to Cointegration

A number of approaches for testing the presence of equilibrium long run relationship among time series variables have been developed and used by many researchers. Most time series studies have used the Engle-Granger (1987), the Fully Modified Ordinary Least Squares (FMOLS) procedure developed by Philips and Hansen (199) or the Johansen Cointegration (1988) to determine the long run relationship between variables of interest in bivariate and multivariate

frameworks. In fact, these techniques have still been employed by many researchers who strongly ague that they are the most accurate methods to apply on I(1) variables. However, other researchers like Kremers et al. (1992) found some weakness with the above techniques. To start with, long run relationship exist only in the context of cointegration of integrated variables of the same order. Also, standard methods for estimation and inference will render inconsistent and inefficient parameters in integrated relationship. In an attempt to overcome and avoid these challenges and drawbacks, a relatively new and superior approach have been developed and popularized by Pesaran and Pesaran (1997), Pesaran and Shin (1997), Pesaran and Smith (1999) and Pesaran et al. (2001). This approach is known as the Autoregressive Distributed Lag (ARDL) Model. The ADRL approach or model has several advantages as compared to the other techniques of cointegration. One of its many advantages is that it can be applied to time series variables irrespective of whether the variables are I(0) or I(1) or fractionally cointegrated while the standard cointegration techniques require that the variables be integrated of the same order (Pesaran & Pesaran, 1997). To add to the above, the Error Correction Model (ECM) can be derived from the ARDL through a simple linear transformation and once the order of the ARDL has been determine, OLS may be used for the purpose of estimation and identification (Pesaran et al, 2001). For these reasons the ARDL approach was therefore adopted to find out whether cointegration actually exist among the variables.

The ARDL framework can be implemented by modelling equation (5) as a conditional ARDL as follows:

$$\Delta lnPDES_t = \mu o + \alpha lnPDES_{t-1} + \alpha_2 lnFPI_{t-1} + \alpha ln_3 CPI_{t-1} + \alpha ln_4 RGDP_{t-1} +$$

$$\alpha_5 lnARL_{t-1} + \alpha_6 lnTLIB_{t-1} + \alpha_7 lnRES_{t-1} + \sum_{i=0}^{p} \phi_{1i} \Delta lnPDES_{t-1} +$$

$$\sum_{i=0}^{p} \phi_{2i} \Delta lnFPI_{t-1} + \sum_{i=0}^{p} \phi_{3i} \Delta lnCPI_{t-1} + \sum_{i=0}^{p} \phi_{4i} \Delta lnRGDP_{t-1} +$$

$$\sum_{i=0}^{p} \phi_{5i} \Delta lnARL_{t-1} + \sum_{i=0}^{p} \phi_{6i} \Delta TLIB_{t-1} + \sum_{i=0}^{p} \phi_{7i} \Delta lnRES_{t-1} + \varepsilon_t \quad (9)$$

Where Δ is the first difference operator. The parameter αi denotes the long run multiplier and ϕji is the short run parameter of the model to be estimated through the error correction framework in the ARDL model, μo is the constant term (drift) while εt is the white noise error term.

The Bound Testing Procedure

The ARDL model testing procedure starts with the bound test. The first step in the ARDL bounds test approach is to estimate equation by applying OLS. The computed F-statistic (Wald test) is then used to test the existence of long run relationship among the variables. The null hypothesis of no long run relationship among the variables is tested against the alternative hypothesis of the presence of long run relationship among the variables. This is given below as:

Ho: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = \alpha_7 = 0$

H_1: $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq \alpha_6 \neq \alpha_7 \neq 0$

Given that the asymptotic distribution of the F-statistic is nonstandard without considering the independent variables being I(0) or I(1), Pesaran et al (2001) generated and presented the appropriate critical values according to the number of

independent variables in the model of presence or absence of constant term or time trend in the model. Therefore, the calculated F statistic is compared with two set of critical values developed on the basis that the independent variables are I(d) where $0 \leq d \leq 1$). The lower critical bound assumes that all variables are I(0) whereas the upper critical values assumes that all variables are I(1). If the calculated F statistic exceeds the upper critical value, then the null hypothesis of no cointegration will be rejected irrespective of whether the variables are I(0) or I(1). This implies that there is a long run relationship among the variables. Conversely, if the F statistic falls below the lower bound then the null hypothesis of no cointegration cannot be rejected. If the F statistic lies within the lower and upper critical bounds, the test is inconclusive (Pesaran & Pesaran, 1997). However, given that Pesaran's critical values are based on simulated large sample size, this study uses the critical values since it is more appropriate for small samples.

In order to choose the optimal lag length for each variable, the ARDL methodology estimates $(m+1)^{k+1}$ number of regressions. Where m is the maximum number of lags and k is the number of variables in the equation (Pesaran & Pesaran, 1997). The order of lags of the ARDL model are selected using one of the following four information criteria: Schawrtz-Bayesian Criteri0n (SBC), Akaike Information Criterion (AIC), the R^2 Criterion, or the Hannan and Quin (HQ) criterion.

In the second stage of the ARDL bounds approach, once cointegration is established the conditional ARDL ($p, q_1, q_2, q_3, q_4, q_5, q_6 q_7$,), the long-run model

for $PDES_t$ can be estimated in order to obtain the long run coefficients and their asymptotic standard errors.

The long run ARDL approach is specified as follows:

$$lnPDES_t = \mu o + + \sum_{i=0}^{p} \alpha_{1i} lnPDES_{t-1} + \sum_{i=0}^{p1} \alpha_{2i} lnFPI_{t-1} + \sum_{i=0}^{p2} \alpha_{3i} lnCPI_{t-1} + \sum_{i=0}^{p3} \alpha_{4i} lnRGDP_{t-1} + \sum_{i=0}^{p4} \alpha_{5i} lnARL_{t-1} + \sum_{i=0}^{p5} \alpha_{6i} TLIB_{t-1} + \sum_{i=0}^{p6} \alpha_{7i} lnRES_{t-1} + \varepsilon_t \quad (10)$$

This involves selecting the orders of the ARDL ($p, q_1, q_2, q_3, q_4, q_5, q_6$) model in the seven variables using Akaike Information Criterion (Akaike, 1973).

The third and the last step in the ARDL bound approach is to estimate an Error Correction Model (ECM) to capture the short-run dynamics of the system. The ECM generally provides the means of reconciling the short-run behaviour of economic variable with its long-run behavior.

The ECM is specified as follows:

$$\Delta lnPDES_t = \mu o = \sum_{i=0}^{p} \phi_{1i} \Delta lnPDES_{t-i} + \sum_{j=0}^{q} \phi_{2j} \Delta lnFPI_{t-j} + \sum_{k=0}^{q} \phi_{3k} \Delta lnCPI_{t-k} + \sum_{l=0}^{q} \phi_{4l} \Delta lnRGDP_{t-l} + \sum_{m=0}^{q} \phi_{5m} \Delta lnARL_{t-m} + \sum_{o=0}^{q} \phi_{6n} \Delta TLIB_{t-n} + \sum_{p=0}^{q} \phi_{7o} \Delta lnRES_{t-0} + \rho ECM_{t-1} + \varepsilon_t \quad (11)$$

From equation (11), ϕ_i represent the short-run dynamics coefficients of the model's convergence to equilibrium and [redacted] is the Error Correction term, the residual from each cointegration lag one period. The coefficient of the Error

Correction Model, ■ measures the speed of adjustment to obtain equilibrium in the event of shocks to the system.

Engle and Granger (1987) argued that when variables are cointegrated, their dynamic relationship can be specified by an error correction representation in which an error correction term (ECT) computed from the long-run equation must be incorporated in order to capture both the short-run and long-run relationships. The error correction term indicates the speed of adjustment to long-run equilibrium in the dynamic model. In order words, its magnitude shows how quick the variables converge to equilibrium when they are disturbed. It is expected to be statistically significant with a negative sign. The negative sign implies that any shock that occurs in the short run will be corrected in the long-run. The larger the coefficients of the error correction term in absolute terms, the faster the convergence to equilibrium

Diagnostic Test

To ensure the goodness of fit for the model, the diagnostic and stability test are also conducted. The diagnostic test examines the serial correlation, functional form, normality and heteroscedasticity associated with the selected model. Pearan and Pesaran (1997) suggest using Brown (1975) stability test. This technique is also known as cumulative (CUSUM) and cumulative sum of squares (CUSUMSQ). The CUSUM and CUSUMSQ are frequently updated recursively and plotted against the breaks points. If the plots of CUSUM and CUMSUMSQ statistic stay within the critical bounds of five percent level of significance, the null hypothesis of stable coefficients in the given regression cannot be rejected.

Otherwise we reject the null hypothesis and conclude that the model is not dynamically stable.

Granger Causality Tests

The study of causal relationships among economic variables has been one of the main objectives of empirical econometrics. According to Engle and Granger (1987), cointegrated variables must have an error correction representation. Granger causality is a term for a specific notion of causality in time series analysis. A variable say X Granger-causes say Y if Y can be explained or predicted using the histories of both X and Y than it can, using the history of Y alone. Grange-causality is thus, a powerful tool, in that it allows one to test for things that one might otherwise assume away or otherwise taken for granted. One of the implications of Granger representation theorem is that if non-stationary series are cointegrated, then one of the series must granger cause the other (Gujarati, 2009). To examine the direction of causality in the presence of cointegrating vectors, Granger Causality test is conducted based on the following:

$$\Delta Yt = \delta 0 + \sum_{i=0}^{p} \beta 1i \Delta Yt\text{-}i + \sum_{i=0}^{p} \phi 1i \Delta Xt\text{-}I + Z1iECTt\text{-}1 + \varepsilon t \quad (12)$$

$$\Delta Xt = \delta 0 + \sum_{i=0}^{p} \beta 2i \Delta Xt\text{-}I + \sum_{i=0}^{p} \phi 2i \Delta Yt\text{-}i + Z2iECTt\text{-}1 + Vt \quad (13)$$

Where ■Y and ■X are the non-stationary dependent and independent variables, ECT is the error correction term, Z1i and Z2i are the speed of adjustments, *p* is the optimal lag order while the subscripts *t* and *t-i* denote the current and lagged

values. If the series are not cointegrated, the error correction terms will not appear in equations (11) and (12). To find out whether the independent variable (X) granger-causes the dependent variable (Y) in equation (11), we examine the joint significance of the lagged dynamic term by testing the null hypothesis:

[redacted]

Implying that the explanatory variable (X) does not granger cause the dependent variable (Y), against the alternative hypothesis that

[redacted]

Implying that the explanatory variable (X) granger causes the dependent variable (Y)

Similarly, to find out whether the independent variable (*Y*) granger cause the dependent variable (*X*) in equation (12), we examine the significance of the lagged dynamic term by testing the null hypothesis:

[redacted]

Implying that the independent variable (Y) does not granger cause the dependent variable (X), against the alternative hypothesis that

[redacted]

Implying that the explanatory variable (Y) granger causes the dependent variable (X). Using the standard F-test or Wald statistic, four possibilities exist: First, rejection of the null hypothesis in equation (11) but failing to reject the null in equation (12) at the same time implies unidirectional causality running from X to Y. Second, a rejection of the null hypothesis in equation (12) but at the same time failing to reject the null in equation (11) implies unidirectional causality running

from Y to X. Third, simultaneous rejection of the two null hypotheses indicates bi-directional causality. Fourth, simultaneous failure to reject the two null hypotheses indicates independence or no causality between the variables of interest

Data Analysis

The study employs both descriptive and quantitative analysis. Charts and graphs were employed to aid the descriptive analysis. Unit root test were carried out on all the variable to ascertain their order of integration in order to avoid the problem of spurious regression. More to the point, the study adopted the newly developed Autoregressive Distributed Lag econometric methodology for cointegration introduced and popularized by Pesaran et al (2001). To obtain both the long run and the short run estimates of the main variables of the study. All estimations were carried out using Eviews version 10 package.

Summary and conclusions

This chapter developed and presented methodological framework suitable for conducting this study. The model was developed on the empirical literature on similar studies. Annual time series data was employed from 1986 to 2016 for all the variables in this study. Stationarity test was conducted using Augmented Dicky Fuller test as well as the Philip Peron test to ensure that the variables are not integrated of any other higher than one to avoid spurious regression. Moreover, the unrestricted error correction models of the empirical model specification were formed to obtain to obtain the Autoregressive Distributed Lag model used to examine the long run and short dynamics among the variables. The

Granger Causality test was also developed for the testing of causal relationship between the variables of interest.

The systematic framework of this chapter now establishes the relationship between food security and trade liberalization which guides us in our estimation. This then link us to the interpretation of our coefficients based on the regression results in the subsequent chapter and to make policy recommendations based on the findings of the study.

CHAPTER FIVE

RESULTS AND DISCUSSION

Introduction

This chapter presents the results and discussion of the findings of the study. The basic rational is to empirically unearth the relationship between food security and trade liberalization in Ghana. In addition, the study examines the time series properties of the data to determine the stationarity status of the variables used in the study. This was successfully done by using the Augmented Dicky Fuller (ADF) and the Philip Perron (PP) testing procedures of unit root testing. Cointegration was also done by making use of the Autoregressive Distributed Lag (ARDL) approach. The analysis of these test then helped us to confirm the relationship between food security and trade liberalization and subsequently the estimation of results and discussion of the findings. To investigate the causal relationship between food security and trade liberalization, the famous pairwise Granger causality test was also conducted and the results discussed as well.

Descriptive statistics

Before engaging in any regression analysis it is important to get a feel your data set to at least to know what information the data is conveying. Summary statistics provide us with a number of characteristics of our data sets. These are: measures of central tendency and these include the mean, median and the mode, measures of dispersion (range, variance, standard deviation, percentiles, quartiles, deciles), measures of normality – kurtosis (measures the degree of peakness or

flatness of the series) and skewness (measures the degree of asymmetry of the series). The results of the summary statistics is given below on table 1

Table 5: *Summary statistics of the variables*

	PDES	FPI	CPI	RGDP	ARL	RES	TLIB
Mean	2542.032	87.60871	21.682	2.31E+10	16.484	1.88E+09	75.88418
Median	2564.00	81.93000	17.473	1.91E+10	17.579	6.97E+08	80.599
Maximum	3077.00	144.1600	59.461	4.82E+10	20.743	5.54E+09	116.0484
Minimum	1729.00	36.87000	8.727	1.00E+10	10.548	1.95E+08	41.08589
Std. dev.	417.1794	35.62334	11.976	1.17E+10	3.615	2.01E+09	21.61866
Skewness	-0.349953	0.227016	1.345	0.883806	-0.321	0.968455	-0.162679
Kurtosis	1.934033	1.793618	4.624	2.537621	1.564	2.254069	1.989101
Jarque-Bera	2.100450	2.146108	12.761	4.311902	3.197	5.564545	1.456711
Probability	0.349859	0.341963	0.002	0.115793	0.202	0.061898	0.482702
Sum	78803.00	2715.870	672.150	7.15E+11	511.007	5.84E+10	2352.410
Sum sq. dev	5221159	38070.66	4302.861	4.08E+21	391.993	1.21E+20	14020.99
Obs	31	31	31	31	31	31	31

Note: SS Dev. represents Sum of Squared Deviation, Std Dev. represents Standard Deviation, J. Bera represents Jarque Bera, Prob represents Probability, Skew represents Skewness while Obs stands for Observation.
Source: Author (2017)

From the table above, the mean which is the average value for each of the variables within the study period is shown. For PDES, FPI and CPI, their mean values are 2542.032, 87.60871 and 21.68225 respectively. What these values represent is that, within the study period (1986-2016) there were on average, 2542.032 dietary energy supply for every individual within the country, 87.60871 also represents the average food production index over the study period, average increase in the consumer price index also stands at 21.68225 over the period. Similar meaning and interpretation goes for all the other variables with their respective values. Considering the data, each of the variable have positive average mean values. What this means is that, none of the variable either perform below

zero percent or have fewer and less negative values as compared to positive values. Following the mean is the median values for all the variable. It can be seen from the table that, the mode which is one of the elements of summary statistics has not appeared. What this means is that none of the variables has a value that repeats itself at least once over the period of study. This is quite clear considering the nature of the data as a time series one. Also, there is varying degrees of deviations of the various observations from their sample means as shown on the table by the standard deviations. Lower deviations indicate slower growth rates while higher deviation represents torrid growth over the period.

Unit Root Test Results

In order to examine the impact of trade liberalization on food security in Ghana, the stationarity status of all the variables (that is, per capita dietary energy supply, food production index, consumer price index, real gross domestic product, arable land, foreign reserves, and trade liberalisation) in the model for the study were determined. This was done to ensure that the variables were not integrated of order two (that is I(2) stationary) so as to avoid spurious results. The order of integration of the variables was tested using the Augmented Dicky-Fuller and Philip Perron unit root testing procedures. On the optimum number of lags included in the test, the Schwarz-Bayesian Criteria (SBC) and Akaike Information Criteria (AIC) were applied to determine the optimum number of lags. The results of the unit root test are presented in table 6.

Table 6 presents the Augmented Dicky-Fuller test with constants and constants and trend at levels and first difference. It can be seen from the results

that except for consumer price index and food production index, none of the variables is stationary at levels. Consumer price index is stationary with both constant and constant and trend while food production index is stationary with constant and trend only. However, after first differencing, it can be seen that all the variable achieved stationarity with both constants and constant and trend.

Table 6. *Results of ADF Unit Root Test*

	LEVELS		
Variables	Constant	Constant & Trend	Decision
PDES	-1.2923 (0.6199)	-2.3244 (0.4090)	Series is not stationary
FPI	0.0034 (0.9517	-3.3201 (0.0823)*	Series is stationary
CPI	-2.9518 (0.0513)*	-3.9374 (0.0236)**	Series is stationary
RGDP	1.1224 (0.9967)	-0.9246 (0.9393)	Series is not stationary
ARL	1.3234 (0.9980)	0.7533 (0.9994)	Series is not stationary
TLIB	-0.2811 (0.9162)	-1.8548 (0.6516)	Series is not stationary
RES	-1.6782 (0.4317)	-1.8385 (0.6606)	Series is not stationary
FIRST DIFFERENCE			
PDES	-7.4421 (0.0000)***	-7.4739 (0.000)***	Series is stationary
FPI	-7.4376 (0.0000)***	-7.3435 (0.0000)***	Series is stationary
CPI	-5.4116 (0.0000)***	-5.1952 (0.0021)***	Series is stationary
RGDP	-5.9825 (0.0738)***	-4.2975 (0.0128)**	Series is stationary
ARL	-2.7797 (0.0736)*	-3.6506 (0.0427)**	Series is stationary
TLIB	-3.5209 (0.0146)**	-3.7837 (0.0328)**	Series is stationary
RES	-5.3273 (0.0002)***	-5.2900 (0.0010)***	Series is stationary

Source: Author (2017)

We can therefore conclude that with the ADF test, consumer price index is stationary I(0) with constant and constant and trend while food production index

is stationary I(0) with constant and trend only. For the rest of the variables, they are non-stationary at levels whether with constants or constants and trend

The Philip-Perron test is also presented below in table 7. It can be depicted from the table that at levels, consumer price index and food production index are stationary. Food production index is only stationary at constants and trend while consumer price index is stationary at constants and at constants and trend as well. The rest of the variables are however, nonstationary at levels. What this means is that those variables are either integrated of order one or of a higher order since they are not at levels. Like the Augmented Dicky-Fuller, it can be seen that all the variables have achieved stationarity after taking their first differencing though at different significance levels. From the results of both the ADF and PP test, it can be confirm that all the variables are stationary after first difference. It is therefore clear from the unit root results discussed above that all the variables are integrated of order zero, I(0), or order one, I(1). Since the test results have confirmed the absence of I(2) variables, the ARDL methodology is used for estimation.

Table 7. *Results of PP Unit Root Test*

LEVELS

Variables	Constant	Constant & Trend	Decision
PDES	-1.7632 (0.3907)	-2.2034 (0.4707)	Series is not stationary
FPI	0.4293 (0.4809)	-3.2764 (0.0893)*	Series is stationary
CPI	-2.9283 (0539)*	-3.6443 (0.0427)**	Series is stationary
RGDP	-4.1855 (0.2956)	-0.94011 (0.9957)	Series is not stationary
ARL	-1.3745 (05812)	-1.18728 (0.8951)	Series is not stationary
TLIB	0.3727 (0.9783)	-1.6176 (0.7618)	Series is not stationary
RES	-1.6894 (0.4262)	-1.7835 (0.6874)	Series is not stationary
FIRST DIFFERENCE			
PDES	-7.3844 (0.000)***	-8.0427 (0.0000)***	Series is stationary
FPI	-7.8996 (0.0000)***	-8.3699 (0.0000)***	Series is stationary
CPI	-13.8486 (0.0000)***	-15.324 (0.0000)***	Series is stationary
RGDP	-6.0673 (0.0000)***	-5.9487 (0.0002)***	Series is stationary
ARL	-2.8032 (0.0702)*	-3.6853 (0.0397)**	Series is stationary
TLIB	-3.3246 (0.0229)**	-3.2231 (0.0997)*	Series is stationary
RES	-5.3271 (0.0002)**	-5.2900 (0.0010)***	Series is stationary

Source: Author (2017)

Estimation of the Long Run Relationship

The main focus of this study is to establish the relationship between trade liberalization and food security in Ghana. It was therefore important to test for the existence of long-run equilibrium relationship between these two variables within the framework of the bounds testing approach to cointegration. Given that the study employed annual data, a lag length of 2 for annual data was used in the bounds test. Pesaran, Shin and Smith (2001) suggested a maximum lag of two for annual data in the bounds testing to cointegration. After the lag length was

adopted, an F-test for the joint significance of the coefficients of lagged levels of the variables was conducted. Thus each of the variables in the model was taken as dependent variable and a regression was run on the others. For instance, LPDES was taken as the dependent variable and it was regressed on the other variables. After that another variable for instance trade openness was taken as the dependent variable and it was also regressed on the other variables. This action was repeated for all the variables in the model. When this was done the number of estimated regressions was equal to the variables in the model.

Pesaran *et al.* (2001) indicates that "this OLS regression in the first difference are of no direct interest" to the bounds cointegration test. It is however, the F-statistics values of all the regressions when each of the variables is normalized on the other which are of great importance. This F-statistics tests the joint null hypothesis that the coefficients of the lagged levels are zero. In order words, there is no long run relationship between them. The essence of the F-test is to determine the existence or otherwise of cointegration among the variables in the long run. The results of the computed F-statistics when LPDES is normalized (that is, considered as dependent variable) in the ARDL-OLS regression are presented in table 8.

From Table 8, the F-statistics that the joint null hypothesis of lagged level variables (i.e. variable addition test) of the coefficients is zero was rejected at 5 percent level of significance level. Further, the calculated F-statistics for FLPDES (.) = 8 .021948 exceeded the upper bound's critical value of (3.2) at 5 percent

level of significance. Therefore, the null hypothesis of no cointegration (i.e. long run relationship) between Food Security and its determinants was rejected.

Table 8. *Results of Bound test for the existence of cointegration*

Critical Bound of the F-statistic: intercept and no trend

K	90% Level		95% Level		99% Level	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
6	1.99	2.94	2.27	3.28	2.88	3.99

Source: Author (2017)
FLPDES(LPDES|LTLIB, LFPI, LCPI, LRGDP, LARL, LRES) = 8.021948**

This result indicates that there is a unique cointegration relationship among the variables in Ghana's Food Security and that all the determinants of Food Security can be treated as the 'long-run forcing' variables for the explanation of Food Security in Ghana. Therefore, there is existence of cointegration among the variables in the Food Security equation and hence we therefore continue with the estimation as explained above.

Table 9: *Estimated Long Run Coefficient using ARDL Approach*
Selected based on SBC. Dependent variable: LPDES

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LFPI	0.387486	0.066286	5.845682	0.0001
LCPI	-0.062500	0.011382	-5.490949	0.0002
LRGDP	-0.368647	0.043686	-8.438466	0.0000
LARL	0.104747	0.011178	9.371161	0.0000
LTLIB	0.162169	0.025903	6.260539	0.0001
LRES	0.131801	0.045971	2.867021	0.0153
C	16.16369	1.098590	14.71312	0.0000

R-squared	0.990438	Mean dependent var	0.015255
Adjusted R-squared	0.983266	S.D. dependent var	0.044583
S.E. of regression	0.005767	Akaike info criterion	-7.171399
Sum squared resid	0.000532	Schwarz criterion	-6.558473
Log likelihood	116.9853	Hannan-Quinn criter.	-6.979438
Durbin-Watson stat	2.319071		

Analysis of Long Run Results

The long run results are presented on table 9 above. The results indicates that food production index, arable land, trade liberalization and amount of foreign reserves have a positive and statistically significant impact on food security. On the other hand, consumer price index and real gross domestic product however show a negative and statistically significant effect on food security. It can be seen that all the results are statistically and practically significant. Because the model is a log-log one, the coefficients here are the elasticity of food security with respect to the various independent variables.

From the results in table 9 above, the coefficient of trade liberalization is statistically significant at one percent significance level indicating that if the country increase trade openness by one percent, food security is expected to increase by 0.162169 percent in the long run. The results obtained in this study

does not completely resolve the conflicting results in the extant literature. It however, contributes to the controversy in the literature by taking side with the works of Dithmer and Awudu (2017) who found trade liberalization to have significantly influenced food security in a positive way in the long run. They found the long run impact of openness to have raised food security. The estimate for trade liberalisation in the above table is in line with the first objective of the study which is to investigate the long run relationship between trade openness and food security in Ghana. The results obtained for trade openness answers the first hypothesis of the study which states that there is no long run relationship between trade liberalisation and food security.

The null hypothesis is rejected at 1 percent significance level which implies that there is a long run relationship between trade liberalization and food security and that the relationship is positive according to the results of the study. What this means is that an increases in trade openness or liberalizing further have the potential of improving food security at the aggregate level over the study period. This idea is consistent with theoretical expectation of the classical views on the role of trade in the macroeconomy in general. Empirically, the work of Thomas and Morrison (2006) has also confirmed these findings. They found trade openness to be advantageous to national food security. Their findings were built on the grounds that liberalising trade can serve as a transmission belt moving food from surplus to deficit nations. Arguments like this are built on the foundations of the comparative advantage theory but only emphasizes the balancing role that trade can play in distributing food more evenly on a global scale. Dithmer and

Awudu (2017) showed that an increase in trade openness of one standard deviation would increase dietary energy consumption (food security) by 93 kcal. According to them, if Cameron should be open to trade as Ghana (in 2007), all else equal, it could increase its per capita dietary energy supply by about 114 kcal, from current 2269 kcal to 2383 kcal. This could be achieved, for example, through a reduction in applied tariffs, which were at 18.9 percent.

Supporting the results of this study with economic theory, it is always argued that trade has the potential of inducing economic growth by enhancing capital formation and efficiency, technological transfer and availability of inputs which go a long way to improve food production and hence food security.

The results of this study however contradicts the findings of Bezuneh and Yiheyis (2012) who found trade liberalisation to have had unfavorable impact on the food security status of selected African countries. From their findings, the fruits of liberalisation have not reached the table of the poor in most developing countries. They found out that the per capita dietary energy supply of the various countries were negatively affected after the episodes of trade openness. Another empirical work by Panda and Ganesh-Kumar (2009) in India and that of China by Chen and Duncan (2008) were conducted on the effect on food and nutritional status by liberalizing trade. The former reported 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. In the case of China, trade reforms adopted to accede WTO are found to worsen food insecurity in the sense of reduced income (viewed from a partial equilibrium

perspective in the context of agriculture) and in terms of self-sufficiency when analyzed from an economy-wide perspective. The results of these studies suggest that the effect of trade openness is negative and that it hampers national food security of the respective countries studied.

If the overall gains from trade are uncertain at the country level, and if potential gains are not distributed equally within society, there may be certain groups of individuals within countries who find themselves worse off in terms of food security than they were before trade liberalisation (FAO, 2003) Similarly, Morrison and Sarris caution that liberalisation of the agricultural sector too early in a country's development can leave the agricultural sector weak, and impede, rather than improve, prospects for economic growth, poverty alleviation, and food security (Morrison & Sarris, 2007).

Furthermore, the coefficient of food production index carries the expected positive sign and is statistically significant at one percent significance level. This means if food production index rise by one percent, it will lead to 0.387486 percent increase in food security in the long run. This is practically significant looking at the direct link between domestic production and food security. Food is made available basically from two main sources-domestic production and food imports. The coefficient of 0.387486 therefore, explains in part the level of importance of domestic production in achieving food security. This result is consistent in the empirical work of Timmer (2004) who found a positive and significant impact of domestic production and food security in the long run. The results also support other findings in the empirical literature. Particularly, it agrees

with Dithmer and Awudu (2017) who also food a positive significant impart of domestic production on the food security status of Cameron, Ghana etc. According to them, a 1 percent increase in the yield index of cereals alone will increase dietary energy consumption by on average 36 kcal for the countries under study. This results however, contradicts the findings of Friel and others in an empirical work; domestic production and food availability. They argues that domestic production may be increasing but this will not necessarily increase food availability if much of domestic produce are exported or go into industrial use (Friel et al. 2015). Despite this divide in the literature, this work can confirm for the case in Ghana that domestic food production index has a positive significant impact on national food security.

Moreover, the coefficient of consumer price index also has the expected sign. It is negative and statistically significant at 1 percent significance level. It shows that a 1 percent increase in the consumer price index will lead to a decrease in food security by 0.062500 percent. The consumer price index measures the general macroeconomic stability of the domestic economy and hence its negative impact on national food security is not surprising. Empirical works in Ghana indicate that fluctuations in major macroeconomic indicators are usually associated with high levels of inflation as measured by the consumer price index. A high rate of inflation causes many economic problems like poverty, unequal distribution of wealth, market imperfections, deficits in balance of payments and unemployment as well as non-economic problems like social evils such as smuggling and hoarding among others. It also disturbs the very important role of

price mechanism and is a great hindrance to future economic planning and also hurts food security in the long run. This is evident in the work of Stockman (1981) who argues that high inflation rates are usually associated with welfare declines. Consistent also with the work of Blandford (1983) is the fact that high inflation adversely affects food security in both short and long runs. He argues that inflation reduces the value of the local currency which make it less competitive in the international market. The ability to import more food will therefore be seriously undermined by this development. Thus inflation has a negative significant impact on food security. The findings is also in line with Tweeten (1979) who found a statistically significant long run negative relationship between inflation and food security. There are few contradictions to these findings in the literature. Thoyibbah Abdul Wahad et al. (2015) showed a statistically positive significant long run relationship between food inflation and food security in Malaysia. Applanaidu et al. (2014) argued that food inflation per se might not be harmful to food security. This is because higher food prices might ionically provide an impetus for greater food availability in the long run.

The coefficient of real gross domestic product is -0.368647. It is statistically significant at 1 percent significance level and has a negative impact on food security in the long run. The -0.368647 is the elasticity of food security with respect to real gross domestic product. What this means is that, a 1 percent increase in real gross domestic product will lead to 0.368647reduction in food security in the long run. This finding might however, not directly appeal to general economic theory but a closer look at the Ghanaian economy will prove it

otherwise. A case in point is the contribution of the mining sector to the economy of Ghana. Except in 2015, the mining industry has been one of the leading contributors to the nation's fiscal purse. 70 percent of FDI is concentrated in the mining sector (Asiedu, 2013). Its contribution to direct domestic revenue improved from GHC 1.3 billion in 2015 to GHC 1.6 billion in 2016, representing a growth rate of 23 percent. What this means to the findings in this work is that, yes, real gross domestic product may be increasing but food security will not necessarily improve or augur well for food security if much of agricultural land is being cleared for mining activities which contribute significantly to gross domestic product. In this instance, gross domestic product will be rising but domestic food production will fall and this will reduce food availability in long run. Consistent with the literature is the work of Applanaidu et al. (2014) who found a negative long run relationship between real gross domestic product and food security in Malaysia. Further aligning with Dithmer and Awudu (2017), despite significant progress (GDP growth) made by many developing countries, sub Saharan African countries were not able to make significant improvements in food security levels despite rapid economic growth. This to them, may be in part explained by low agricultural productivity in those countries.

On the contrary, the findings of Afrin (2014) found real GDP to have contributed positively at 5 percent significance level to the food security status of Bangladesh in the long run. According to his findings, Bangladesh real GDP growth represent long term economic resources that have a positive influence on national food security. The finding indicates that a 1 percent increase in real GDP

leads to about 0.345 percent increase in food security in the long run at 5 percent significance level. A study conducted on the Asian Free Trade Area to find out whether trade openness have increased the food security status of member countries also revealed that real gross domestic product have long term positive impact on the food security status of member countries (Herath et al, 2014). The growth of real gross domestic product was found to have a positive association with increased food security. In Idonesia, Timmer (2004) noted that in the long run--over the past four decades-improvements in food security in Indonesia have generally been driven by pro-poor economic growth and a successful Green Revolution, led by high-yielding rice varieties, massive investments in rural infrastructure, including irrigation, and ready availability of fertilize.

This study also found the coefficient of arable land growth to be positive as expected and is statistically significant at 1 percent significance level. In line with the a priori expectation, arable land is shown to have a good influence on food security in Ghana. The coefficient is 0.104747 and is positive. What this means is that, if arable land increase by 1 percent, food security will increase by 0.104747 percent. In other words, the elasticity of food security with respect to arable land is 0.104747. The findings here is not surprising since arable land is considered as one of the major determinants of child nutrition according to the Ghana Living Standard Survey (GLSS). Availability of arable land is an indication of an important domestic resources and the likelihood for domestic food production to increase leading to more food availability.

A study conducted by Herath et al. (2014) on the impact of regional trade agreements on food security; a case Association of South East Asian Nations (ASEAN) free trade agreement also revealed that arable land significantly influenced the food security status of member nation in a favourable way. They reported 0.0074527 coefficient for arable land which is statistically significant at 5 percent significance level. Even at the micro level, (Dithmer & Awudu, 2017; Feleke et al, 2005) indicated that households with larger farmlands are more likely to be food secured because of higher production levels. Bezuneh and Yiheyis (2014) also found the long run average effect of arable land on the food security status of some selected African countries including Ghana to be positive and statistically significant at 1 percent significance level. The average coefficient value of arable land for the selected countries was recorded as 0.1727 meaning that a 1 percent increase in arable land will result in on the average 0.1729 percent increase in food security for the countries under study. Contrary to the above findings is the work of Afrin (2014) who found arable land to be insignificant in the long run for the country of Bangladesh. His findings suggest that arable land does not significantly affect the food security status of Bangladesh in the long run because land under cultivation are used optimally and only small amount of fallow land are available. Hence production increase is subject to higher yields.

From the table above, the coefficient of amount of foreign reserves also carries the expected sign and is statistically significant at 5 percent significance level. It is positive implying that foreign reserves exhibit good outcome on food security in the long run. It means if reserves increase by 1 percent, food security

will increase by 0.131801 percent in the long run. The findings in this work are consistent with the work of Dithmer and Abdulai (2017). who found foreign reserves to have great positive impact on food security through import financing. They provide strong support for the argument that limited foreign exchange availability has been a constraint upon the ability of sub-Saharan countries to obtain the level of food imports needed to ensure short run food security, and has therefore contributed directly to the significant year to year fluctuations in consumption experienced by these economies.

The long run results indicate that any disequilibrium in the system as a result of shock can be corrected in the long run by the error correction term. The error correction term that estimated the short run adjustment to equilibrium is presented as follows:

EC= L(PDES) - (0.3875*L(FPI) - 0.0625*L(CPI) - 0.3686*L(RGDP) +0.1047*L(ARL) + 0.1622*L(TLIB)) + 0.1318*(RES) + 16.1637)

Short Run Estimates (DLPDES is the dependent variable)

The existence of a long run relationship among food security and its exogenous variables allows for the estimation of long run estimates. The long run estimates were reported in table 9 above. The short run estimates also based on the Schwartz Bayesian Criteria (SBC) employed for the estimation of the ARDL model are reported in table 10.

Some descriptive statistics can be obtained from table 9. It can be observed that the adjusted R^2 is approximately 0.98. It can therefore be explained that approximately 98 percent of the variations in food security is explained by the

independent variables. Also, a DW-statistics of approximately 2.32 reveals that there is no autocorrelation in the residuals because it falls below the maximum threshold of 2.5 as explained by theory. A rule of thumb is that a test statistic value in the range of 1.5 to 2.5 are relatively normal. Values outside of this range could be cause for concern. Field (2009) suggests that values under 1 or more than 3 are a definite cause for concern.

According to Kremers, Ericsson, and Dolado (1992), a relatively more efficient way of establishing cointegration is through the error correction term. Thus, the study discerns that the variables in the model show evidence of moderate response to equilibrium when shocked or disturbed in the short-run. Theoretically, it is debated that an error correction mechanism exists whenever there is a cointegration relationship among two or more variables. The error correction term is thus obtained from the negative and significant lagged residual of the cointegration regression. The ECM stands for the rate of adjustment to restore equilibrium in the dynamic model following a disturbance. The negative coefficient is an indication that any shock that takes place in the short-run will be corrected in the long-run. The rule of thumb is that, the larger the error correction coefficient (in absolute terms), the faster the variables equilibrate in the long-run when shocked (Acheampong, 2007). The result showed that the coefficient of the lagged error correction term ECT (-1) exhibits the expected negative sign (-0.940346) and is statistically significant at 1 percent. This indicates that approximately 94 percent of the disequilibrium caused by previous year's shocks converges back to the long run equilibrium in the current year.

Table 10: *Estimated Short-Run Error Correction Model using the ARDL Approach.*
ARDL (1, 1, 0, 1, 1, 1, 0) selected based on SBC. Dependent Variable: DLPDES.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLFPI	0.393739	0.019472	20.22060	0.0000***
DLFPI(-1)	0.110691	0.034152	3.241158	0.0101**
DLCPI	-0.001628	0.000139	-11.71688	0.0000***
DLCPI(-1)	0.000429	0.000165	2.600328	0.0287**
DLRGDP	0.124692	0.049772	2.505281	0.0336**
DL(ARL	0.160778	0.012779	12.58135	0.0000***
DLARL(-1)	0.080440	0.010667	7.540886	0.0000***
DLTLIB	0.040643	0.010069	4.036521	0.0029***
DLTLIB(-1)	-0.045226	0.013599	-3.325599	0.0089***
DLRES	1.608667	0.122587	13.12262	0.0000***
DLRES(-1)	-0.623926	0.057033	-10.93981	0.0000***
ECM(-1)*	-0.940346	0.057958	-16.22470	0.0000***

Note: *,** and *** represents significance level at 10%, 5% and 1% respectively
Source: Author (2018)

R-square 0.990438	Mean dependent var 0.015255		
Adjusted R-squared	0.983266	S.D. dependent var	0.044583
S.E. of regression	0.005767	Akaike info criterion	-7.171399
Sum squared resid	0.000532	Schwarz criterion	-6.558473
Log likelihood	116.9853	Hannan-Quinn criter.	-6.979438
Durbin-Watson stat	2.319071		

Analysis of Short Run Results

The table 10 above presents the short run dynamic coefficients of the estimated ARDL model. Consistent with the short run results, the coefficient of trade openness has the theorized positive impact on food security in the short run. The coefficient of trade openness is statistically significant at one percent significance level. It carries a positive sign thus exacting a favourable impact on

food security in the short run. The coefficient is 0.040643 meaning that if trade is liberalised or opened further by one percent, food security will increase by 0.040643 percent in the short run. This results is in line with the second objective of the study which is to investigate the short run relationship between trade openness and food security in Ghana. The results answer the second hypothesis of the study which states that there is no short run relationship between trade openness and food security in Ghana. The null hypothesis is rejected at one percent significance level which implies that there is short run relationship between trade openness and food security in the short run and that the relationship is positive. What this means is that increasing trade openness has the potential to stimulate food security in Ghana at the aggregate level over the study period in the short run.

The results obtained does not resolve the controversy over the standing debate about the appropriate role of trade in food security but rather contribute to the literature by taking side with studies such as Diaz-Bonilla and Lucio (2000) which concluded that trade openness is good for food security in the short run. It is further empirically evident in the work of Headey et al, (2014) that trade openness has a short run relationship with food security. To him, trade liberalization helps to reduce thin markets by increasing competition among suppliers which helps to dampen price volatility, ultimately benefiting food security. The role of international trade in economic development and food security is enormous in the literature. For Ghana, the results obtained suggest that trade openness policy adopted as part of the structural reforms in 1986 has helped

open the economy and raised food security in the short run. This emphasises the fact that trade acts as a transmission belt by transferring food surplus from countries with abundant supplies to deficit countries thus enhancing food security in the short run. Also, Agarwal noted that many developing countries lack the initial tools and resources to pursue domestic food security and therefore, liberalising trade will be much beneficial to them in the short run (Agarwal, 2014).

On the other hand, there are a number of contradictions from the above findings in the literature. For example, a study by Abdullateef and Ijaiya (2010) on agriculture trade liberalisation and food security in Nigeria established that the trade policy adopted during the 1986 to 2003 did not impact on the development of the agriculture sector and major policy efforts did not address the fundamental problem of food security. It is 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. The results obtained in their study suggest that the capacity to develop appropriate apparatus for equitable food production and distribution in the face of globalisation is weak in the short run. This is evident from the experiences obtained from the two regimes of before and after trade liberalisation. Madeley (2000) also concluded that liberalisation measures under World Bank/IMF sponsored structural adjustment programs and under the World Trade Organisation's Agreement on Agriculture were making the poor more vulnerable to food insecurity. The short run impact of these reforms were not seem to have improve the food security

status of the poor. Some economists, such as Chang, argue that for countries with low levels of industrialisation, a policy of food self-sufficiency and security are perfectly sensible, as specialization and openness to trade can be too risky and result in serious negative consequences arising from hunger and malnutrition in the short run (Chang, 2009). The lagged value of -0.045226 also indicates that the previous year openness does not lead to an increase in food security in the short run.

Also, the lagged value of trade liberalization does not have the expected sign but is statistically significant at one percent. Thus with a negative value of -0.045226, it can be explained that a one percent increase in trade liberalisation in the last year leads to -0.045226 decrease in food security in the current year or period.

The results from table 10 show that the coefficient of the short run food production index is positive and statistically significant at 1 percent significance level. It does not pose any contradiction to its long run estimate as seen from the long run results above. In both cases it has shown favourable impact on food security. Its coefficient is 0.393739 and is statistically significant at one percent significance level. It is the short run elasticity of food security with respect to food production index. What this implies is that, a one percent increase in food production index will lead to 0.393739 percent increase in food security in the short run.

The short run dynamics for this relationship are also clearly visible in the literature and this can be seen in the work of Beckford and Campbell (2013) who

argues that the productivity of the agricultural sector is critical in addressing both short and long term needs of food security in CARICOM region of the Caribbean. Fasoyiro and Taiwo (2012) also empirically revealed that short term food insecurity in Nigeria is basically a problem of low agricultural productivity. Also, a study conducted by FAO concluded that farms in poor countries tend to have lower yields per hectare than in richer countries and the possibilities of achieving short term food security are very minimal (FAO, 2013). This further explains the importance of the nation' food production index which measures the performance of the agricultural sector. The lagged value of 0.110691 also indicates that the previous year food production index has a positive outcome on food security. That is to say a 1 percent increase in food production index will lead to 0.110691 percent increase in food security in the current year.

On the contrary, Staatz (1994) noted that while increased cash crop production may not increase food availability in the short run, in the longer term it provides a source of revenue for improving rural infrastructure and it also allows, through income generation, great access of the poor to food via the market mechanism.

Also, the coefficient of consumer price index carries the expected sign and is statistically significant at one percent significance level. Consumer price index has a negative sign indicating that its impact on food security is adversarial in the short run for Ghana and this is consistent with the long run results. Thus, it is explained that a one percent increase in the consumer price index will lead to 0.001628 decrease in food security in the short run. The negative effect of the

consumer price index seems more severe in the long run than in the short. The possible explanation is that the initial price increase may serve as an incentive to increase supplies but as this continues it will become wise to keep other tangible assets than to exchange them for money and hence food supply will be adversely affected. This results indicates how it is important to control inflation as measured by the consumer price index in the Ghanaian economy by putting in appropriate policies. Its impact in both short and long run has been negative. Inflation growth is unfavourable to the general macroeconomic stability and since food security at the national level is a macro indicator, it makes sense to establish this relationship. Consistent with the literature, Oppong also found a negative and statistically significant relationship between inflation and food supply in Ghana (Oppong, 2016). High inflation will negatively affect imports and reduce food supplies from abroad to augment local production thus affecting food security. Looking at the lagged value however, it is positive and significant at 1 percent significance level implying that past inflation has positive impact on food security in the current year. That is, last year inflation has good outcome for food security this year. This is practically significant in Ghana especially for rural farmers who normally raised their produce significantly in the coming year following a price spike in the previous year. Additionally, Asayehgn (2016) noted that food insecurity was basically a problem of inflation in Ethiopia. Contrary to this finding is the work of Timmer (2004) who revealed that, in the short run, food security in the country of Indonesia has been intimately connected to high rice prices.

Unlike the coefficient of real gross domestic product in the long run which was negative and statistically significant at 1 percent significance level, its short run dynamics indicates that it has a positive sign and is statistically significant at five percent significance level. This goes in line with the a priori expectation of a positive relation with food security in Ghana. This means that in the short run, a one percent point increase in real GDP will induce food security to increase by 0.124692percent. Thus the short run impact of real GDP on food security is that it exacts a favourable influence unlike its short run effect. Consistent with Timmer (2005), in a study on economic growth and food security: An Asian perspective, he noted that economic growth following the green revolution had improved the food security status of most Asian countries. FAO has noted that, following the last decade, economic growth has taken place in all regions and provides evidence showing that this growth can be a powerful driver for increased food security when translated into agricultural growth and in particular when it is inclusive and reaches smallholder farmers and women.

Contesting the argument that economic growth contributes to food security, Torero (2014) argues that rather than economic growth contributing to food security, it is food security that induces economic growth. Actually, Torero persuasively argues that economic growth is only sustainable if developed countries try to achieve food security as a base for their citizens. In his empirical findings, Torero establishes that "… a 10 percent increase in economic growth only reduces chronic malnutrition by 6 percent" After establishing that there is no linear correlation between economic growth and food security, Torero asserts that

this asymmetrical relationship between economic growth and food security indicates that economic growth by itself won't resolve the problem of chronic malnutrition but needs to be taken as one of the key variables in any food security strategy (Torero, 2014). Adugan (2016) also noted that the simple change in the national outputs does not enable to and sustains food security by its own. There are many factors that affect food security in addition to increase in the economic growth. That only economic growth cannot improve food entitlement. Even at the time of during green revolution (1980) few Asian countries experienced surplus agricultural production, they could not achieve food security for all their people or household. Economic growth can facilitate the food security, but it is not the only means for achieving the food security. In other words, economic growth may be necessary conditions for improving food security, but it not sufficient conditions.

Moreover, the coefficient of arable land also maintained its positive sign and is statistically significant at 1 percent significance level which is consistent with the long run results. The results therefore suggest that if arable land increase by 1 percent, food security will increase by 0.160778 percent in the short run. Thus the long run and short run results indicates that arable land has been advantageous to food security in Ghana. The positive effect of arable land on food security is greater in the short run (0.160778) than in the long run (0.104747) meaning that size of land is important in the short run but in the long run greater efficiency per hector of production is more important. The lagged value of arable land is also positive and statistically significant at one percent significance level meaning that land in the previous year have positive influence on food security in

the current year. This results move in line with the outcome of studies by Adom (2014). This is factual in the sense that as lands are made available for the cultivation of crops, food supply will increase. If there is more land then farmers can engage in large scale production.

Also, the coefficient of amount of foreign reserves is statistically significant at 1 percent significance level. It is positive implying that amount of foreign reserves is beneficial to food security in the short run. The coefficient is 1.608667 and this means that when we increase foreign reserves by one percent, it will lead to1.608667 increase in food security in the short run. This means that as reserves increases it will give more capacity to be able to finance food related imports thus making more food available to Ghana in the short run. The lagged value of amount of foreign reserves is also statistically significant at 0ne percent significance level implying that amount of foreign reserves in the previous year has negative impact on the current year food security. Consistent with this study is the work of Herath who also found that amount of foreign reserves is positively related to food security for the Association of South East Asian Nations (Herath 2014). This finding is further supported by others such as Bezuneh and Yiheyis (2012). A constraint on the availability of foreign exchange causes food insecurity by limiting a country's ability to buy on the international market in order to stabilize consumption in years of production shortfalls. Diakosavvas (2001) argued that food imports increase as foreign exchange reserves increase in developing countries because food imports 'crowd out' non-food imports in the use of foreign exchange. The need for food imports arises from shortfalls in

domestic food production perhaps caused by changes in consumer tastes as a consequence of rising incomes. Fluctuations in foreign exchange reserves could then result in a short-term food insecurity problem.

The coefficient of the error correction measures the speed of adjustment to obtain long run equilibrium in the event of shocks to the system. It is negative and statistically significant as expected. Its value of – 0.940346 is the magnitude at which the variables converge at equilibrium in the long run. Thus the negative implies that any shock that occurs in the short run will be corrected in the long run.

Diagnostic Tests

Diagnostics test were conducted for the ARDL model. The tests as reported in table indicate that the estimated model passes the Langrangean multiplier test of residual serial correlation among variables. Also, the estimated model passes the tests for Functional Form Misspecification using square of the fitted values. The model also passed the Normality test based on the Skewness and Kurtosis of the residuals. Thus, the residuals are normally distributed across observations. Finally, the estimated model passes the test for heteroscedasticity test based on the regression of squared residuals on squared fitted values.

Table11. *Results of diagnostic test*

Test	F-statistic	P-value
Serial Correlation	1.8740	0.8553
Functional Form	0.4112	0.6711
Normality	1.7156	0.4241
Heteroskedasticity	1.7886	0.1644

Source: Author (2018)

Stability Tests

Pesaran *et al* (1985) suggests that the test for the stability for parameters using cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) plots be conducted after the model is estimated. This is done to eliminate any bias in the results of the estimated model due to unstable parameters. Also, the stability test is appropriate in time series data, especially when one is uncertain about when structural changes might have taken place.

The results for CUSUM and CUSUMSQ are depicted below. The null hypothesis is that coefficient vector is the same in every period and the alternative is that it is not (Bahmani-Oskooee and Nasir, 2004). The CUSUM and CUSUMSQ statistics are plotted against the critical bound of 5 percent significance level. According to Bahmani-Oskooee and Nasir (2004), if the plot of these statistics remains within the critical bound of the 5 percent significance level, the null hypothesis that all coefficients are stable cannot be rejected. Figure 9 depicts the plot of CUSUM for the estimated ARDL model. The plot suggests the absences of instability of the coefficients since the plots of all coefficients fall within the critical bounds at 5 percent significance level clearly showing convergence. Thus, all the coefficients of the estimated model are stable and therefore we can say that the coefficients are not changing systematically over the period of the study.

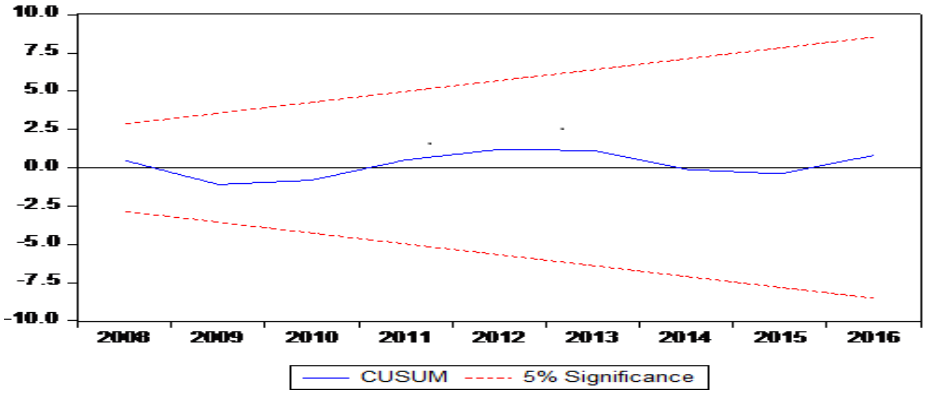


Figure 9: Plot of Cumulative Sum of Recursive Residuals
Source: Author (2018)

Also the plot of CUSUMSQ for the estimated ARDL model is shown on figure 10. The plot also suggests the absences of instability of the coefficients since the plots of all coefficients fall within the critical bounds at 5 percent significance level. Thus, all the coefficients of the estimated model are stable over the period of the study in the sense that they are not changing erratically.

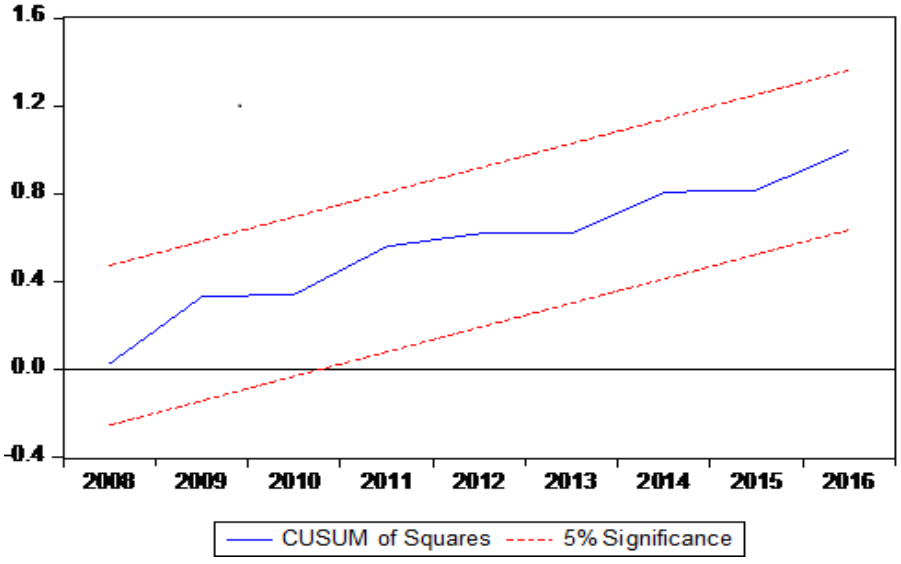


Figure 10: Plot of Cumulative Sum of Squares of Recursive Residuals
Source: Author (2018)

Granger Causality Tests

In order to examine the predictability of trade openness on food security, Granger causality test was applied to measure the linear causation among the variables. Employing the Pairwise granger causality test attributed to Engel and Granger (1987), the following results were obtained as depicted in Table 8: In testing for causality between variables, the following outcomes can be expected: a test concludes that a variable Granger causes the other when the set of coefficients for the two variables are statistically significant.

Table 12: *Results of Pair-wise Granger Causality Tests*

Null Hypothesis:	F-Statistic	Prob.
D(FPI) does not Granger Cause D(PDES)	3.5161	0.0409**
D(PDES) does not Granger Cause D(FPI)	1.33800	0.2820
D(CPI) does not Granger Cause D(PDES)	0.32699	0.7244
D(PDES) does not Granger Cause D(CPI)	1.38025	0.2716
D(RGDP) does not Granger Cause D(PDES)	3.0231	0.0675*
D(PDES) does not Granger Cause D(RGDP)	0.63522	0.5389
D(ARL) does not Granger Cause D(PDES)	0.61255	0.5506
D(PDES) does not Granger Cause D(ARL)	0.49055	0.6185
D(TLIB) does not Granger Cause D(PDES)	2.7707	0.0768*
D(PDES) does not Granger Cause D(TLIB)	0.43254	0.6540
D(RES) does not Granger Cause D(PDES)	4.23737	0.0271**
D(PDES) does not Granger Cause D(RES)	1.20847	0.3169

Source: Author (2018)

Thus, causality can be assumed to move from one variable to the other. On the other hand, a test concludes that a variable does not Granger cause the other, when the set of coefficients on the variables are not statistically significant. The above Table reports the results for the Granger causality between the variable of interest in the study. From the table, the null hypothesis that trade openness does not Granger cause food security can be rejected at 10 percent level of significance meaning that the lag values or histories of trade liberalization together with that of per capita dietary energy supply can help in explaining or predicting variations in food security, than it can using only lag values or histories of food security alone. On the other way, Granger causality is not rejected implying that the lag values of food security together with the lag values of trade liberalization do not predict variations in trade liberalization. The results suggest that there is a unidirectional causality between food security and trade liberalization. The result is in line with the third objective of the study which is to examine the direction of causality between trade liberalization and food security. The third hypothesis of no directional causality between trade liberalization and food security is rejected at 10 percent and the alternative which implies that there is unidirectional causality from trade liberalization to food security is accepted.

From the Table 12 it can also be seen that the null hypothesis that food production index does not granger cause food security is also rejected at 5 percent level of significance. The hypothesis that trade liberalization does not granger cause food production index is not rejected implying that there is unidirectional causality from food production index to trade liberalization.

Also, the null hypothesis that RGDP does not granger cause food security is rejected at 5 percent level of significance. However, the null hypothesis that food security does not Granger cause RGDP is not rejected implying that the lag values of food security together with that of RGDP do not predict variations in RGDP. Thus, there is a unidirectional causality from RGDP to food security.

Moreover, the null hypothesis that RES does not Granger cause food security can be rejected since the resulting coefficient from the test is statistically significant at 5 percent. However, the null hypothesis that food security does not granger cause RES cannot be rejected implying that the lag values of food security together with that of RES do not predicts variations in RES. Thus, a unidirectional causality between RES and food security is found. This is an indication that RES is a critical variable in achieving food security in Ghana.

Conclusion

The main focus of this chapter was the estimation of the ARDL model and the presentation and apparent discussion of its results. The chapter began with presentation of the descriptive statistics then proceeds with the tests for unit roots in the series by employing the ADF and PP test for unit root. The tests were conducted in levels and in first difference with intercept only, and intercept with trend. The results of the tests confirmed that FPI, and CPI were stationary at levels whereas PDES, RGDP, ARL, TLIB and RES were not stationary at levels. However, when the first difference of these non-stationary series was taken, the study found them to be stationary. The study concluded that FPI, and CPI are integrated of order zero I(0), while PDES, RGDP, ARL, TLIB and RES are

integrated of order one I(1). All variables were transformed into natural logarithm. The study further tested for the existence of a cointegration relationship among the variables.

The long run results revealed a positive and statistically effect of trade liberalization on food security. This implied a complementary relationship between the two variables. The study also found a positive and statistically significant effect of food production index and arable land on food security. Consumer price index and real GDP exerted a negative and statistically significant effect on food security.

The short run estimates also provide evidence of statistically significance and positive effect of trade liberalization on food security. Thus, short run changes in trade liberalization leads to an increase in food security. Food production index, real GDP, arable land and amount of foreign reserves exhibited the expected signs and exerted a positive and statistically significant effect on food security in the short run. Consumer price index exerted a negative and statistically significant effect on food security. Finally, the model passed the parameter stability tests of serial correlation, non-normal errors, heteroscedasticity, CUSUM and CUSUMSQ. The study, in conclusion found a directional causality between trade liberalisation and food security.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The aim of this chapter is to elaborate on the findings of the study, draw conclusions upon these findings and also to provide policy recommendations. The chapter begins with a summary, then concludes and makes policy recommendations.

Summary

The study sought to examine, as the main objective, the relationship between trade openness and food security in Ghana using annual time series dataset from 1986 to 2016. The study set out to examine the possible existence of long run and short run relationship between trade liberalization and food security. The study in addition sought to examine the possibility of a causal relationship between the two variables and also to examine the direction of causality. In view of this, the Autoregressive Distributed Lagged Model (ARDL) approach to bounds testing developed by Pesaran and Shin (1997) was adopted to examine the long run and short run dynamic parameters of the model.

The study began with the descriptive statistics then with the tests for unit roots in the variables used in the study. This was done to check for the stationarity properties of the variables or series employed in the study. Thus, the study employed Augmented Dickey-Fuller (ADF) Phillips-Perron (PP) tests for unit roots testing. These tests for the presence of unit roots were done in levels and in first difference with constant and trend.

The ADF and PP tests for unit roots revealed that per capita dietary energy supply (food security), real GDP, trade openness, arable land and amount of foreign reserves were stationary after first difference, that is they are integrated of order one I(1). On the other hand, food production index and consumer price were stationary in levels and are thus integrated of order zero I(0). This allowed the use of ARDL model which although ignores the stationary problems in series, requires that variables are integrated of an order not higher than one.

The next step was to examine the possible long run relationships among the variables in the study. The bounds tests results for long run relationship revealed that in the long run, trade liberalization exerted a positive and statistically significant effect on food security. Thus, the study concludes the existence of a complementary relationship between trade liberalization and food security. This suggested that, trade liberalization serves as a catalyst for food security. This finding is in line with the classical argument that trade liberalization resulting from comparative advantage leads to economic prosperity. This is because trade openness opens the economy to competition which enhances efficiency in domestic production and also serves as a transmission mechanism to move food surplus to deficit countries.

The long run results also revealed that food production index exerted a positive and statistically significant influence on food security in the long run. This emphasizes the crucial role that the local agricultural sector productivity plays in making food available to Ghana.

Also, the estimates of the long run results showed that arable land (ARL) exerted a positive and significant influence on food security in the long run. An increase in agricultural land enables the production of more food crops.

The results from the long run revealed a negative and statistically significant effect of inflation on food security. Thus macroeconomic stability is important in determining food security.

Moreover, the results from the long run showed that real GDP exerted a negative and statistically significant effect on food security in the long run. This is an indication that long term GDP growth may not necessarily be geared towards food security.

Finally, the long run results revealed a statistically significant and positive effect of amount of foreign reserves on food security. The short run dynamics also revealed that trade openness exerted a positive and significant effect on food security in the current period. This led the study to conclude that short run changes in trade openness leads to an increase in food security in the current period and thus posit a complementary relationship between the two variables. The lagged value however, indicated that the previous period openness has a negative effect on food security.

Also, the study found that food production index exerted a positive and statistically significant effect on food security in the short run just as in the long run. This re-emphasizes the significant role that domestic food supply plays in the food equation of Ghana.

Again, the study found that the consumer price index exerted a negative and statistically significant effect on food security in the short run. This is an indication that an increase in the consumer price index is hampering in the short run.

On real GDP, the study revealed a positive and significant influence on food security in the short run. This results is however, contrary to the findings in the long run. This led the study to conclude that real gross domestic product growth is good for achieving food security in the short run.

Arable land on the other hand, exerted a positive and statistically significant effect on food security in the short run. This means that arable land is an important domestic resources in Ghana both in the short run and long run for achieving food security. The short-run results further revealed that amount of foreign reserves has a statistically significant and positive effect on food security in the short run. This shows that amount of foreign reserves is beneficial in the short run for financing of food imports.

It was necessary to establish a long run relationship among the variables in the study and this was given by the error term. The results revealed that: the negative and statistically significant coefficient of the error term further consolidates the existence of a long run relationship among food security, trade liberalization, food production index, consumer price index, arable land and amount of foreign reserves. The size of its coefficient suggests that about 94 percent of disequilibrium caused by shocks to the system in the previous year converges back to the long equilibrium in the current year.

The diagnostic tests for the model revealed that the model passes the tests of serial correlation, functional form misspecification, non-normal errors, and heteroskedasticity. The parameter stability test which was conducted by plotting the graphs of the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares recursive residuals (CUSUMSQ) also revealed the existence of a stable relationship between trade openness and food security of the entire period of the study.

The study also examined the existence and therefore the direction of causality between trade liberalization and food security by utilizing the Pairwise granger causality test approach. The results of the test revealed a directional causality between trade liberalization and food security. The same findings were also made of the other variables such as real GDP and amount of foreign reserves. It was revealed that there is a unidirectional relationship between the said variables and food security.

Conclusions

From the results and discussion that have been elaborated, the objective of the study which was to examine the effect of trade liberalization on food security was accomplished. The study tested the long run, short run and causal relationship between trade liberalization and food security in Ghana using annual time series dataset from 1986 to 2016.

The empirical evidence from the study reveal that trade liberalization, food production index, amount of foreign reserves and arable land exerted a positive and significant effect on food security in the long run and short run. Real GDP

exerted positive and significant effect on food security in the short run but in the long run it exerted a negative and significant effect on food security. The consumer price index exerted a negative influence on food security in both the long run and short run effects.

This gives an indication that trade liberalization is significant for improving food security in the short and long term. Also, increase in food production index, arable land, amount of foreign reserves and real GDP leads to food security in the long run and short run with the exception of reserves and real GDP which do not lead to food security in the long run. The study also revealed a negative and statistically significant influence of the consumer price index on food security in both the short run and long run. This gives an indication that lower rate of inflation as measured by the consumer price index serves to boost food security whereas higher rate of inflation adversely affect food security in both the short run and long run.

Finally, the study revealed a unidirectional causality relationship between trade liberalization and food security. This gives an indication that the past values of trade liberalization can help in explaining food security than using past values of food security only.

Recommendations

Based on the findings from the study, the following recommendations are proposed.

The global trade in food is an economic activity, but it is also an activity deeply tied to food security, rural livelihoods, culture, ecology, and politics. As

such, evaluation of the interface between trade liberalization and food security must take a range of issues and methods of analysis into account. Per the results of this study trade liberalization is beneficial to food security in Ghana and opening up further will make more food available to Ghana. The study therefore recommends moderately opening up to trade to boost food security while considering other sectors as well.

It further caution against the formation of unilateral trade deal by government in order to avoid retaliative measures by other governments which will adversely affect the food security of the nation.

The study recommends that ministry of food and agriculture identify and empower large target farmers as strategic food growers as a long term strategy for achieving food security. Because of the prevalence of smallholders, an agricultural technology revolution, which takes cognizance of size peculiarity becomes necessary and is recommended as a short term measure.

Also, domestic policies which aim at increasing production would need improvement in rural infrastructural supportive services, agricultural marketing incentives, technical services and resource deployment, especially investment allocation for direct food production and an increase of productivity (yields per person and per hectare) as supported by the ministry of food and agriculture.

From the study, an increase in the consumer price index was food security hampering. On the basis of this, it is recommended to keep inflation at stable level in the economy. Therefore, policy makers and Bank of Ghana should concentrate on those options which keep the inflation rate stable and below the level which

has been found helpful for the achievement of sustainable food security. Stable and moderate inflation is also helpful for minimising the uncertainties and fluctuations in the macroeconomy, which, in turn, boost food security in the country. So, maintaining price stability will ultimately be the best policy recommendation to the Bank of Ghana for stable and sustained food security of the country.

The study also proved agricultural land as an important element in the food security equation of Ghana. It is therefore, recommended that the ministry of food and agriculture should critically address issues that threatening land availability for the productive activities such as farming. Measures to increase agricultural land should also be considered.

Finally, it is necessary that government consider increasing the foreign reserves of the nation as a key component of improving food security due to its short and long runs positive effects

Limitations

Although the study does provide valuable information on trade liberalization and food security, it possess some limitations. The study has incorporated only food availability to measure food security at the national level and has not incorporated food accessibility, food stability and food utilization which are other key pillars in the food security of a nation. Therefore, future research needs to incorporate these three pillars on estimating food security.

Also due to the paucity of micro data, the study was not conducted at the household or individual level which is more useful unit of analysis to determine

the effect of liberalization on vulnerable groups of society (the issue of availability versus access).

In all, notwithstanding these limitations, the findings of this study retain a considerable degree of reliability and exactness that render this thesis suitable for academic reference and formulations of policies.

Directions for future research

It is suggested that for future research on food security, it is recommended that other researchers should include other key components of food security which include accessibility, stability and utilization.

Also, similar research at the household level will be beneficially in this regard since the study was only conducted at the national level which does not give the micro picture.

Finally, the inclusion of other important variables influencing Ghana's food security is important for future research.

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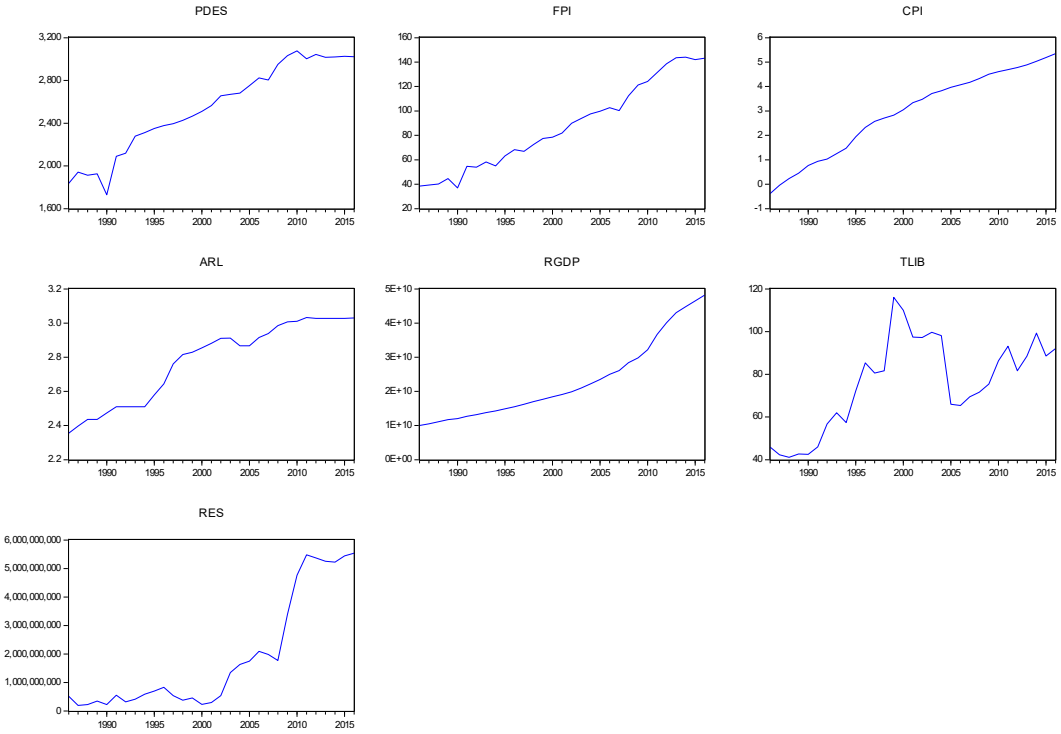
APPENDICS

APPENDICS A

Plot of the Variables (series) at level



APPENDICS B

Plots of the Variables (series) at first difference