EFFECTS OF EXOGENOUS FOOD AND FUEL PRICE SHOCKS AND WELFARE IMPLICATIONS IN KENYA: A COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS

By

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

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LIST OF ABBREVIATIONS

ACP	-	Africa Caribbean and Pacific
ADF	-	Augmented Dickey-Fuller
AERC	-	African Economic Research Consortium
AfDB	-	African Development Bank
ASAL	-	Arid and Semi Arid Lands
ASDS	-	Agricultural Sector Development Strategy
AU	-	African Union
BCM	-	Bivariate Correlation Models
BEC	-	Broad Economic Category
BRM	-	Bivariate Regression Models
CBK	-	Central Bank of Kenya
CBok	-	Cotton Board of Kenya
CDE	-	Constant Difference of Elasticities
CES	-	Constant Elasticity of Substitution
CET	-	Constant Elasticity of Transformation
CGE	-	Computable General Equilibrium
COMESA`	-	Common Market for Eastern and Southern Africa
CPI	-	Consumer Price Index
CR	-	Consumption Ratio
CRS	-	Constant Returns to Scale
CV	-	Compensating Variation
DF	-	Dickey-Fuller

EAC	-	East Africa Community
EADB	-	East Africa Development Bank
ECM	-	Error Correction Model
ECT	-	Error Correction Term
EPA	-	Economic Partnership Agreement
ERC	-	Energy Regulatory Commission
ESTJ	-	Enke-Samuelson-Takayama-Judge
FAO	-	Food and Agriculture Organization
GDP	-	Gross Domestic Product
GE	-	General Equilibrium
GoK	-	Government of Kenya
GTAP	-	Global Trade Analysis Project
HCDA	-	Horticultural Crops Development Authority
HO	-	Heckscher-Ohlin
IBRD	-	International Bank for Reconstruction and Development
ICAO	-	International Civil Aviation Organization
ICC	-	International Criminal Court
IDA	-	International Development Association
IEA	-	International Energy Agency
IFAD	-	International Fund for Agricultural Development
IFC	-	International Finance Cooperation
IGAD	-	Intergovernmental Authority on Development
ILO	-	International Labour Organization

IMF	-	International Monetary Fund
IMO	-	International Meteorological Organization
IMSO	-	International Mobile Satellite Organization
Interpol	-	International Police
IOC	-	International Olympic Committee
IOM	-	International Organization for Migration
IPU	-	Inter-Parliamentary Union
IRF	-	Impulse Response Functions
ISI	-	Import Substitution Industrialization
ISO	-	International Organization for Standardization
ITSO	-	International Telecommunications Satellite Organization
ITU	-	International Telecommunication Union
KCC	-	Kenya Cooperative Creameries
KDB	-	Kenya Dairy Board
KIHBS	-	Kenya Integrated Household Budget Survey
KIPPRA	-	Kenya Institute for Public Policy Research and Analysis
KMC	-	Kenya Meat Commission
KNBS	-	Kenya National Bureau of Statistics
KPC	-	Kenya Pipeline Company
KPRL	-	Kenya Petroleum Refineries Limited
KPSS	-	Kwiatkowski–Phillips–Schmidt–Shin
KSA	-	Kenya Sugar Authority
KTDA	-	Kenya Tea Development Authority

LES	-	Linear Expenditure System
LOP	-	Law of One Price
MA	-	Moving Average
MIGA	-	Multilateral Investment Guarantee Agency
MSM	-	Markov-Switching Models
NBR	-	Net Benefit Ratio
NCPB	-	National Cereals and Produce Board
NIB	-	National Irrigation Board
NOCK	-	National Oil Corporation of Kenya
NRDS	-	National Rice Development Strategy
OECD	-	The Organization for Economic Co-operation and Development
OPEC	-	Organization of Petroleum Exporting Countries
OTS	-	Open Tender System
PBK	-	Pyrethrum Board of Kenya
PBM	-	Parity Bound Models
PP	-	Phillips-Perron
PPP	-	Purchasing Power Parity
RHCP	-	Rural Hard-Core Poor
RP	-	Rural Poor
RNP	-	Rural Non-Poor
RPED	-	Regional Programme on Enterprise Development
SADC	-	Southern African Development Community
SAM	-	Social Accounting Matrix

SAP	-	Structural Adjustment Programme
SBK	-	Sisal Board of Kenya
SRA	-	Strategy for Revitalizing Agriculture
SRM	-	Switching Regime Models
SS	-	Stolper-Samuelson
SSA	-	Sub-Saharan African
TAR	-	Threshold Autoregressive
TBK	-	Tea Board of Kenya
TOT	-	Terms of Trade
UHCP	-	Urban Hard-Core Poor
UP	-	Urban Poor
UNP	-	Urban Non-Poor
UN	-	United Nations
UNCTAD	-	United Nations Conference on Trade and Development
UNESCO	-	United Nations Educational, Scientific and Cultural Organization
UNHCR	-	United Nations Human Rights Commission
UNIDO	-	United Nations Industrial Development Organization
USA	-	United States of America
VAR	-	Vector Auto Regression
VECM	-	Vector Error Correction
WB	-	World Bank
WCO	-	World Customs Organization
WHO	-	World Health Organization

WMO	-	World Meteorological Organization
WTO	-	World Trade Organization

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DEDICATION

This thesis is dedicated to my beloved parents the late *Francis Owino Okuma* and the late *Wilfrida Adhiambo Owino*

ABSTRACT

This thesis investigates the likely effects of international food and crude oil price shocks on Kenya's domestic market prices and households' welfare amidst deepening international economic integration. These products constitute 60 per cent of commodities used to measure the consumer price index and Kenya is a net importer of both. However, very little hard information about the actual effects of international price shocks on domestic prices and how firms and households react to them appears to be available.

The study used a CGE model constructed from the Global Trade Analysis Project (GTAP) model. The CGE model describes Kenya in 2007 and is integrated with the 2005/2006 Kenya Integrated Household Budget Survey data. The world price scenarios for food and crude oil products during the 2007 - 2008 periods are used to simulate the effects of the price shocks in the CGE model. The resulting effects endogenously model households' responses to production, consumption and income streams.

The analyses indicate that elasticities of demand for imported food and crude oil products in Kenya are fairly elastic implying that when international prices fall, import demand rises by a more than proportionate amount and vice versa. However, the international price shocks are not fully transmitted into the domestic markets. Besides, crude oil price shocks depress urban and rural household incomes and are evenly spread. But the food price shocks raise the rural households' incomes and reduce the incomes for urban households. Furthermore, rural households accrue net income gains from simultaneous food and oil price shocks whereas urban households are net losers.

The findings imply that changes in exogenous food and oil prices have potential to affect the county's balance of payments through import surges when international prices fall. Besides, there exists low transmission of external price shocks to domestic markets largely due to substantial government regulatory involvements in the two sectors. Most importantly, exogenous food and oil price shocks affect rural and urban households differently depending on whether they are net buyers or sellers as well as being owners of factors of production. The study recommends the removal of tariffs on staple foods and fuel products and enhancement of cash transfers to all poor urban households among other measures in order to build resilience at household levels.

CHAPTER ONE

INTRODUCTION

1.1 Background

International food and crude oil prices have been unpredictable since the beginning of the year 2000 and this has raised global concerns. This is mainly because changes in international prices are usually transmitted to domestic markets due to deepening international economic integration[1] (Bhattacharyya and Williamson, 2011). Higher international prices instigate negative terms-of-trade (TOT) shocks for net importers of these commodities and pose economic challenges like growing import bills, insecurity in supplies, and unsustainable growth of public expenditure, particularly on social safety nets[2]. Whereas the price effects are uncertain and depend on the structures of an economy, they are likely to be distributed disproportionately across sectors and households, with the brunt of the impact being borne, most likely, by intensive consumers of these commodities (Tlhalefang and Obonye, 2013).

For developing countries and Africa in particular, instability in the price of staple foods is a source of risk to poor segments of population. This is because volatility of food prices tends to be higher in Africa than other regions (Minot, 2011). In addition, poor households allocate, often more than 60 per cent of their budgets to food, so a given variability in prices has large effects on their purchasing powers (FAO, 2011). Moreover,

[1] Commodity price shocks are times when prices suddenly increase or decrease thereby affecting supply and demand in local markets.

[2] Terms of trade refer to a measure of how much imports an economy can get for a unit of exports. A rise in the prices of exports in international markets would increase the TOT, while a rise in the prices of imports would decrease it. For example, countries that export oil will see an increase in their TOT when oil prices rise, while for those that import oil, TOT would decrease.

the share of the population that depends on agriculture for its livelihood is generally larger in Africa than other regions (Minot, 2012).

During the period 2003 – 2008, global food and crude oil prices dramatically increased by 118 per cent and 347.6 per cent, respectively (World Bank, 2013). The prices fell sharply in 2009 and then picked up again in 2011 reaching higher levels than 2008 in 2012. The crude oil price shocks were largely attributed to scarce supplies and buoyant demand from emerging market economies, whereas the potential sources of food price hikes are summarized as global warming, changes in the use of agricultural land, panicky trade behaviours and increased production and diversion of crops for bio-fuel (OECD, 2008; World Bank, 2008; FAO, 2008).

There have been persistent decline in international food and oil prices since the year 2012. For instance, international food prices declined by 14 per cent between August 2014 and May 2015 whereas crude oil prices plummeted by 41 per cent between May 2014 and May 2015 (World Bank, 2015). The large global supplies in 2014 and prospects for good production in 2015 are behind the sustained decline in food prices. Conversely, the strong growth in oil supplies and weak global demand from a sluggish economic recovery following the financial crisis explain the downward pressures on international oil prices.

Evans (2008) summarizes the factors responsible for the rising food and oil prices in poor countries as being structural in nature, including small-scale subsistence production, high dependence on food aid, low levels of agricultural production for specific commodities, low capacity levels, and lack of diversification of alternative energy sources. In addition, although the world produces enough food to feed everyone,

competing use of food, skewness of food production and distribution and food waste distort prices and affect supplies (UNCTAD, 2012).

The issue of unpredictable changes in international prices has important implications on policy. First, the short run impacts of food and oil price changes are ambiguous. For instance, lower oil prices may reduce production costs as well as selling prices of food producers. On the other hand, consumers are likely to benefit from lower oil costs, hence overall impacts depends on whether net losses to producers outweigh net gains to consumers or vice versa. Second, the price trends have revived interest in regulating markets as a necessity for fighting price instabilities. Thus, the argument for direct and indirect government interventions to stabilize food and oil prices has been accepted by a growing number of countries (Minot, 2012).

The quantitative effects that changes in the landed prices of imports have on domestic prices can also be looked at from the perspective of the degree to which imported and domestically produced versions of a good substitute for one another in demand (Warr, 2005). Hence, it is assumed that imported and domestically produced goods are perfect or imperfect substitutes of each other. The perfect substitute model ignores such factors as lags in buyers' responses and differentiation of products. On the other hand, imperfect substitute's model argues that products are distinguished not only by their kind but also their place of production. This assumption is also referred to as the "Armingtion assumption" following the paper by Armington (1969).

Indeed, trade theory suggests that shocks[3]and subsequent policy reforms undertaken by governments bring about changes in economic activities across various sectors and therefore re-allocation of resources through changes in the prices of labour, goods, capital and services. These have implications on fiscal revenues, domestic output, employment and welfare. Yet, little is known about the behavioural responses of various consumers and producers to unanticipated food and crude oil price changes in poor countries, including Kenya. Leyaro (2011) attributes the limited information to lack of appropriate historical data on production, consumption and prices by which to estimate behavioural parameters or elasticities.

There exist several perspectives into the impacts of external trade shocks in developed and developing countries. According to FAO (2011), the impacts on poor countries are deemed greater than on developed countries due to lack of sufficient reserves for financing imports, and the inflexibility to restrict exports when domestic supply shortages prevail. Closely related to this view is the argument by Seale, *et al*., (2003) that consumers in developing countries reduce food expenditures by over 8 per cent for every 10 per cent hike in food prices, while those in affluent countries like the United States of America (USA) barely adjust their food expenditures by 1 per cent. According to Arndt, *et al*., (2008), the effects of higher food and oil prices on households depend on what they are engaged in producing and the products that constitute their consumption basket. It also depends on the extent to which agricultural outputs or supplies respond to price changes, how exports respond to such changes and the demand for crude oil in the entire economy.

[3] The term 'shock' is used to describe a disturbance to the economy that was unanticipated. Ordinarily, firms and households are likely to be forward-looking and, at least to some extent, are able to incorporate anticipated changes in their economic environment into their behaviour.

At the macro level, Kose and Reizman (2001) attribute the intensity of external price shocks to the degree to which domestic and world markets are integrated, ease of mobility of factors of production, the initial distribution of wealth and incomes, and existing regulatory and institutional frameworks. Easterly, *et al*., (1993) observe that households' incomes are also affected by adjustments in macroeconomic indicators and public policy responses aimed at accommodating changes in the terms of trade. The extents of the effects vary from short to long term; rural versus urban areas and levels of incomes of various households.

Similarly, the empirical evidences about the economic effects of higher global food and oil prices in Sub-Saharan African (SSA) are mixed. Tlhalefang and Obonye (2013) pinpoint that the impacts of the trade shocks differ across countries depending on economic structural features. They rule out any consensus about the intensity of the effects across household categories. On one hand, higher agricultural prices may represent an opportunity for farmers to raise their incomes and therefore improve the livelihood of rural populations in poor countries. On the other hand, rising food prices adversely affect livelihoods, especially in urban areas where many households rely on purchased food. In addition, higher crude oil prices affect both rural and urban households due to the economy-wide use of oil and its linkages in the production and distribution processes.

The analytical studies on trade shocks conducted in SSA are based on different approaches ranging from simple static partial equilibrium models to dynamic general equilibrium models. The partial equilibrium approaches have been the most popular owing to their simplicity and possibility for in-depth analysis of the policy issues arising

from external shocks. However, they are limited in scope to handle issues that affect output and prices from other sectors, unlike the general equilibrium models (Cornwall, 1984). Some studies have used multi-country models to compare the impacts of external shocks in countries of similar characteristics (Wodon and Zaman, 2008; Abbott and Borot, 2011; Baltzer, 2013). Other set of studies have focused on the country-specific impact of the food crisis and conclude that they vary across different household groups, depending on the level of urbanity, income group and geographical location (Arndt, *et al*., 2008; Reys, *et al.*, 2009). Overall, Amikuzuno (2010) points out that the findings of these studies have been equally heterogeneous and blames failure to use data of relevant frequency in their analysis. He argues that agricultural markets exhibit high frequency data than can be captured in monthly and quarterly data.

For Kenya, the inter-connectedness of the economy to other economies in the rest of the world can be traced back to economic and political reforms undertaken from the 1980s and the subsequent heightened quest for economic integration into regional and global economies. Although international food prices have reduced in recent years, the instability in staple food and oil prices are an important source of risk for developing and least developed countries (Minot, 2012).

This study is important for Kenya from two perspectives; first, higher global prices are of concern since the country is a net importer of food and crude oil products. These commodities significantly contribute to overall price trends and have the biggest weights in the consumer basket (Government of Kenya, 2010). However, information about the likely effects of international food and crude oil price shocks on various household groups in Kenya is scanty. In addition, little is known about how the foreign

goods compete with domestic goods in the markets, given the seemingly numerous supplying areas of the imported products. This is important as it reflects on the extent of integration between the domestic and other foreign markets and subsequently the transmission of external prices to domestic markets. Secondly, Kenya is in the process of undertaking fundamental structural reforms, under the framework of the Vision 2030 programme, to ensure food and energy security among other goals. There is need to comprehensively examine the distributional consequences of external commodity price shocks and develop an appropriate policy response strategies based on the behavioural aspects of the various economic agents in the Kenyan economy.

This study applies a computable general equilibrium (CGE) model to provide more insights into economy-wide distributional effects of global food and crude oil price shocks across different household categories in Kenya. The present model is based on the Kenyan economy during 2007, but it can be extended to other countries in SSA. The analysis begins by examining the empirical relationship between the landed imports and domestic prices for selected agricultural commodities and estimating import substitution or 'pass-through' elasticities[4] which are subsequently used in the general equilibrium model. The key focus is to ascertain how the stream of income sources and expenditures of various households are affected, and the optimal strategies for minimizing the negative impacts and/or maximizing the benefits associated with food and crude oil price changes.

1.2 The Research Problem

High, volatile and rising global food and oil prices determine the decisions of economic agents and policy makers of a domestic economy (World Bank, 2008; Minot,

[4] Pass-through elasticity looks into the proportional changes of imported and domestic prices of a commodity.

2012). Specifically, commodity price shock episodes influence distribution of incomes across various economic agents depending on their roles and position in markets (Ivanic and Martin, 2008). At the same time, the use of domestic protectionist policies lead to failure of international markets to guarantee supplies when and where needed. In turn, the transmission of the combined effects into domestic markets is aggravated by the interdependence and interconnectedness of economies, thereby increasing vulnerability and exposure to the vagaries of unforeseen economic shocks.

Whereas the fact that adverse effects caused by external price shocks on Kenya's economy is not in doubt, little hard information about the actual effects on domestic prices and how firms and households react appears to be available. Besides, the income distributional consequences of these shocks different household categories remain unclear. So far, empirical studies on external shocks and effectiveness of social assistance programmes give mixed results. Besides, the methodologies employed by previous studies are limited in either theoretical foundations or scopes and appropriate data. Consequently, the government responses to immediate effects of unpredictable shocks on households are hardly well informed and often mounted on existing long term social protection schemes[5]. Yet trade shocks affect individuals and households differently depending on the economic activities they are engaged in and their consumption behaviors (Selliah, *et al.*, 2015). A clear understanding of how different households are affected is important in enhancing the effectiveness of government interventions and building resilience at individual, household and national levels. This partly explains why repeated distribution of food to poor families in arid and semi-arid lands (ASALs) has

[5] Major social assistance programmes include education bursaries, school feeding programmes, Orphans and Vulnerable Children (OVC) programmes, Older Persons cash transfer and youth enterprise fund, among others (Government of Kenya, 2011a).

kept people alive but hardly reduced poverty levels (Government of Kenya, 2011a). This thesis contributes to the existing literature by using the GTAP CGE model to analyze economy wide effects of external trade shocks in Kenya. The model is modified for Kenya and based on plausible economic relationships and equilibrium assumptions. The results play a part in filling knowledge gaps about the behavior of economic agents and the welfare implications across different categories of households.

1.3 Research Questions

Although it is widely accepted that external price shocks affect domestic market prices, little is known about the extent to which they affect domestic prices and the stream of incomes accruing to various sectors and categories of households. Hence, this study seeks to address the following questions:-

a. What are the magnitudes of the price elasticities of demand for imported crude oil and food products in Kenya?
b. To what extent are international food and crude oil price shocks transmitted into domestic markets?
c. How do unanticipated changes in food and crude oil prices affect the welfare of different categories of households in Kenya?

1.4 Research Objectives

The general objective of this study is to analyze the effects of exogenous food and oil price shocks on domestic markets and household welfare in Kenya. The specific objectives include:-

a. To estimate the price elasticities of demand for imported food and oil products in Kenya.

b. To evaluate the degree to which international food and oil price shocks affect domestic market prices.
c. To analyze the effects of the changes in domestic food and oil prices on the welfare of different household categories.
d. To suggest appropriate policy measures based on the outcomes of the first, second and third objectives.

1.5 Significance of the Study

This study looks into the effects of international oil and food price shocks on domestic prices and welfare of different categories of households in Kenya. Trade shocks are important to study because of their tendency to trigger changes in the incomes and expenditures of various economic agents. Ultimately, such effects prompt changes in allocations of government budgets and overall economic development (Addison and Ghoshray, 2013). Commodity market price shocks influence government budgets and priorities for countries that heavily rely on commodity exports like is the case for Kenya. Given the uncertainty as to how the government should respond to international price shocks and resultant economy-wide effects, there are persuasive arguments to model the effects of international food and crude oil price shocks on rural and urban household incomes and expenditures in Kenya.

The effects on the domestic economy is exacerbated by the fact that Kenya is a small economy that is heavily exposed to events in global markets, over which it has little if any influence. Furthermore, volatility of global food and oil prices worsens the already weak fiscal and foreign reserve condition and undermines the government's efforts to mobilize sufficient domestic resources to mitigate negative effects of trade shocks.

Attempts to mobilize external financial assistance often lead to worsening the debt burden, engendering public investment spending cuts and increasing budgetary deficits. The fiscal challenge is made worse by the fact that the country is a net importer of food and crude oil products. Besides, over 46 per cent of the total population in Kenya lives below poverty line, where as households' expenditures on food and fuel account for over 60 per cent of items used to measure the consumer price index. In reality, higher and more volatile food prices raise concerns about availability and access to food and stability of its access. These create additional hardships to the poor and vulnerable populations who are less able to withstand the negative effects on their incomes.

Thus, international food and oil prices have social, political and economic implications in Kenya. The effects are triggered by changes in price incentives to various economic agents and in circumstances where the households and other agents are obliged to reduce their consumptions when prices escalate or relative taxes on food and crude oil products increase. Meanwhile, the global process of trade liberalization and removal of special protective regimes continue. However, Kenya’s effective participation in these negotiations is weakened by lack of adequate financial and technical resources to effectively support negotiations of welfare enhancing trade pacts.

So far, this is the first study to use the GTAP model to analyze trade shocks in Kenya. The other scientific contribution is the application of an improved household survey data within a general equilibrium framework, to analyze the behavioral responses of economic agents to trade shocks and the welfare implications of such shocks across various categories of households. So far, a number of recent studies have looked at the impacts of escalating food and fuel prices on household welfare using different methods.

The findings of previous studies are ambiguous in the sense that there is no consensus on the distributional impacts of external price shocks. Most empirical studies have used partial equilibrium methods which not only assume perfect substitutability between domestic and foreign products, but also ignore activities and market linkages. The CGE-based studies are faulted on the grounds of either analyzing effects on single households, assuming perfectly competitive market conditions and using relatively old data sets.

In addition, the thesis findings form a strong basis for government policy interventions during episodes of trade shocks, given the deepening of economic integration between Kenya and her trading partners.

1.6 Scope of the Study

This thesis looks into how changes in international prices for food and oil products affect their demand in the domestic market. In addition, the study analyses the transmission of international price shocks to domestic market prices. The other key focus is on how the incomes and expenditures of various categories of households are affected by unprecedented changes in global prices of food and crude oil products through changes in consumer prices, factor incomes and government spending. Food and crude oil products are particularly being considered in the analysis because they constitute a substantial share of the consumer basket for the majority of Kenyan households. The prices of these products are also highly volatile and unpredictable in international markets.

1.7 Organization of the Thesis

The rest of the thesis is structured as follows: chapter two contains an overview of the Kenyan economy, including the key economic policy reforms undertaken by the

government in the agricultural and petroleum sub-sectors. The chapter also elucidates major global episodes of food and oil price shocks since the 1960's.

In chapter three, a review of theoretical and empirical literature is carried out. Specifically, the former covers the theoretical foundations of price transmission and the various pass-through applications in economic literature. On the other hand, the latter looks into the various empirical studies on price transmissions and market integration. It also covers the studies that employed import substitution elasticity methodology and specifies an import demand model which is used in estimating the import substitution elasticity parameters applied in the general equilibrium analysis. The purpose is to lay ground for estimation of realistic elasticity parameters for use in the CGE model rather than use uniform values as done in many other studies.

The methodology used in the study is discussed in detail in chapter four. It begins by providing the rationale for application of a general equilibrium model and then describes the structure, elasticity parameters and closure rules applied in the CGE model. It also contains data sources and implementation of the CGE model. The chapter ends by specifying apriori assumptions made and describes various experiments carried out in the study. Two categories of experiments are described; the price shock scenarios and policy response scenarios. In each case, positive and negative shocks are simulated. The policy response experiments are based on the effects of the combined oil and food price shocks with the aim of restoring the initial levels of household incomes and expenditures prior to the price shocks.

Chapter five contains the study results in respect of the stipulated research objectives and the experiments carried out. The first section is the introduction. The

second section begins by presenting the estimated elasticity parameters which are used in the CGE model. The results for the price shock experiments are presented in the third section followed by the policy response analysis in section four. The presentation of the results of the simulations is done in terms of separate experiments for food and crude oil price shocks, and then followed by combined shocks to give a holistic view of the price change effects.

The final chapter contains five sections. Section 1 constitutes the summary and conclusion made in the thesis. In the second section, policy suggestions based on the findings of the study are made. Subsequently, the contributions and limitations of the study are highlighted in sections 3 and 4, respectively, whereas the last section recommends areas for further research.

CHAPTER TWO

AN OVERVIEW OF THE KENYAN ECONOMY

2.1 Introduction

In this chapter, an overview of the Kenyan economy is provided. The chapter further outlines the agricultural and energy sectors in Kenya, including historical perspectives of policy reforms undertaken since independence. Finally, the major constraints and challenges bedeviling the sectors are also highlighted.

2.2 A General Overview of the Economy

2.2.1 Location and Geography

According to Government of Kenya (2004a), Kenya is situated on the east coast of Africa, and lies along the equator. The country has a total surface area of 587,000 km^2 of which 11,000 km^2 are covered by water and a coastline of about 600 km along the Indian Ocean. Only about 16 per cent of the remaining 576,000 km^2 landmass is of high and medium agricultural potential, with adequate and reliable rainfall. The country gained independence in 1963 and laid down strong foundations for attaining economic success and political stability (World Bank, 2003).

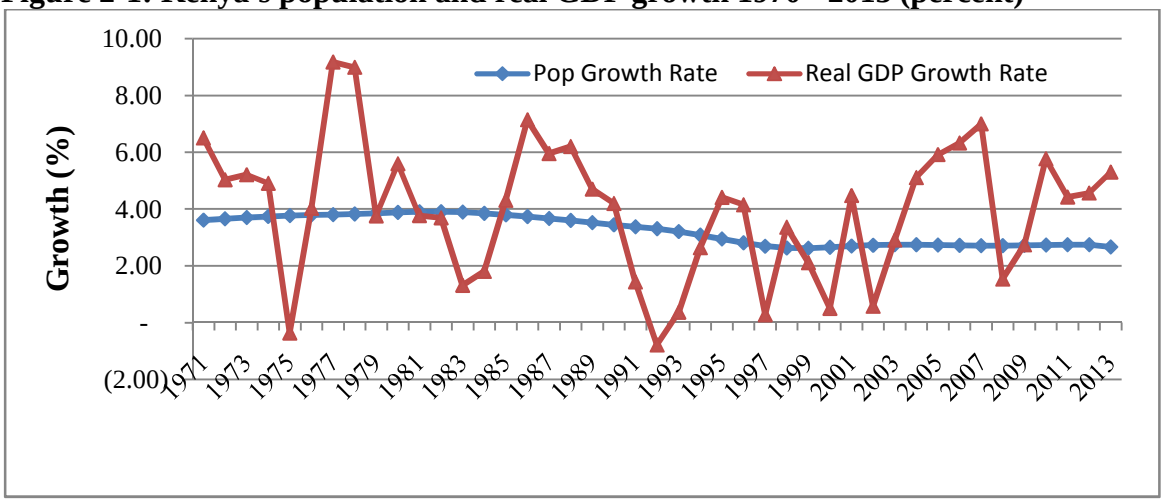
2.2.2 Evolution of development policies and economic performances

Under the guidelines of the "Sessional Paper No. 10 of 1965 on African socialism and its application to planning in Kenya", the economy grew rapidly in the period immediately following independence, with an annual average Gross Domestic Product (GDP) growth rate of six per cent from 1963 to 1973 (Government of Kenya, 1965). The key sectors that drove the growth of the economy were the agricultural, industrial and services sectors (World Bank, 2004).

The rapid economic growth experienced during the first decade after independence was largely attributed to the expansion of the agricultural sector, expansionary fiscal policies, and the import substitution industrialization (ISI) strategy adopted by the government (World Bank, 2003). The ISI strategy aimed at attaining industrial diversification and growth through the protection of domestic firms against competition from foreign firms (RPED, 2004). The Kenya government mainly used overvalued exchange rates, import tariffs and quantitative restrictions, foreign exchange controls, and import licensing to implement the import substitution strategy (Ikiara, *et al.*, 2004).

Economic performance after the first decade of independence was mixed, with GDP growth rate being quite volatile over the period 1970 - 2013. For instance, there was rapid growth in 1976 due to the coffee boom. Thereafter, the growth rate began to deteriorate and slumped to 3.8 per cent toward the end of the 1970s. The trends for GDP and population growth rates between the years 1970 and 2013 are shown in Figure (2-1).

Figure 2-1: Kenya's population and real GDP growth 1970 - 2013 (percent)



Source: United Nations Statistics, 2014.

According to Ikiara, *et al.*, (2004), several factors attributed to the poor economic growth during the second decade after independence. These included, but not limited to the collapse of the original East African Community (EAC) in 1977; the erosion of fiscal prudence in government spending, partly due to the windfalls from the boom in coffee prices in 1976; the second oil shock in 1977; and reduced export earnings due to the anti-export bias of the import substitution strategy. The other important factor was the burgeoning public sector during the decade. In this regard, several parastatals or public corporations were established and these posed a huge drain on public funds and the banking system (Swamy, 1994).

From the statistics presented in Figure 2.1, the average GDP growth rate during the 1980's reduced to 4.4 per cent from 5.3 per cent the previous decade. Growth in agriculture declined to 3.7 per cent annually, the industrial sector expanded by 3.9 per cent per year, and services grew at an average rate of 5 per cent per year (World Bank, 2004).

During the second half of the 1980's, the government mainly focused on the implementation of the Structural Adjustment Programme (SAP) under the tutelage of the World Bank and the International Monetary Fund (IMF). The SAP reforms aimed at improving market incentives, resource allocation and macroeconomic stabilization. According to the World Bank (1995), the key features of the reforms included liberalization of the foreign exchange market; credit market and agricultural commodities markets, as well as privatization of some parastatals; the lifting of domestic price controls; and export promotion programme. These reforms were mainly driven by the desire to maintain fiscal sustainability following the execution of expensive public sector

investments and government subsidies financed by borrowing from domestic and external sources during the previous decade. Selected macroeconomic indicators of the Kenyan economy during the period 1970 - 2013 are shown in Table 2-1.

Table 2-1: Macroeconomic Indicators, 1970 - 2013 (Annual averages)

	1970 - 1979	**1980 - 1989**	**1990 - 1999**	**2000- 2009**	**2010 - 2013**	**2014**
Population (millions)	13.3	19.4	24.6	35.4	42.0	45.0
Real GDP (millions, US$)	4,602.7	9,130.2	11.146.9	19,928.6	35,751.2	62,720.0*
Real GDP growth rate (per cent)	5.3	4.4	2.2	3.7	5.0	5.3
Government revenue as a percentage of GDP	N/A	18.2	19.8	22.0	24.1	18.8
Government expenditure as a percentage of GDP	N/A	21.8	24.2	24.5	29.8	24.0
Current account balance (US$ billions)	N/A	-0.40	-0.25	-0.6	-3.18	-5.01
Current account balance as a percentage of GDP	N/A	-3.85	-1.95	-2.31	-8.30	-7.98
Gross debt as per cent of GDP	N/A	N/A	54.37	51.65	48.20	58.9
Inflation (per cent)	N/A	11.5	16.7	7.6	8.3	7.2
Nominal exchange rate (Ksh per US$)	7.48	14.25	49.47	75.01	84.19	87.92
Share of agriculture to GDP (per cent)	36.18	31.64	27.75	25.05	24.23	27.3
Share of manufacturing to GDP (per cent)	13.36	13.42	11.73	10.15	9.56	10.0
Share of transport to GDP (per cent)	6.26	6.93	8.02	9.78	9.75	8.3
Share of wholesale and retail trade to GDP (per cent)	6.42	6.66	9.13	10.64	11.97	8.2

Source: UN Statistics, 2014; IMF, 2014 and World Bank, 2014; Economic Survey, 2015

* Re-based figure

Kenya had its worst economic performance since independence during 1991 - 1993 periods. According to RPED (2004), the major factors behind the feeble economic performance were institutional and regulatory weaknesses bedeviling agricultural, land, and industrial policies. These were compounded by deteriorating international terms of trade, increased government controls and crowding out of private sector, while the import substitution policies made the manufacturing sector uncompetitive. Specifically, tight import controls and foreign exchange controls, made the domestic environment for investment unattractive for both foreign and domestic investors. Thus, annual real GDP growth averaged only 2.2 per cent and the share of agricultural production shrank by 3.9 per cent in 1993. Population growth exceeded the real GDP growth rate. Real per capita GDP contracted leading to an increase in the number of people living in poverty. Inflation reached a record 46 per cent in 1993, and the government's budget deficit was 12 per cent of GDP.

Consequently, bilateral and multilateral donors suspended programme aid to Kenya and put the government on notice to embark on economic reforms and restore greater confidence in the economy. Notable among these was the three-year suspension of lending and the holding back of the US$ 90 million structural adjustment credit by the IMF and World Bank, respectively in June 1997. These measures were a direct response to government’s slow pace of economic reforms and alleged economic mismanagement of resources. Some of the notable delays included complete removal of import licensing system and the full liberalization of foreign exchange and commodity markets (O'Brien and Ryan, 2001). Furthermore, the Goldenberg scandal whereby the government

subsidized gold exports more than required levels reportedly took place between 1991 and 1993.

Subsequently, the government eliminated price controls, foreign exchange controls and import licensing as part of the reforms. Moreover, a number of publicly owned companies were privatized, with exception of those in the transportation, communications, banking and utilities. The Banking Act of 1989 was amended to strengthen and improve bank regulations and supervision and in 1991, all interest rates were fully deregulated. In addition, the government also carried out retrenchment of civil servants for the first time.

The above highlighted measures led to improvement of the economy with real GDP growth rate rising to over 4 per cent between 1994 and 1996 (World Bank, 2003). The growth was however short-lived, and the economy entered a period of slowing or stagnant growth. Reduced agricultural production following adverse weather conditions and increased political tensions ahead of the general elections of December 1997 together contributed to depressed economic growth experienced during the period.

Between the years 2000 and 2002, the economic performance was below its potential with real GDP growth slowing down to 0.6 per cent in 2002. At the time, there were political uncertainties related to the 2002 general elections while the relations between the government and major donors continued to be frosty. In addition, corruption had become more entrenched, weak infrastructure, poor economic management, intermittent droughts, and volatile international commodity prices. However, the economy picked up in 2003 following the reform programmes instituted by a new political administration under auspices of the "Economic Recovery Strategy for Wealth

and Employment Creation 2003 -2007". Subsequently, the economy began to recover in this period, with real GDP growth rate registering 2.8 per cent in 2003 and rising to 7.0 per cent in 2007. The World Bank and the IMF also resumed their financial support to the government. However, a number of compounding domestic and external factors negatively affected the economy thereafter. The domestic factors included the post-election violence in early 2008 and adverse weather conditions which affected agriculture production. These were compounded by rising global food and fuel prices and the global financial crisis. Together, these factors slowed down GDP growth rate to less than two per cent in 2008. There was modest improvement during 2009 when the economy registered a growth rate of 2.7 per cent (Government of Kenya, 2013b).

Like the previous decades, economic performance in the present decade, beginning the year 2010, has been uneven. Although growth rose to nearly 10 per cent in 2010, average real GDP growth remains 5 per cent over the last four years. In 2013, GDP at current prices was estimated at US$ 40.4 billion. Real GDP growth rate was 5.3 per cent during the year 2014, against 5.7 per cent growth rate recorded during the year 2013 (Government of Kenya, 2015).

The Government of Kenya (2015) economic survey indicates that the main economic sectors in terms of their contribution to GDP included the agriculture sector (including crops, livestock and forestry), which accounted for about 27.3 per cent of GDP and about 75 per cent of employment. The sector suffers from the impacts of adverse climatic conditions. For instance, poor rains in some parts of the country lead to decline of maize production during the year 2014. However, production of some food commodities like Irish potatoes and pulses improved offsetting the negative effects of the

declined maize production. Other increases were realized in notable crops like tea, coffee, cut flowers and fruits, while production of sugar cane and pyrethrum declined during the year. The other key drivers of the economy were manufacturing sector (10 per cent), transport and communication sector (9.5 per cent) and wholesale and retail trade which accounted for 8.2 per cent of GDP.

The international trade indicators show trade deficits in Kenya's merchandise trade attributed to high import bills (Government of Kenya, 2015). The balance of trade deteriorated from a deficit of Ksh 911.0 billion in 2013 to a deficit of Ksh 1,081.1 billion in 2014 or an 18.7 per cent increase as indicated in Table 2-2. On the other hand, the balance of payments position improved from a surplus of Ksh 31.8 billion in 2013 to a surplus of Ksh 126.1 in 2014. This was attributed to increased international reserves due to proceeds received from the sale of the Eurobond. The current account deteriorated further by 30.2 per cent from a deficit of Ksh 411.7 billion in 2013 to a deficit of Ksh 536.1 billion in 2014 mainly due to the widening of the visible trade deficit.

Table 2-2: Balance of Trade 2010 - 2014 (Ksh millions)

	2010	2011	2012	2013	2014
Exports	409,794	512,604	517,847	502,287	537,236
Imports	947,206	1,300,749	1,374,584	1,413,316	1,618,321
Balance of Trade	(537,412)	(788,145)	(856,737)	(911,029)	(1,081,085)
Total Trade	1,357,000	1,813,353	1,892,431	1,915,603	2,155,557
Cover Ratio[6]	43.26	39.41	37.67	35.54	33.20

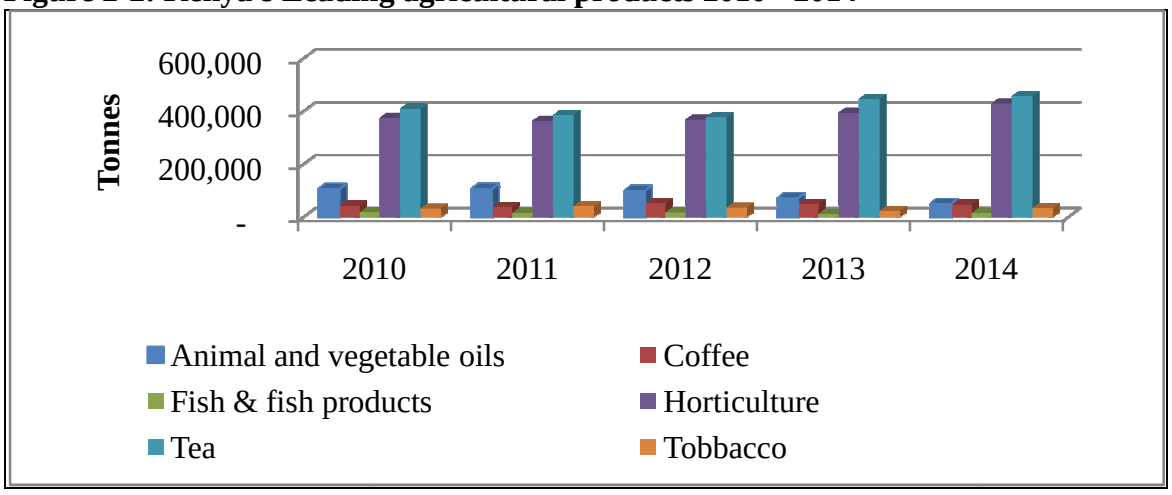
Source: Government of Kenya, 2015

According to Government of Kenya (2015), food and beverages continued to be the leading foreign exchange earner despite its decline in contribution to domestic export earnings from 42.8 per cent in 2013 to 40.84 per cent in 2014. Non-food industrial

[6] Cover ratio refers to the ratio of total exports to imports multiplied by 100.

supplies constituted 27.02 per cent and consumer goods (27.89 per cent) during 2014. The leading agricultural exports in Kenya include tea, horticulture, animal products, coffee and tobacco (Figure 2-2).

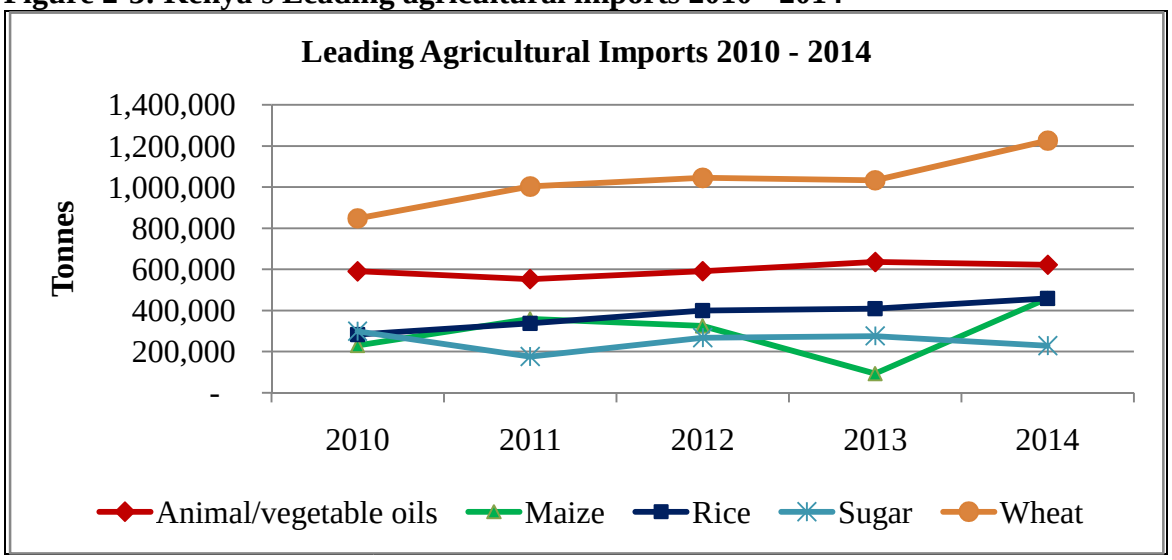
Figure 2-2: Kenya's Leading agricultural products 2010 - 2014



Source: GoK, 2015

On the other hand, the main imports during the year 2014 were non-food industrial supplies (28.56 per cent), fuel and lubricants (21.4 per cent), machinery and equipment (17.2 per cent) and transport equipment (17.2 per cent). In terms of imports of food products, wheat, rice, maize and sugar are leading import commodities (Figure 2-3).

Figure 2-3: Kenya's Leading agricultural imports 2010 - 2014



Source: GoK, 2015

In terms of export market destinations, Africa has remained Kenya's leading export destination followed by European Union market. During 2014, the two markets accounted for 44.9 per cent and 25.9 per cent of total export earnings, respectively. In Africa, the EAC market accounted for 52 per cent of the total earnings, whereas the European Union contributed the bulk of the export earnings (Table 2-3).

Table 2-3: Value of Exports by destination 2010 - 2014

	Exports					Imports				
Region	**2010**	**2011**	**2012**	**2013**	**2014**	**2010**	**2011**	**2012**	**2013**	**2014**
1. Africa										
EAC	101.312	137,155	134,946	124,957	125,798	20,206	26,429	30,547	28,758	36,629
Rest of Africa	87,602	110,446	115,643	106,517	115,565	94,598	124,825	108,208	119,081	109,512
Total Africa	**188,914**	**247,600**	**250,589**	**231,474**	**241,363**	**114,804**	**151,254**	**140,755**	**147,839**	**146,141**
2. Europe										
Western Europe	101,689	126,402	114,411	111,594	128,038	185,431	227,599	225,543	231,597	245,651
Eastern Europe	7,734	9,844	10,784	11,705	10,927	18,484	27,350	24,226	39,039	40,294
Total Europe	**109,422**	**136,246**	**125,195**	**123,299**	**138,965**	**203,914**	**254,950**	**249,769**	**270,635**	**285,945**
3 America										
USA	22,522	25,772	26,405	29,936	38,290	39,316	44,547	65,966	57,412	168,720
Canada	1,170	1,190	1,516	1,297	1,690	7,068	7,418	13,372	6,525	7,886
Other	688	630	820	2,533	5,684	9,264	27,203	39,955	20,539	10,869
Total America	**24,380**	**27,592**	**28,740**	**33,765**	**45,664**	**55,647**	**79,168**	**119,293**	**84,477**	**187,476**
4. ASIA										
Middle East	30,525	32,940	42,065	39,502	35,806	168,726	299,611	284,117	219,880	227,969
Far East	51,075	62,673	63,395	68,056	64,212	399,195	509,556	572,408	676,820	762,204
Total ASIA	**81,600**	**95,613**	**105,460**	**107,558**	**100,018**	**567,921**	**809,123**	**856,525**	**896,700**	**990,173**
5. Australia & Oceanic	767	1,049	1,894	2,858	3,465	3,932	2,997	8,112	13,040	7,500
6. Rest of World	4,712	4,504	5,968	3,332	7,761	987	3,214	134	624	1,086
TOTAL	**409,794**	**512,604**	**517,847**	**502,286**	**537,236**	**947,206**	**1,300,749**	**1,374,587**	**1,413,316**	**1,618,321**

Source: Government of Kenya, 2015

2.2.3 Regional and International Cooperation

Kenya participates in a number of regional and international organizations[7]. On international trade matters, Kenya is pursuing regional economic integration with the aim of enhancing long-term growth prospects through expansion of markets for goods and services. According to Government of Kenya (2009), Kenya is an active participant of the East Africa Community (EAC) which established a customs union in January 2005 and a common market 1st July 2010. The EAC Common Market Protocol provides for the free movement of goods and services and the rights of establishment in all five member states, namely Burundi, Kenya, Rwanda, Tanzania and Uganda. Kenya is also a signatory to the Common Market for Eastern and Southern Africa (COMESA) and is among the countries spearheading the formation of the EAC, COMESA, and the Southern African Development Community (SADC) Tripartite Free Trade Agreement (TFTA). The latter is envisaged to form a free trade area and subsequently establish a customs union. If realized, the tripartite free trade area would cover 26 countries. Besides, Kenya has recently concluded negotiating an Economic Partnership Agreement (EPA) with the European Union under the EAC framework and is a founder and active member of the World Trade Organization (WTO) which came into force in 1995.

2.2.4 Social Protection Schemes in Kenya

The overarching policy on social protection[8] from adverse economic shocks is contained in the Kenya National Social Protection Policy 2010, which is anchored on the Kenya Vision 2030 and the Constitution of Kenya 2010 (Government of Kenya, 2011a).

[7] Kenya participates in the following ACP, AfDB, AU, CCD, COMESA, EAC, EADB, FAO, ICAO, IDA, IFAD, IFC, IGAD, ILO, IMF, IMO, IMSO, Interpol, IOC, IOM, IPU, ISO, ITSO, ITU, MIGA, UN, UNCTAD, UNESCO, UNHCR, UNIDO, WCO, WHO, WMO and WTO.

[8] Social protection encompasses social assistance, social security and health insurance programmes.

In the context of national development, the ultimate goal of the social protection policy is to ensure all Kenyans live in dignity and are given the opportunity to exploit their capabilities for social and economic development. This goal is reflected in the Kenya Vision 2030, which aims to provide a "high quality of life for all citizens by the year 2030". Likewise, social protection is among the constitutional rights provided for in Article 43 of Kenya's constitution, which asserts the "right for every person to social security and binds the State to provide appropriate social security to persons who are unable to support themselves and their dependents".

The social protection policy specifically seeks to protect individuals and households from adverse impacts of economic shocks that are capable of pushing them into poverty or into deeper poverty and to support individuals and households to manage such shocks in ways that do not trap them in poverty by reducing their exclusion. The other objective is to strengthen their ability to graduate from being reliant on social assistance to becoming financially stable. In this regard, the government has developed several safety net programmes targeting specific categories of beneficiaries including but not limited to (1) cash transfers[9], (2) food distribution, (3) public works and (4) Grants (Government of Kenya, 2011a).

2.3 Overview of the Agricultural Sector in Kenya

2.3.1 Characteristics and performance

Agriculture has remained the mainstay of the Kenyan economy since independence in 1963. This is made so considering that about 80 per cent of the population live in the rural areas and depend directly on agriculture production for their

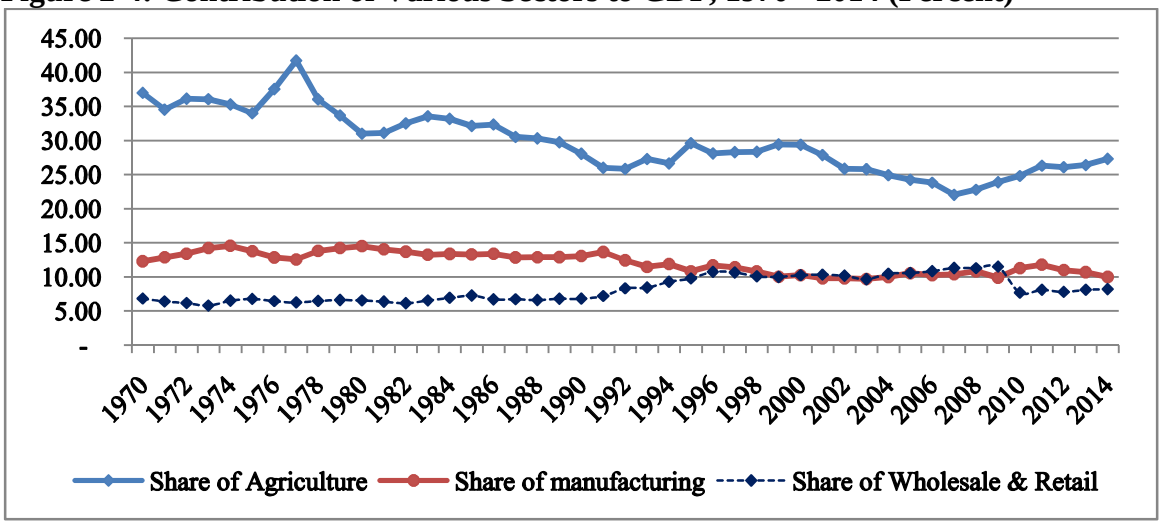
[9] The cash transfer programmes include: Orphans and Vulnerable Children Cash Transfers (OVCCT), Older Parsons Cash Transfers (OPCT), Hunger Safety Net Programme (HSNP) and the Urban Food Subsidy.

livelihood. According to Government of Kenya (2013a), about 84 per cent of Kenya is arid and semi-arid land and not suitable for rain-fed farming. Under these circumstances, sustained agricultural growth requires intensification and substitution towards more high-value products as well as the expansion of the cultivated area through irrigation. In addition, the agricultural sector is characterized by smallholder mixed farming of livestock, food crops, cash crops, fishing and aquaculture. The smallholders account for 70 per cent of total marketed agricultural production. The average size of land cultivated by smallholder farmers is 1.6 hectares and below. The major food crops cultivated include maize, rice, potatoes, bananas, cassava, beans, vegetables, sugar, wheat, sorghum, millet and pulses.

Jayne and Muyanga (2012) observe that the other important characteristic of the agricultural sector in Kenya is the shrinking land holdings amidst the paradox of land abundance. This is mainly attributed to population growth, rising urbanization, land leases for large-scale commercial investments, effects of climatic changes and poor tenure systems. The study further established that Kenya has witnessed a gradual decline in mean farm size over the past 50 years, and that the rural population growth rate has outstripped the growth in arable land. In addition, there has been substantial decline in land-to-labour ratios in agriculture. Cultivated land per person in agriculture has declined from 0.462 hectares in the 1960s to 0.219 hectares in 2008. The analysis further established that farm productivity and incomes tend to rise with population density up to 600–650 persons per kilometer square. Beyond this threshold, the analysis indicate that rising population density brings about sharp declines in farm productivity, total household incomes, and asset wealth accumulation.

The share of agricultural and other sectors to GDP for the period 1970 - 2014 is shown in Figure 2-4. According to Government of Kenya (2015), the sector accounted for about 27.3 per cent of the GDP and contributed 27 per cent indirectly through linkages with manufacturing, distribution and other service related sectors during the year 2014. It also substantially contributed to foreign exchange earnings, raw materials for agro-based industries and employment during the same period. More specifically, the agricultural sector accounted for about 65 per cent of Kenya's total exports, 18 per cent and 60 per cent of the formal and total employment respectively, during the year. Therefore, agricultural activities do not only drive Kenya's economy, but also the means by which majority of the Kenyan population derive their livelihoods.

Figure 2-4: Contribution of Various Sectors to GDP, 1970 - 2014 (Percent)



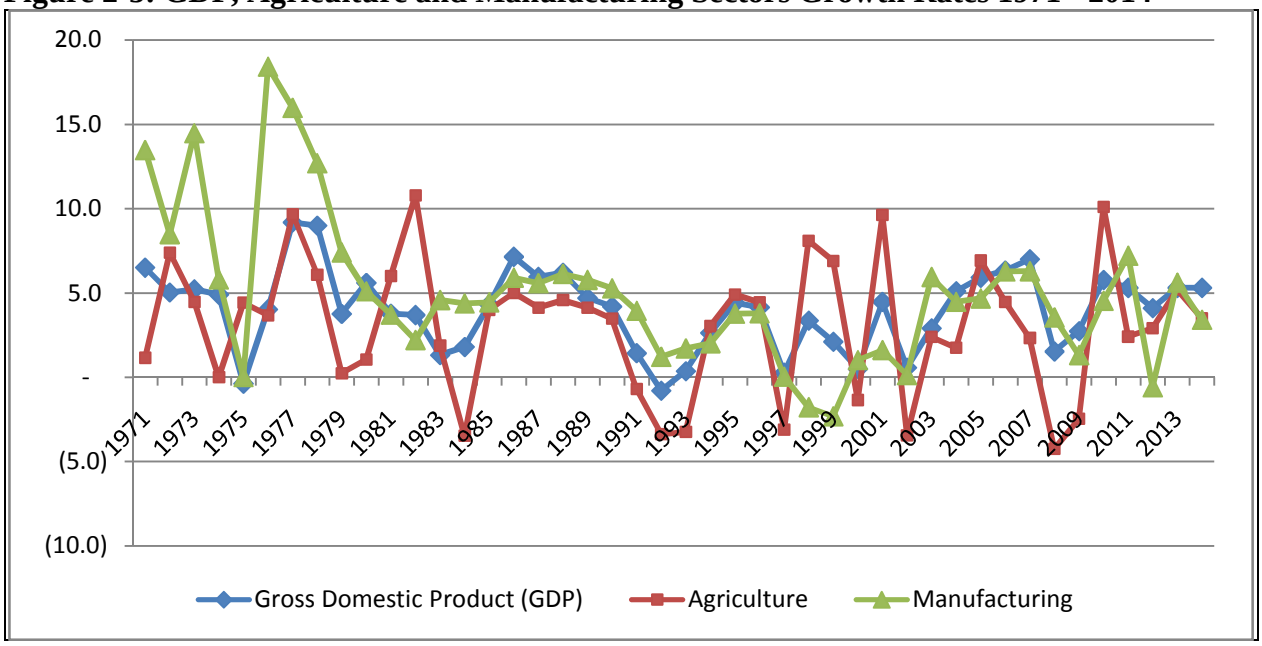
Source: UN Statistics, 2014.

The economic performance of the agricultural sector has been quite erratic since the 1970s as shown in Figure 2-3. Agricultural production rapidly expanded immediately after independence following redistribution of colonial estates to native farmers, diffusion of new crop strains and opening up of new areas to cultivation. Nevertheless, the growth of the sector in the 1970s was very volatile. After a slump in 1974, productivity sharply

rose in 1976 due to the windfalls of the coffee boom. Growth rate further declined in 1979, partly due to the indirect effects of the oil crisis.

The performance of the sector in the 1980s and thereafter was largely driven by changing climatic conditions and economic and political factors. For instance, there was a severe drought in 1984, while the successive general election periods from 1992 saw sharp declines in agriculture growth attributed to post election violence in major farming areas as indicated in Figure 2-5.

Figure 2-5: GDP, Agriculture and Manufacturing Sectors Growth Rates 1971 - 2014



Source: FAO databank, 2014 http://www.fao.org/statistics/en/. Accessed on 12th October, 2014

Griffith-Jones and Ocampo (2009) attribute the subdued annual growth rate starting in 2007 to political tensions prior to the general elections in December 2007 and the post election violence that affected major agricultural production areas, high fertilizer prices occasioned by rising global fuel prices and the global economic down-turn occasioned by the financial melt-down in the United States of America in mid 2008. The

erratic performance of the sector clearly points to the need to promote irrigation-based agriculture.

The budgetary allocation to the agricultural sector has been fluctuating over the past five decades since independence. Ongaro (2012) indicates that, on average, the country spent over 10 per cent of its total government budget on agriculture during the first decade after independence (1963–1973). Subsequently, this declined to an average of 7.5 per cent in the period (1980 - 1989) and plummeted to a record low of 3 per cent in the period (1990 - 2000). Subsequently, Kenya raised the budgetary allocation on the agricultural sector ministries from 1.6 per cent in 2003 to almost 8 per cent in 2007/2008. The government has since been increasing resource allocation to the agriculture sector since 2009/2010. The estimates of June 2012/2013 budget indicated that about 10 per cent of the total expenditures were allocated to the broad agriculture and rural development, environmental protection, and water and housing sector. It is noteworthy that these efforts are in tandem with the 2003 Maputo Declaration as a step towards addressing food insecurity in the country.

2.3.2 Institutional and Regulatory Reforms in the Agricultural Sector

Nyangito, *et al.*, (2004) pointed out that reforms in the agricultural sector were carried out within the broad framework of policy shift from government control of economic activities to a liberalized economy. During the first two decades after independence (1963 -1980s), the policies were geared towards protection of the domestic economy and promotion of the import substitution strategy to support the agricultural sector and rural incomes. The policy instruments used to achieve these objectives were provision of farm input subsidies, quantitative restriction of imports, and imposition of

high tariffs on imports and credit. The government also directly controlled and actively participated in agricultural production, processing and marketing through cooperative societies, state-run farmer organizations and parastatals[10].

The major functions of these bodies were to regulate production through procurement of inputs and marketing of agricultural produce. According to Schmidt (1979) and DAI (1989), the marketing of cereals, especially maize, was done through both formal and informal systems. The formal maize marketing system was strictly regulated and managed by the National Cereal and Produce Board (NCPB), the successor to two previous maize marketing boards. On the other hand, the informal system operated freely, that is, unregulated and unofficial with many market participants operating parallel to the formal system.

However, the performances of most of the regulatory institutions were dismal, and often required additional budgetary provisions to meet their operational costs (Government of Kenya, 2004a). In addition, their existence in nearly every agricultural activity often led to overlaps, duplication and conflict of interest, therefore undermining the government's efforts. These constraints led to deterioration of agricultural sector performance and necessitated policy reforms.

Subsequently, the Structural Adjustment Programmes (SAPs) were introduced in mid 1980s as detailed in the Sessional Paper No.1 of 1986 on "Economic Management

[10] There were 18 commodity regulatory boards and 9 companies performing specialized services on behalf of the government by the year 2000. State-run farmer organizations included; the Kenya Tea Development Authority (KTDA) and Kenya Cooperative Creameries (KCC); State boards included: the National Cereals and Produce Board (NCPB), National Irrigation Board (NIB), Horticultural Crops Development Authority (HCDA), the Sisal Board of Kenya, Pyrethrum Board of Kenya, Kenya Sugar Authority, Coffee Board of Kenya, Tea Board of Kenya, Kenya Dairy Board, Cotton Board of Kenya and Kenya Meat Commission (Government of Kenya, 2004a).

for Renewed Growth"[11]. In the agricultural sector, the aim was to promote the role of the private sector and increase productivity and competition in domestic markets. The key reforms undertaken included removing price controls, ending government control on import and export markets, setting prices and distributing farm inputs.

Subsequently, price controls for all food items, except maize and agricultural inputs, were eventually abolished in 1992 (Mutahi, 1996). Thus, the private sector was allowed to directly purchase maize from farmers, whereas the role of NCPB was to manage the strategic reserves and act as the buyers' last resort.

In addition, free movement of commercial maize from high producing areas such as Rift Valley to low producing areas such as Eastern Province was allowed to reduce food insecurity in the country. Omamo (1998) argued that the decontrol of movement of maize led to reduction in the costs of transportation due to realization of economies of scale arising from larger volumes. However, the policy reforms implemented in the 1980s and 1990s also failed to stimulate growth in the agricultural sector. The dismal performance of the agricultural sector persisted, resulting into a sharp decline of the overall performance of the economy (Government of Kenya, 2004a). This was largely attributed to lack of complementarity of reforms and an ineffective institutional and regulatory framework for implementation (Nyairo, 2011). For instance, liberalization was carried out without the development of alternative marketing strategies to stabilize market prices. Ongaro (2012) noted that budgetary allocations to agricultural sector declined steadily from an average of 11 per cent in 1980 to less than 4 per cent by 2002. Besides, the resources allocated to sectoral ministries were largely absorbed by recurrent

[11]The other important policy documents were Sessional Paper No 1 of 1994 on Recovery and Sustainable Development to the year 2010; Economic Recovery Strategy for Wealth and Employment Creation 2003 - 2007 and Strategy for Revitalizing Agriculture 2004-2014.

as opposed to development expenditures, with three quarters being absorbed by the parastatals.

Subsequently, the Strategy for Revitalizing Agriculture (SRA) 2004- 2014 was formulated to carry-forward on-going institutional and policy reforms. The SRA prioritized increased budgetary allocations, institutional reforms, capacity building, investment capital for development of support infrastructure, and provision of seed funds as critical to revitalization of the sector. According to Government of Kenya (2012), a major step was the increase in budgetary allocations to agricultural sector ministries from 1.6 per cent in 2003 to almost 8 per cent in 2008 and 10 per cent in 2013, in line with the recommendations of the African Union Maputo Declaration on agriculture and food security in 2003.

Presently, the long-term development of the agricultural sector is guided by Vision 2030, which seeks to promote an innovative and commercially-oriented sector. Under the guidance of the Agricultural Sector Development Strategy-ASDS (2009-2020), the policy objectives are to increase agricultural productivity, embrace commercialization of agriculture as a profit making activity and to enhance competitiveness of agricultural products. Together, these are geared towards enabling the sector to attain national food security requirements, increase exports for foreign exchange earnings and facilitate the creation of employment opportunities (Government of Kenya, 2007a).

The government's food security interventions can be classified into short, medium and long term measures. The short term interventions are invoked through the National Cereals and Produce Board (NCPB) Act (cap 338) of 1986, revised edition 2012. Article 13 of the Act specifically empowers the Board to maintain a national strategic reserve of

maize, wheat, and scheduled agricultural produce, and for that purpose, has the power to purchase surplus maize, wheat or scheduled agricultural produce grown in Kenya. Wangia, *et al.,* (2002) note that the strategic reserves maintained by the NCPB have substantially reduced from over 30 million bags during the pre-liberalization period to between 3 - 4 million bags after full liberalization. The latest policy is for a strategic reserve of 3 million bags that can last 3 months, while awaiting imports and US$ 60 million that can be used to import an additional 3 million bags of maize to last 3 months so as to save on the cost of handling/storage and to avoid raising producer prices unduly at the expense of consumers. In addition, Ministerial Declarations and Presidential Decrees are commonly used in setting purchasing prices by the NCPB, controlling exports/imports and providing subsidies to agricultural inputs like seeds and fertilizers as in 2008 and 2013.

The medium to long term strategies on food security are enshrined in the National Food and Nutritional Security Policy and the Kenya Vision 2030, respectively (Government of Kenya, 2011b). The former seeks to address the link between food security and poverty reduction[12] and the National Cereals and Produce Board (NCPB) is expected to maintain strategic reserves for foodstuffs, particularly maize, to be released to the market during grain shortages.

Under the Vision 2030 framework, the flagship projects related to addressing food security issues include: (i) the enactment of a consolidated agricultural reform bill to harmonize and rationalize contradictory development, regulatory, licensing, processing and marketing of agricultural parastatals; (ii) fertilizer-cost reduction investment; (iii)

[12]Food and nutrition security refers to a situation where all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO).

establishment of disease-free zones; (iv) land-use master plan and Arid and Semi Arid Lands (ASAL) development programme to bring one million acres under irrigation.

The other sector specific policy relating to national food security is the National Rice Development Strategy (NRDS) 2008-2018 which has the objective of doubling rice production in both rain-fed and irrigated conditions by 2018. Under this strategy, the government seeks to expand the area under rain-fed and irrigated rice, reduce field and storage losses of rice, improve farmers' access to credit and high quality inputs, improve farmers' access to certified rice seed, and provide advisory extension support services.

2.4 Overview of the Energy and Petroleum Sub-Sector

2.4.1 Characteristics and Performance

The petroleum sub-sector is broadly divided into three categories namely: upstream (exploration and production), mid-stream (storage, refining and transportation) and down-stream (supply and distribution). Midstream and downstream operations are usually combined. The history of oil marketing in Kenya began in 1903 during colonial times, with the main imports being kerosene and later on gasoline. Royal Dutch Shell established the first depot at Shimanzi area in Mombasa Island.

The energy and petroleum sector plays a critical role in the socio-economic development of Kenya's economy. Petroleum and electricity constitute the main sources of commercial energy and are the main drivers of the economy. The energy and petroleum sector relies wholly on importation of crude oil used in the transport sector, power generation, commercial and industrial sectors, and domestic use by households (Table 2-4).

In 2014, the road transport, aviation and industrial/commercial use account for the largest proportions of petroleum products at 70.9 per cent, 13.5 per cent and 11.5 per cent, respectively (Government of Kenya, 2015). At the same time, the agriculture, retail and road transport, rail transport, power generation and government consumptions all registered increases in consumption. The other sectors experienced declines in consumption of petroleum products during the same period.

Table 2-4: Consumption of Petroleum by Sectors (per cent)

Consumer Category	2007	2008	2009	2010	2011	2012	2013	2014
Agriculture	1.81	1.18	0.73	0.89	0.79	0.62	0.77	0.92
Retail pump outlets and road transport	50.32	51.36	56.80	62.29	55.98	61.43	69.41	70.88
Rail transport	0.53	0.43	0.23	0.01	0.19	0.32	0.38	0.40
Marine	N/A	0.03	0.20	0.42	0.69	0.36	0.67	0.47
Tourism	0.37	0.26	0.23	0.20	0.20	0.17	0.15	0.13
Aviation	20.37	18.10	16.38	16.48	17.26	18.28	14.90	13.47
Power generation	12.81	11.50	10.29	7.92	8.52	3.26	1.73	2.51
Industrial and commercial	13.10	15.38	15.76	11.64	16.39	15.56	12.47	11.46
Government	0.27	0.40	0.52	0.42	0.54	0.35	0.19	0.24
Balancing item	0.43	1.36	-1.13	-0.27	-0.56	-0.36	-0.69	-0.47

Source: Government of Kenya, 2013a

The demand for petroleum products has been increasing over the last three years. The total demand has increased from 3,697.7 thousand tonnes in 2012 to 3,939.5 thousand tonnes in 2014. In terms of consumption by type of fuel; light diesel oil, aviation spirit, motor spirit and fuel oil are the most highly consumed in Kenya (Table 2-5). Kerosene is used for cooking and lighting, especially for the rural and urban poor households and as a substitute for wood fuel. Thus, kerosene is subsidized due to its implications on consumption and household welfare.

Table 2-5: Petroleum Consumption by Category (per cent)

Type	2007	2008	2009	2010	2011	2012	2013	2014
Liquefied petroleum gas	2.48	2.69	2.07	2.33	2.37	2.57	2.48	3.79
Motor spirit (super and regular)	11.77	12.17	12.79	15.86	14.57	17.00	20.68	22.94
Aviation fuel	20.54	17.93	15.85	14.40	17.46	18.49	14.78	13.50
Illuminating kerosene	8.41	7.81	9.22	8.39	6.99	8.49	7.91	7.62
Light diesel oil	35.80	36.42	39.22	40.29	37.89	40.85	42.75	43.70
Heavy diesel oil	1.29	0.96	0.66	0.66	0.72	0.57	0.50	0.07
Fuel oil	19.71	22.02	20.20	18.07	20.01	12.01	9.91	8.33

Source: Government of Kenya, 2013a

The country is a net importer of petroleum products which account for 20 to 25 per cent of the national total import bill (Government of Kenya, 2015)[13]. Both quantities and values of imported petroleum products have been increasing in the recent past as shown in the Table 2-6.

Table 2-6: Value of Imports and Exports of Petroleum Products (Ksh millions)

Year	2010	2011	2012	2013	2014
Imports					
Crude oil	72,598	124,042	68,086	41,037	-
Petroleum fuels	119,462	196,649	237,700	248,687	292,515
Lubricating oils	123	0	6	7	0
Lubricating greases	8,596	17,058	21,130	25,643	40,631
Total	**200,780**	**337,749**	**326,922**	**315,374**	**333,146**
Domestic Exports					
Petroleum fuels	1,835	2,642	1,093	647	204
Lubricating oils	471	1,741	39	0	1
Lubricating greases	2,308	3,371	2,685	735	106
Total	**4,614**	**7,754**	**3,817**	**1,382**	**310.3**
Re-Exports					
Petroleum fuels	3,979	4,825	4,825	9,395	46,545
Lubricating oils	51	2	2	-	-
Lubricating greases	2,072	3,179	4,733	1,108	426
Total	**6,102**	**8,006**	**9,560**	**10,504**	**46,970**
Total Exports	**10,716**	**15,760**	**13,377**	**11,885**	**47,281**
Net Balance	**190,064**	**321,989**	**313,544**	**303,489**	**285,865**

Source: Government of Kenya, 2015

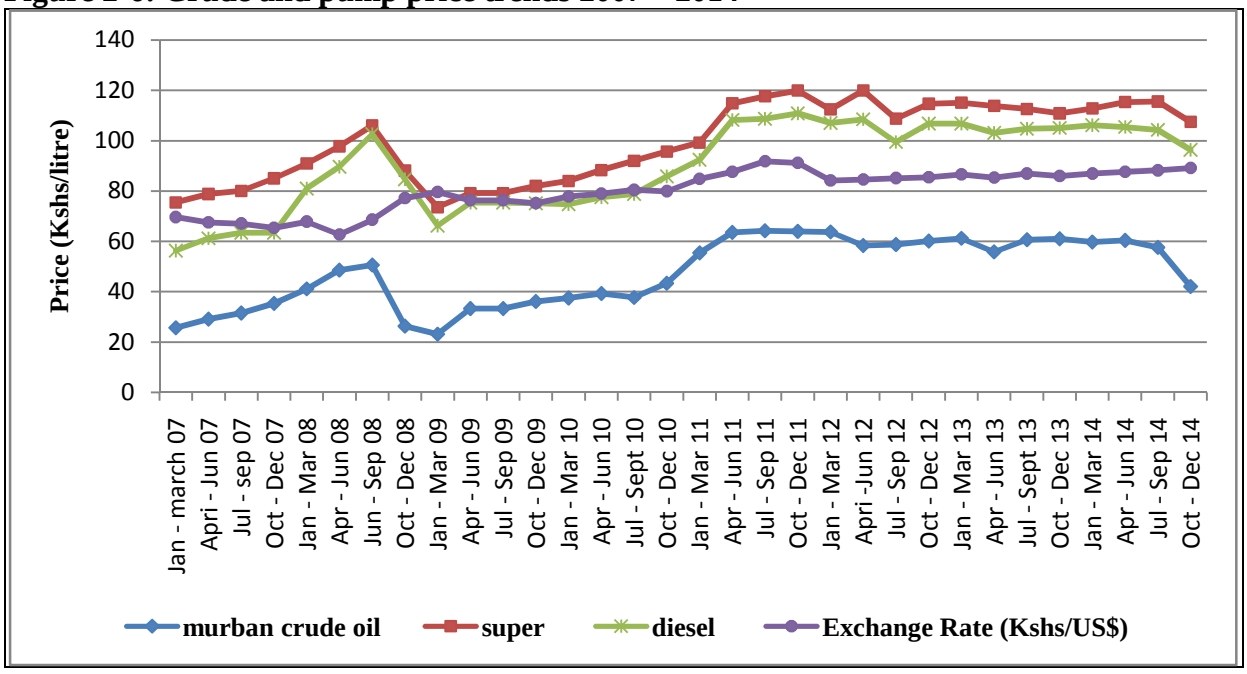
[13] Commercial reserves of petroleum were discovered in Northern Kenya in March, 2012. Subsequently, this has elicited renewed government efforts to develop adequate petroleum production capacity and supply infrastructure to meet market requirements to match the increasing demand for petroleum products locally.

Total quantities expanded by 11.7 per cent, while value increased by 17.6 per cent between 2013 and 2014, whereas the total import bill increased by 5.6 per cent in 2014 (Government of Kenya, 2015).

The domestic market is largely oligopolistic with over 55 per cent being controlled by three main oil marketing companies namely Shell, Total and Kenol/Kobil during the year 2014. During the year, 71companies were licensed to import petroleum products and 176 marketed petroleum products in the domestic market[14].

There exists pro-cyclical movement of international crude oil prices and domestic prices for petroleum products in Kenya (Figure 2-6). For instance, when the international price of crude oil rose by 46 per cent from US$ 62.05 per barrel in December 2006 to US$ 90.60 per barrel in December 2007, the domestic prices increased.

Figure 2-6: Crude and pump price trends 2007 – 2014



Source: Energy Regulatory Commission, 2012; Government of Kenya, 2015

[14] The leading companies include, are Shell, Total, Kenol/Kobil, Oil Libya, Chevron and the National Oil Corporation of Kenya (NOCK), in which the government owns 50 per cent of share capital.

When the international prices rose to about US$140 per barrel in August 2008, domestic prices for super and diesel increased as well. Domestic prices reduced when the international prices plummeted to less than US$ 50 by March 2009. Imported petroleum products are paid for in the United States Dollars. The depreciation of the Kenya shilling against the US Dollar therefore negates any drop in international crude oil prices and maintains high prices for the imports.

2.4.2 Institutional and Regulatory Reforms in the Energy Sector

According to Government of Kenya (2004b), structural and regulatory reforms in the energy sector in Kenya began after mid 1990s, following the enactment of the Electric Power Act 1997, the Sessional Paper No. 4 of 2004 and the Energy Act No 12 of 2006. These legislations provided the legal basis for liberalization of procurement, distribution and pricing of energy-related products in Kenya. More specifically, the petroleum sub-sector was regulated by the Petroleum (exploration and production) Act 1994 and the Petroleum Development Fund Act No. 4 of 1991.

The Energy Act No. 12 of 2006 consolidated all laws relating to energy and provided for the establishment of the Energy Regulatory Commission (ERC) as a single sector regulatory agency. The Act states in Section 5(a) (ii) that the objectives and functions of ERC include regulating importation, exportation, transportation, refining, storage and sale of petroleum and petroleum products. The Commission also issues construction permits for all petroleum related facilities including pipelines, refinery, bulk storage facility or retail dispensing site under Article 90 of the Energy Act No. 12 of 2006. The Act further requires full compliance with environmental, health and safety control measures by operators and prohibits adulteration of petroleum products. The

reforms have over the period enabled increased private sector participation in further development of the sector. The impetus for additional reforms in the sector has been boosted following the unveiling of the national development blueprint, Kenya Vision 2030 and the promulgation of the Constitution of Kenya in 2010 both of which have placed the sector at the centre of driving Kenya's economic growth and development.

The key players in the petroleum sector include the Ministry of Energy and Petroleum, the Kenya Petroleum Refineries Ltd (KPRL), the Energy Regulatory Commission (ERC), the Kenya Pipeline Company (KPC) and the National Oil Corporation of Kenya (NOCK). KPRL is responsible for processing 1.6 million tonnes of crude oil which meets about 50 per cent of the local demand. The 50 per cent balance of local demand is met through importation of refined petroleum products. The importation of crude oil is coordinated by the Ministry of Energy through an Open Tender System (OTS) in which all licensed importers are required to participate through legal notice No. 197 of 2nd December 2003. The Ministry coordinates another OTS for importation of 35 per cent of refined products in which all licensed companies are entitled to participate. The companies are allowed to import the balance of 15 per cent of refined oil on their own outside the tender system. However, the refined has been converted into an import and storage terminal following recommendations from the ERC (Government of Kenya, 2015). In addition, KPC is responsible for operation of the oil pipeline system for the transportation and storage of petroleum products, while NOCK is responsible for petroleum exploration and fuel marketing.

The Energy Regulatory Commission regulates the prices of petroleum and related products through Legal Notice No. 196 under the Energy (petroleum pricing) Regulations

of 2010. The law provides for setting the maximum wholesale and the retail prices of petroleum products at a wholesale depot or retail dispensing site through an agreed formula[15]. The price regulations, which started during the month of December 2010, are set for a month running from 15th to 14th of the following month. The intention is to afford importers recovery of their costs, while ensuring fair prices to consumers. However, the discovery of oil in northern Kenya and the neighboring countries is likely to change the reliance on imported oil used in the domestic economy. Delloite (2013) observes that the discovery of hydrocarbons within the region, specifically the discovery of oil in Uganda in 2006 and natural gas deposits in Tanzania, has brought new stimulus and hope of harnessing the power of the industry to benefit the local people. However, whether these new discoveries will help reduce and stabilize domestic oil prices remains a fundamental question.

2.5 Historical Episodes of Food and Oil Price Shocks in Kenya

2.5.1 Episodes of Food Price Shocks

There have been positive and negative effects of external agricultural and food price shocks in the Kenyan economy. The positive effects have mainly been experienced in the coffee and tea sub-sectors, whereby household incomes increased following the rise in international market prices. Apparently, the structure of Kenya's export sector is

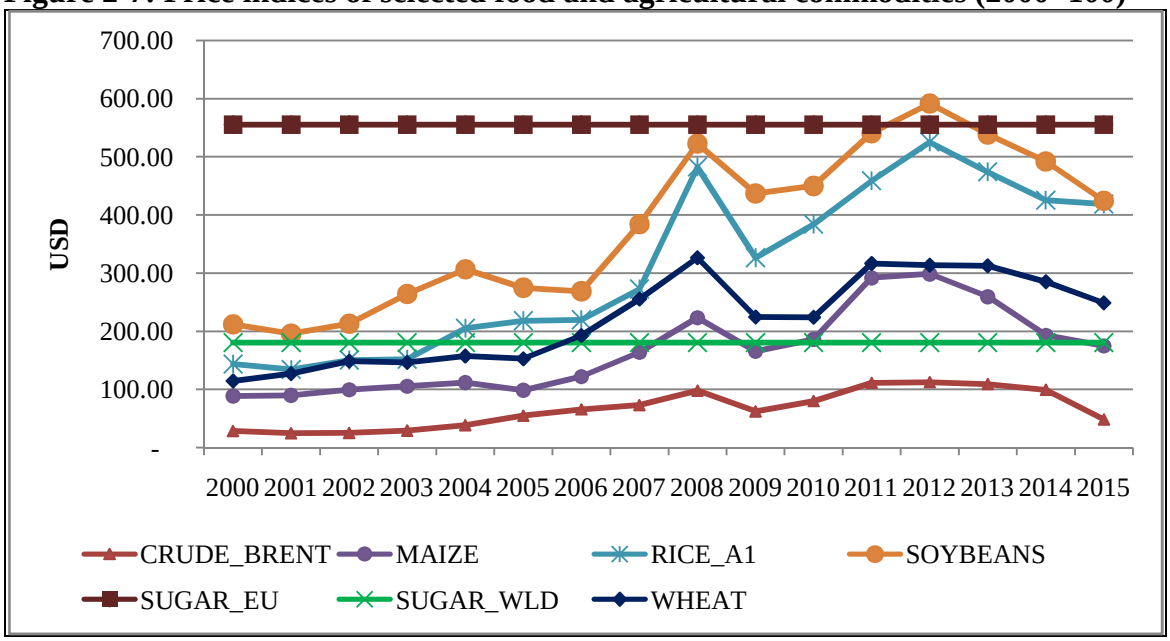
[15] For retail site, the price for Super Petrol, Regular Petrol, Kerosene, and Automotive Diesel is set in accordance with the following formula:
Pr=Pw+mr+z Where: -
Pr = the maximum retail price of Super Petrol, Regular Petrol, Kerosene, or Automotive Diesel applicable in shillings per liter,
Pw = the maximum wholesale price for Petrol, Regular Petrol, Kerosene, or Automotive Diesel
mr = the allowable maximum retail gross margin as set,
z = the delivery rate from the nearest wholesale depot to a retail dispensing site in shillings per liter as determined.

predominantly composed of primary agricultural commodities, mainly tea, coffee and horticulture. Therefore domestic prices are quite vulnerable to fluctuations in world prices. Thus, according to various editions of economic surveys, export growth has been highly erratic since independence. The export earnings have been fluctuating and are based on a few traditional primary products.

During the period 1976-79, there was a major fall in global production of coffee and a rise in international prices following the damage of Brazilian coffee crop by frost. The economy benefited from expenditure tax earnings and the improved terms of trade following the quadrupling of coffee prices. At the same time, the prices of tea were also temporarily high. Bevan, *et al.,* (1989) notes that the gain in terms of trade was equivalent to a third of the GDP recorded in 1975. The increase in earnings accrued directly to private sector agents and tea farmers, especially considering that the government did not impose a windfall tax. This was unlike other coffee producing countries which raised substantial revenues from export tax proceeds. They further suggest that the coffee boom had two major impacts on the economy. First, the income windfall encouraged savings, private investment and changes in the use of resources between activities which had major implications in GDP changes. Secondly, it led to redistribution of incomes from tradable to non-tradable sectors, as well as from rural to urban areas due to the foreign exchange control regime at the time. The coffee farmers received windfall incomes. Consequently, this raised their expenditures for both tradable and non-tradable items leading to increased domestic prices and generating large rents in the urban sector. In this way, some of the income windfalls were transferred from the country-sides to urban areas.

Kimuyu (2005) points out the second but short-lived, coffee and tea booms in 1986. However, this did not have the dramatic effects associated with the earlier one and the government introduced a progressive coffee tax to stabilize prices. The period post the year 2000 was characterized by hikes and volatility in commodity prices occasioned by various factors as indicated in Figure 2-7.

Figure 2-7: Price indices of selected food and agricultural commodities (2000=100)



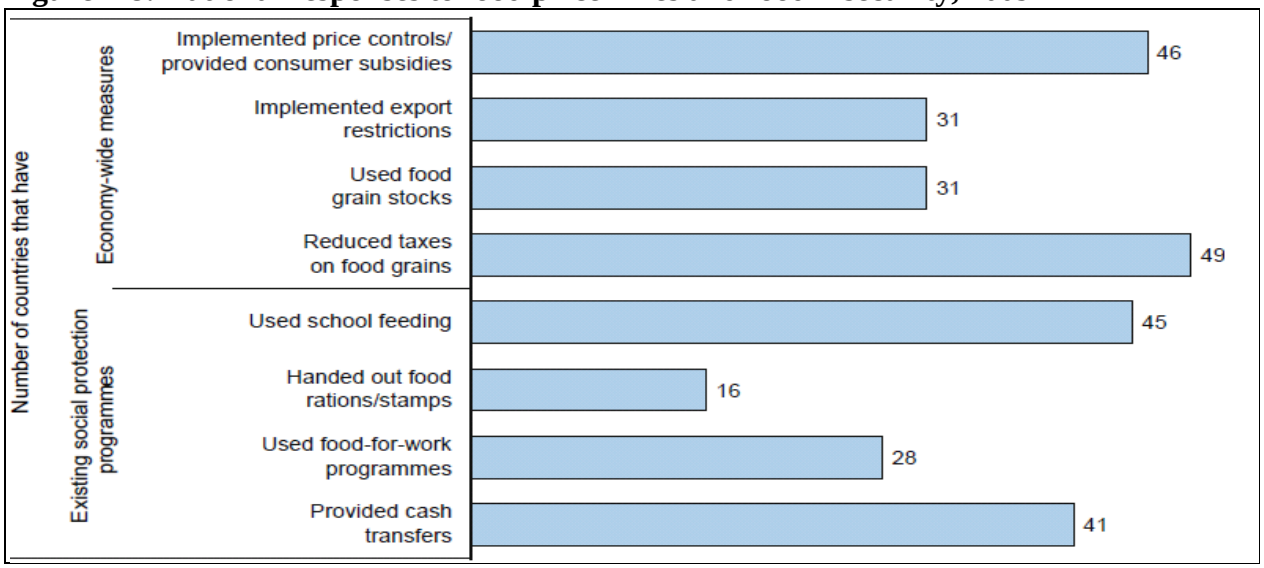
Source: FAO, 2015 http://www.**data**bank.worldbank.org/**data**/reports.aspx? : Accessed on 6th April, 2015

Roache (2010) notes that the global food price movements observed between 2003 and 2008, widely attributed to demand and supply factors, adversely affected Kenya's economy. Rapsomanikis (2009) attributes a significant contribution from the demand side to rapid increase in per capita income in the emerging economies, as well as increased demand for livestock feeds and bio-fuels in developed countries. On the supply side, the key factors were the protracted adverse weather conditions in some major food producing countries, and a decrease in productivity, mainly reflecting the secular fall in

the real price of agricultural output, which, in turn, had lowered incentives for investing in this sector. The same factors led to price escalations during the period 2010 – 2012.

In response to the 2007-2008 food price shocks, governments adopted different strategies depending on whether a country was a net food supplier or buyer as well as the nature of existing social protection programmes as shown in Figure 2-8.

Figure 2-8: National responses to food price hikes and food insecurity, 2009[16]



Source: Compilation based on World Bank online information, extracted March 2015. http://siteresources. world bank.org/NEWS/Resources/rising_chart_apr08.pdf.

Meijerink, *et al.,* (2009) observe that the Kenya government reacted to the food price surges using direct market intervention measures, notably lowering import taxes, imposition of export bans and direct price controls. Subsequently, the Price Control (Essential Goods) Act 2011 was enacted to regulate domestic market prices of essential commodities, including major cereals and oil products, in the bid to make them affordable and protect the livelihoods of the poor and vulnerable in the wake of the global

[16] Not all countries that are considered food insecure by the FAO and/or the WFP have taken measures. There are 91 countries that are reported to have taken intervention measures. These include 37 in Africa, 11 in East Asia and the Pacific, 17 in Eastern Europe and Central Asia, 9 in the Middle East and North Africa, 8 in South Asia and 9 in Latin America and the Caribbean.

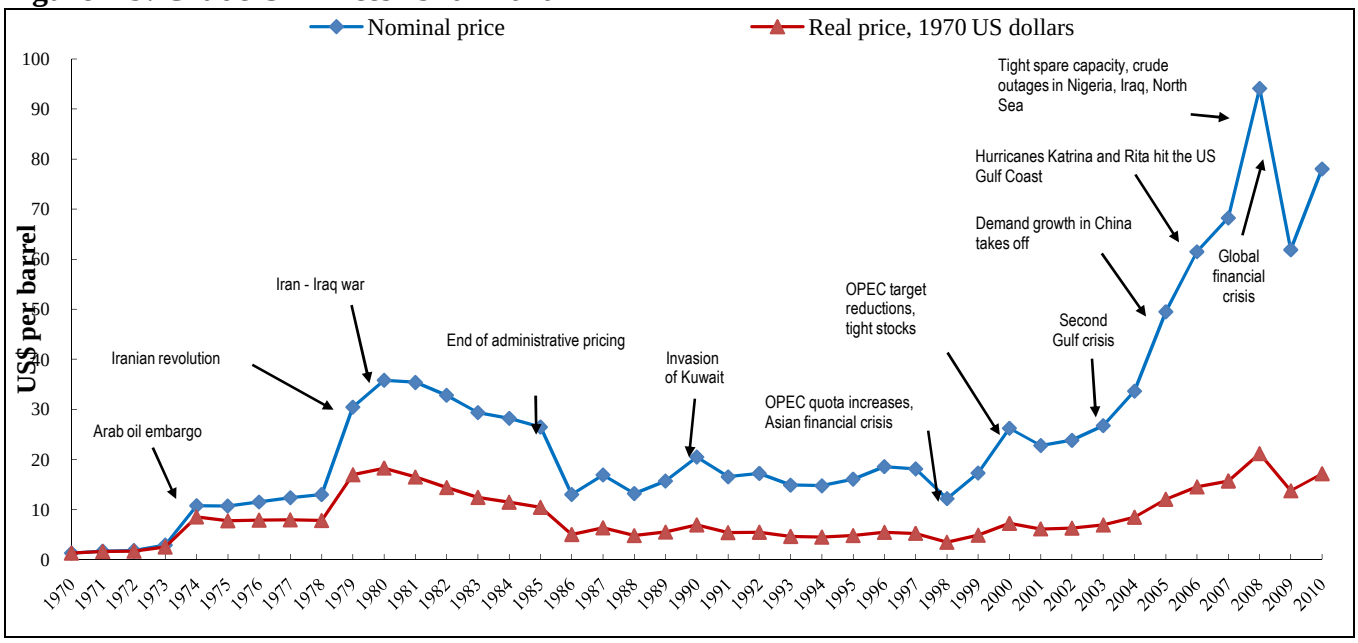
financial crisis and post-election violence. The other measures adopted by the government included agricultural input subsidy programmes to increase production and stimulate supply response (Government of Kenya, 2013a). However, these measures have been criticized by local producers and traders for failing to stimulate private investment in agricultural production.

However, there has been a persistent decline in international food prices since 2012. According to the World Bank's Food Price Watch (June, 2015), the international prices of all key commodities declined to different extents. For instance, international wheat prices dropped by 20 per cent, sugar by 28 per cent, maize by 6 per cent, rice by 18 per cent and Soya beans by 11 per cent. The drop in prices has been attributed to improvements in productions in both exporting and importing countries and rise in international reserves. Apparently, Kenya is a net importer of these commodities.

2.5.2 Episodes of Oil Price Shocks

The major global oil price shocks that affected domestic Kenyan prices can be described in terms of five major episodes, namely the oil embargo of 1973-1974 imposed by the Organization of Petroleum Exporting Countries (OPEC), the Iranian revolution of 1978-1979, the Iran-Iraq war which started in 1980, the first Persian Gulf War of 1990-91, and the global fuel price spike of 2007-2008 (IEA, 2007). Hamilton (2003a) suggests that all major fluctuations in the global oil prices can be attributed to disruptions in the production and supply in international markets triggered by political, economic and unforeseen natural events (see Figure 2-9).

Figure 2-9: Crude Oil Prices 1970 - 2010



Source: OECD Fact book 2011-2012.

The first oil crisis started in October 1973 when members of OPEC proclaimed an oil embargo which instigated the rise of the Arabian light prices from US$ 1.84 per barrel in 1972 to US$ 10.77 per barrel in 1974[17] (Hammes and Wills, 2005). The oil price shocks passed on to the Kenyan economy and adversely affected foreign exchange reserves coupled with fiscal deficit financing and increased import bills. The crisis was a major factor for the shift of policy to quantitative import restrictions, import-substitution, deeper foreign exchange controls, and the strengthening of the Price Control Act in 1972, ostensibly to align the price control system with the country's income policy and control of wages (Government of Kenya, 1986).

According to Hamilton (2003b), the second oil crisis occurred in 1978/1979 following the Iranian revolution and international prices rose to nearly US$ 40 per barrel from nearly US$ 10 per barrel. Iran had apparently defied the 1973-1974 Arab states

[17] 1 barrel is equivalent to approximately 158.9 litres of crude oil (OECD Fact book 2011-2012).

embargo and increased oil production, and it was experiencing big public protests. The protests spread to the oil industry and the strike by 37,000 workers, employed in the nationalized oil refineries, led to reduction in production from 6 million barrels per day to about 1.5 million barrels per day (about 7 per cent of world production). This was further prolonged into early 1980s following the Iraq - Iran war which reduced global oil production. These, together with other domestic factors, put many countries, including Kenya's economy under recessionary pressure.

Thereafter, prices declined gradually. In 1986, Saudi Arabia substantially increased its oil production, whereas the US and Europe reduced their demands. According to Rasmussen and Roitman (2011), oil price collapsed and greatly benefitted oil consuming countries, including developing countries like Kenya, which also coincided with the implementation of the structural adjustment programmes favouring government expenditure cuts and price de-controls within the economy.

The first gulf crisis in 1990 sparked off another shock which raised the international prices to a new peak. Crude oil prices started to decline in 1997 due to the impact of the Asian financial crisis and international prices remained under US$ 25 per barrel. Thereafter, prices started to rise in 1999 when OPEC countries reduced productions and tightened crude oil stocks. However, there was a short-lived sharp reduction in prices during the period 2001 and 2002 but the prices remained above US$ 30 per barrel due to expectation of the war in Iraq during the first quarter of 2003. In late August 2005, the Hurricane Katrina hit the eastern coast of the US Gulf of Mexico, which is a major producer of crude oil and international prices subsequently rose to US$ 60 per barrel.

Following increased demand for oil in emerging economies, especially China, international prices remained high during the years 2006 and 2007 and rose to US$ 96.50 per barrel. The price trend was attributed to several factors including depreciation of the US dollar, geo-politics of Asia and the Middle East, and the global financial crunch.

Killian and Vega (2011) stated that crude oil prices surpassed the distinctive US$ 100 per barrel level in early 2008, and rose to a new all time peak of US$ 150 per barrel in July 2008. However, prices fell to US$ 40 per barrel at the beginning of the year 2009 due to reduced demand following the onset of the global financial crisis. Later in the year, prices stabilized to a range of US$ 70 and US$ 80 per barrel, before rising to US$120 a barrel in March 2012 (Samya, *et al*., 2012). Due to the direct effects of international price swings in the domestic economy, the government enacted the Legal Notice No. 196 under the Energy (Petroleum pricing) Regulations 2010 in a bid to smooth domestic petroleum prices from international price shocks and cushion investors from possible losses.

The above historical account indicate that international price swings of international food and crude oil prices are widely reflected in domestic prices in Kenya. Hence, a profound theoretical understanding and associated empirical evidences of how world food and crude oil price signals are transmitted to the domestic economy and understanding the distributional effects price changes is essential. The next chapter is dedicated to the theoretical and empirical reviews of the international and domestic market price transmission mechanisms undertaken in this study.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

This chapter contains four sections: the introduction, theoretical literature on pass-through elasticity of price transmission, theoretical literature on import demand models and previous empirical studies. The aim is to provide a comprehensive review of the foundations of the theories and methods behind the literature on price transmission and market integration. Together, these form the basis for comprehending how external market price signals can influence domestic market prices.

It may be recalled that the first and second objectives of this study are to estimate the substitutability between domestic and imported products and the degree to which changes in international food and oil prices are transmitted to the domestic market, respectively. The linkages between prices of imports and domestic products, and by extension the factor prices and incomes, is broadly looked into from the pass-through elasticity and the import demand approaches. The former explores how upstream prices or those quoted in higher markets affect those in lower markets with special focus on price transmission and the law of one price (LOP)[18]. The indicators for price transmission are measured in terms of transmission elasticities. The latter is defined as the percentage change in the price in one market given a one per cent change in price in another market. The price transmission elasticity is important in denoting the extent of market integration (Minot, 2011). A review of empirical techniques, including correlation coefficient,

[18] LOP says that foreign and domestic prices of a commodity are equal when both are expressed in the same currency and adjusted for transaction costs.

regression, co-integration and causality, and vector auto regression (VAR) models is carried out. The evolution of analytical techniques is largely motivated by criticisms labeled against some of the assumptions made under various methods. For instance, evidence about non-linearity contrary to the assumption of linearity in price series and new information, including the role of market power, transactions costs, trade flow information about prices, and variations in data frequencies inspire new researches.

Subsequently, the theoretical literatures on import demand models are reviewed. Import demand models estimate import demand elasticities or the degree to which imported and domestically produced goods substitute one another in demand. The choice of the import demand approach is motivated by the reason that international trade may reinforce or offset demand shocks including preference shocks, tastes and government expenses depending on the nature of trade between countries. The neoclassical trade theories, the Keynesian framework, and the new trade theory, provide the framework for the review of import demands in international trade literature. According to the trade theories, the demand for imports can be modeled using relative incomes and prices in a market economy. The elasticity estimates are crucial parameter inputs into the computable general equilibrium model, which is afterward used to address the other objectives of this thesis.

Specifically, there is greater focus on the imperfect substitute model, which is more suitable in the context of this thesis. Unlike the perfect substitute models, the former takes into account the cross-hauling of products, whereby the same commodities are exported and imported by the same country simultaneously. If this was not the case, then each country would specialize in either importing or exporting a particular good at a

given time period. Hence, in the case of imperfect substitute model, the law of one price need not hold. In actual sense, demand for imports is determined by several factors, including preference factors such as product designs, sizes and durability, as well as foreign prices, incomes and availability of foreign exchange. However, detailed discussions on these are outside the scope of this thesis.

3.2 Theoretical Literature Review

3.2.1 Price Transmission and the Law of One Price

The analyses of price relationships began with Cassel (1918) who introduced the concept of purchasing power parity (PPP), implying that national prices are equal at aggregate levels when expressed in the units of one common currency. An integral part of the PPP is the law of one price (LOP) in which individual commodity prices, in spatially separated markets, are equal when adjusted for foreign currency exchange rates and transportation costs (Baffles, 1991; Mohanty, et al., 1998). Furthermore, Ardeni (1989) noted that when there is disparity between the prices, an opportunity for arbitrage arises, and arbitrageurs will actively seek profit by transferring goods from lower to high priced markets, until prices are equalized in the respective markets[19].

Mathematically, the PPP and LOP can be expressed as in equation (3.1) in absolute terms[20].

$$P_t^d = P_t^f * E_t^{d/f} \quad \text{.....(3.1).}$$

[19] The 9th edition of the Concise Oxford Dictionary (1995) defines arbitrage as buying and selling of stocks or bills of exchange to take advantage of varying prices in different markets.

[20] From a mathematical standpoint, the models between LOP and PPP are interchangeable, where LOP concentrates on price of a particular good from an overall basket of goods that comprises the price level which is tested by PPP.

where P_t^d and P_t^f are domestic and foreign price levels respectively, $E_t^{d/f}$ is the exchange rate between the domestic and foreign currency and subscript "t" refers to the time period. If equation (3.1) does not hold, then an opportunity for arbitrage exists. The relative version of the PPP examines the relative percentage changes in aggregate price levels over time, and expressed as equation (3.2).

$$\%\Delta P_t^d = \%\Delta P_t^f + \%\Delta E_t^{d/f} \quad \text{.....(3.2).}$$

Later on, the Enke-Samuelson-Takayama-Judge (ESTJ) equilibrium model postulate that when a commodity is sold in competitive foreign and domestic markets, full price transmission of prices take place and deviate from each other by the amount of transfer costs, when converted to a common currency (Amikuzuno and Ogundari, 2013)[21]. The ESTJ model predicts market integration through changes in supply and demand conditions in one market, which affect trade and therefore, prices in other markets. In consequence, equilibria are restored through spatial arbitrage. Thus, by causing prices in different markets to converge, arbitrage ensures that commodities trade in the same price in all markets.

Fossati, *et al.* (2007) note that trade between two regions take place, under the assumption of perfect competition, if the import price plus transport cost equals the export price. Such markets are said to be fully integrated into one, if a price change in the export market induces an equal change in the import market[22]. Baffes and Ajwad (2001) argued that incomplete price transmission also occurred due to high transaction costs as a result of poor transport and communication infrastructure and policy distortions

[21] The ESTJ model was developed by Enke (1951); Samuelson (1952); and Takayama and Judge (1971).
[22] A market is an area within which the price of a commodity tends to be uniform. Where allowance is made for transportation costs, market integration refers to adherence to the law of one price (Stigler, 1969).

introduced by government interventions in the forms of domestic price controls, import tariffs, quotas and subsidies.

Furthermore, Sexton, *et al.* (1991) indicate poor state of physical infrastructure, transport and communication services also give rise to large marketing margins. This is because they raise the costs of delivering imported commodities to the domestic market for consumption, and insulate domestic markets from increases in international prices. Under these circumstances, changes in world market prices are not fully transmitted to domestic prices and economic agents partially adjust to shifts in world supply and demand (Taylor, *et al.*, 2001; Taylor, 2003). Moreover, Badiane and Shively (1998) argue that non-competitive trade practices, such as oligopolistic behaviour and collusion among domestic traders, have the tendency to maintain higher price differences between international and domestic prices than those determined by transfer costs.

3.2.2 Econometric Approaches to Price Transmission

(a) Simple Regression and Correlation Coefficient Analysis

The simple regression and correlation coefficient analysis are among the oldest methods used in studying price transmission (Dercon, 1995). In these methods, a high correlation coefficient between domestic and international prices indicates co-movement of the prices and is a sign of an efficient market. According to Amikuzuno and Ogundari (2013), bivariate correlation models (BCM) test for the existence of LOP. The model measures the degree of market integration and co-movement of a set of prices when transfer costs are held constant. For instance, suppose P^i_t and P^j_t are two sets of prices in markets (i) and (j), respectively which are connected by trade for a homogenous

commodity and (t) is the time period, the correlation coefficient (r) is obtained by equation (3.3).

$$r = \frac{cov\left(p_{t,}^{i}\, p_{t}^{j}\right)}{\sqrt{var(p_{t}^{i})var\left(p_{t}^{j}\right)}} \quad \text{.....(3.3).}$$

On the other hand, the bivariate regression models (BRM) of price transmission and market integration are commonly specified in equation (3.4) (Amikuzuno and Ogundari, 2013).

$$P_{t}^{i} = \beta_0 + \beta_1 p_{t}^{j} + \beta_2 T_t + \beta_3 R_t + \varepsilon_t \quad \text{.....(3.4).}$$

where P^{i}_{t} and P^{j}_{t} are the prices in markets (i) and (j) respectively and can either be differenced or in logarithmic form. T_t is transaction cost and R_t denotes other factors influencing prices. The β's are the coefficients to be estimated. The two markets are taken to be perfectly integrated if

$\beta_1 = \beta_2 = 1$ and $\beta_0 = 0$.

However, static models have certain fundamental limitations which make them inappropriate, although they are easy to estimate using only price data. To begin, their assumption about stationary price behaviour and fixed transactions costs makes them underestimate the extent of market integration (Barrett and Li, 2002; Baulch, 1997; Fackler and Goodwin, 2001). In addition, static models do not consider non-linearity in market relationships due to arbitrage conditions, unsynchronized price cycles, discontinuous trade and non stationary transfer costs. These assumptions render linear representations and models not useful and inaccurate. Finally, the coefficients can sometimes be high, even if no trade exists between the two markets, if the prices in the

two markets are affected by the same factors, namely inflation and seasonal movements (Timmer, 1974; Golleti and Babu, 1994).

(b) The Dynamic Models

Fackler and Goodwin (2001) refer to dynamic market integration models as the dynamic time-series properties of data. They argue that contrary to stationarity assumption in static models, market prices are quite often non-stationary in time series analysis. This implies that they randomly drift apart when disturbed rather than return to a mean value. Thus, the best estimates for future prices are the current prices. Under the circumstances, a given pair of non-stationary variables may have a statistically significant relationship, yet they are actually unrelated to each other when a large sample is considered. Taylor, *et al.* (2001) portend that dynamic market integration models account for the dynamic nature of prices and transaction costs by lagging dependent variables in their specifications. Hence, unlike the static approaches that merely investigate whether markets are integrated or segmented, the dynamic methods go further by estimating the speeds of price adjustment. The commonly used dynamic models in market integration analysis are presented as follows:

(i) Granger Causality Tests

Granger (1969) causality test shows whether there exists transmission of prices between two markets and the direction of the causality of such transmission. For instance, considering two prices p^i and p^j for two markets (i) and (j), respectively, p^i is said to granger-cause p^j if both current and lagged values of p^i improve the accuracy of forecasting p^j (Judge, *et al*., 1988). Conventional Granger causality models are stated as in equations (3.5) and (3.6).

$$P_t^i = \sum_{k=1}^{n} a_k \, p_{t-k}^i + \sum_{k=1}^{n} b_k \, p_{t-k}^j + \varepsilon_{it} \quad \text{.....(3.5).}$$

$$P_t^j = \sum_{k=1}^{n} c_k \, p_{t-k}^i + \sum_{k=1}^{n} d_k \, p_{t-k}^j + \varepsilon_{jt} \text{.....(3.6).}$$

where $p^i$and p^j stand for prices in the domestic market (i) and the international market (j), respectively. The unknown parameters a_k, b_k c_k and d_k are the corresponding coefficients of the *k-th* included lagged prices (k = 1, 2, ……,, n) and ε_{it} and ε_{jt} represent unobservable serially independent market shocks. Equation (3.5) postulates that current prices in country i or p^i is related to past values of itself as well as that of country j or p^j and (3.6) postulates a similar behaviour for the variable p^j.

Gupta and Mueller (1982) distinguish four possible causal directions between (i) and (j) which can be identified from the granger causality model. First, the unidirectional causality in which market i uses information from market j in the price formation process, whereas market i does not use the corresponding market information from market i. Thus, (j) granger causes (i) but (i) does not granger cause (j) in this case $\sum b_k \neq 0$ but $\sum c_k = 0$ in equations (3.5) and (3.6), respectively. Second, the converse also holds, that is (i) granger causes (j) but (j) does not granger cause (i). This implies that $\sum c_k \neq 0$ but $\sum b_k = 0$ in equations (3.5) and (3.6), respectively. The presence of unidirectional causality signifies informational inefficiency and provides an opportunity for extra-normal profits from arbitrage. Third, is the feedback or bilateral causality which occurs when $\sum a_k$, $\sum b_k$, $\sum c_k$ and $\sum d_k$ are all different from zero in both regressions. In this case, each market employs equivalent information from other market in forming price expectations and information from one market cannot be profitably exploited in the other market. Lastly, when no market uses information from any other, the markets are independent

and in this case, $\sum b_k$ and $\sum c_k$ are both equal to zero. Independence of markets is possible when transfer costs between them are prohibitively high.

However, Witzke, *et al.* (2011) noted that the granger causality approach is criticized by many authors for neglecting non-stationarity of time series data and that it merely suggests the presence of integration between two markets if shocks are transferred between them. In addition, it does not capture the driving forces behind the direction of causality, or the magnitude of the coefficients of the market prices. Besides, Fackler and Goodwin (2001) question the validity of the lead and lag causality assumption on grounds of the dynamics in the price adjustments with respect to the existence of delivery lags.

(ii) Ravallion and Timmer Models of Market Integration

In Ravallion's (1986) model, several small markets are linked to one large central market. In this model, market integration is tested by examining whether the price of a commodity in a given producer market is influenced by its price in the central market. The current price of the commodity in the peripheral market is regressed on its lags and on the current and lagged prices of the central market. The variant of Ravallion's model is shown in equation (3.7).

$$P_{it} = \sum_{j=1}^{n} a_{ij}\, p_{it-j} + \sum_{j=0}^{n} b_{ij}\, p_{1t-j} + c_i X_{it} + \varepsilon_{it} \quad \text{.....(3.7).}$$

for all i = 2, 3,....., N. a_{ij}, b_{ij} and c_i represent parameter estimates, j (j= 1, 2,....., n) stands for the lag length and X_i denote a vector of other factors that influence prices in the local markets. If $b_{ij} = 0$, market segmentation exists, since the prices in market (1) does not influence those for market (i). On the other hand, if $b_{ij} = 1$, immediate transmission of price shocks take place. Thus, there is a "strong" short run integration if

b_{i0} = 1 and $a_{ij} = b_{ij} = 0$ for any $j > 0$ (the lagged prices have no influence). In addition, "weaker" short run market integration exists if $\sum_{j=1}^{n} a_{ij} + \sum_{j=0}^{n} b_{ij} = 0$, that is, the effects of the lagged price in the central market and the lagged price itself cancel each other out in general. Hence, for the long run integration to be existent, the equivalence of equation (3.8) holds.

$$\sum_{j=1}^{n} a_{ij} + \sum_{j=0}^{n} b_{ij} = 1 \quad \text{.....(3.8).}$$

In the Timmer's (1987) model, the assumption is made that the central market price is predetermined relative to the regional market prices. The model makes two modifications to the Ravallion model: first, taking the logarithm of the prices and second, using a single lag rather than six as is the case with Ravallion (1986). Timmer's specification is shown in equation (3.9).

$$P_t^i = C_0(p_t^1 - p_{t-1}^1) + (C_0 + C_{1i})p_{t-1}^1 + C_{11}p_{t-1}^i + \gamma X_{it} + \varepsilon_{it} \quad \text{.....(3.9).}$$

It is assumed that $\gamma = 0$, while $C_0 + C_{1i}$ and C_{11} represent the contributions to the history of current prices in the central and regional markets, respectively. However, Witzke, *et al.* (2011) casts doubt on whether international commodity markets are spatially integrated based on these models.

(iii) Impulse Response Functions

Impulse Response Functions (IRFs) refer to the effects of exogenous shocks to the variables in the moving average representation of a VAR system (Sims, 1980). Considering a system of k prices, the set of impulse responses can be represented in equation (3.10).

$$P_{t+n} = \sum_{k=0}^{\infty} m_k \, e_{t+n-k} \quad \text{.....(3.10).}$$

where t is time, n is the period ahead, k = (0, 1,2,....., ∞) indicates lagged periods, P_{t+n} is the vector of prices, m_k is the k^{th} coefficient matrix of the MA representation and represent the unit shocks in the variables in the system.

According to Goodwin and Piggot (2001), IRFs examine whether a price series converges quickly after an exogenous shock or not. Thus, if an exogenous shock to prices in one market evokes an equilibrating response in the prices of the other market, the two markets can be deemed to be integrated. However, IRFs provide a very general view of market integration and can as well be interpreted as either dynamic disequilibrium adjustments or equilibrium adjustments to ongoing changes in the economic fundamentals. It is therefore difficult to identify the correct interpretation using price data alone (Goodwin, *et al.*, 1999).

(iv) Cointegration Models

Following Ravallion's (1986) seminal work, cointegration models are used to estimate and test long run equilibrium relationships between nonstationary variables (Engle and Granger, 1987 and Johansen, 1991). The models presuppose that observable variables, which exhibit nonstationary behavior, maintain long-run relationships and that the residuals of their cointegrating equation are stationary (Mohanty, *et al.*, 1998). Cointegraton models are based on the Law of One Price (LOP), which is the fundamental theoretical basis for price transmission and market integration (Perman, 1991). The LOP can be written as equation (3.11).

$$P_w - P_d \leq t \quad \text{.....(3.11).}$$

where p_w and p_d represent the prices of commodities in the world market and the domestic market respectively, and *t* represents the transaction costs associated with

importing or exporting the commodity. According to Equation (3.11), the gap between the international and the domestic prices of a commodity is to be smaller than or equal to the transaction costs involved.

Rapsomanikis, *et al.* (2003) explain that when spatial arbitrage occurs, the difference between the prices in the two markets move towards the transaction cost. When a shock hits one of the markets, the prices in the respective markets may drift apart initially. This is because the shocks may not be transmitted instantaneously to other markets due to delays in transport. In the long-run, arbitration makes it possible for the prices to converge given the underlying long run equilibrium relationship.

According to Prakash (2011), the co-integration of a pair of markets occurs if prices in the markets converge in the long run towards the LOP. Suppose two prices p_{1t} and p_{2t}, in spatially separated markets, contain stochastic trends and are integrated of the same order, say I(d). Then the prices are considered to be cointegrated if there exists some value β such that equation (3.12) is integrated of order zero.

$$P_{1t} - \beta p_{2t} = \mu_t \quad \text{.....(3.12).}$$

where β represents the co-integrating vector in the case of two price variables and μ_t represents the error term. There exists co integration between the two prices if they move closely together in the long run although they may drift apart in the short run.

Cointegration analysis is commonly carried out using the Engel and Granger's (1987) bivariate analyses and the Johansen's (1991) variance autoregressive (VAR) multivariate analyses approach. The analysis starts by testing unit roots in the price series individually under a null hypothesis of unit roots. This can be done by using the Dickey-Fuller (DF) and Augmented Dickey-Fuller - ADF (Dickey and Fuller, 1979), or the

Phillips-Perron - PP (Phillips and Perron, 1988). The Engle and Granger (1987) procedure involves testing the null hypothesis of no cointegration by applying unit root tests on the error term (u_t)[23] .

Johansen (1991) proposed an alternative approach that does not suffer from the above draw-backs, namely the trace test and the maximum eigen value test for testing co integrating relations. The trace statistic tests the null hypothesis that there are "r" cointegrating relations against the alternative of "m" cointegrating relations. Thus, we test

H_O : K = r
H_A : K = m, where m > r

To test the existence of cointegration, r is set equal to zero implying no cointegation and examine whether the null hypothesis can be rejected. If this is the case, then we conclude there is atleast one cointegration relationship. On the other hand, the maximum eigen value tests the null hypothesis that there are "r" cointegrating relations against the alternative of "r + 1" cointegrating relations. Thus, we test

H_O : K= r
H_A : K = r+1

So starting with r equals zero, and rejecting the null hypothesis implies that there is only one possible combination of the nonstationary variables to yield a stationary process.

According to Nkendah and Nzouessin (2006), if prices p_{1t} and p_{2t}, from two spatially separated markets, respectively are cointegrated, then the Vector Error Correction Model (VECM) is represented by equation (3.13).

[23] Davidson and Mackinon (2004) report that the Phillips–Perron test performs worse in finite samples than the ADF test.

$$\begin{pmatrix}\Delta P_{1t}\\ \Delta P_{2t}\end{pmatrix}=\begin{pmatrix}u_1\\ \mu_2\end{pmatrix}+\begin{pmatrix}\alpha_1\\ \alpha_2\end{pmatrix}(p_{1t-1}-\beta p_{2t-1})+A_2\begin{pmatrix}\Delta p_{1t-1}\\ \Delta p_{2t-1}\end{pmatrix}+\cdots+A_k\begin{pmatrix}\Delta p_{1t-k}\\ \Delta p_{2t-k}\end{pmatrix}+$$

$$\begin{pmatrix}v_{1t}\\ v_{2t}\end{pmatrix}\text{.....(3.13).}$$

where v_{1t} and v_{2t} represent independently and identically distributed disturbances with zero mean and constant variance. The operator Δ denotes that the price variables have been differenced and are stationary. The parameters contained in matrices A_2, ..., A_k, measure the short run effects, while β is the cointegrating parameter that characterizes the long run equilibrium relationship between the two prices.

Tharcisse and Francois (2013) state that the levels of the variables enter the ECM combined as the single entity (p_{1t-1} - βp_{2t-1}). This combination reflects the errors or any deviations from equilibrium and also corresponds to the lagged error term of equation (3.13). In this model, the vector $\begin{pmatrix}\alpha_1\\ \alpha_2\end{pmatrix}$ contains parameters, usually $0 < |\alpha_i| < 1$, i = 1,2, referred to as error correction coefficients, that measure the extent of corrections of the errors that the market initiates by adjusting p_{1t} and p_{2t} to restore the long run equilibrium relationship. The speed with which the market returns to its equilibrium depends on how close the parameter α_i is, to one. In addition, the short run adjustments are consistent with the long run equilibrium relationship, and allow for assessment of the speed of adjustment, which shapes the relationship between the two market prices.

Rapsomanikis, *et al.* (2003) support the view that ECM models are suitable for testing gradual rather than instantaneous price transmission and take into account disruptions of trade and other impediments to market integration over time. Furthermore, the framework can be used to assess the extent to which government policies, transaction costs and other distortions may delay full adjustment to equilibrium in the long run.

Failure to reject the null hypothesis implies that the two prices drift apart in the long run, and are driven by stochastic trends that are not proportional.

The other test, which is complementary to unit root test, is the Kwiatkowski–Phillips–Schmidt–Shin (KPSS). The latter examines whether an observable time series is stationary around a deterministic trend (Kwiatkowski, *et al*., 1992). Nakajima, *et al*. (2011) argue that by testing both the unit root hypothesis and stationarity hypothesis, one can distinguish series that appear to be stationary, have a unit root, and whose data is not sufficiently informative to ensure they are stationary or integrated.

Ardeni (1989) challenged the results of past studies that rely on econometric models to test the LOP on grounds that the variables used in the analysis are non-stationary. Besides, econometric approaches rely on use of information on prices only and the relationship that exist between price differentials and transport costs. Thus, the factors that affect market integration and price transmission are not taken into account. Lastly, transaction costs create a band in which the prices move independently of each other and inhibit direct arbitrage.

(c) Switching Regime Regression Models

Switching regime models (SRM) predict the regulatory structure governing trade on the basis of information on prices and transport costs (Listorti, 2013). The SRM models overcome the weaknesses associated with conventional tests that rely on price data alone, without considering the role played by transport and transfer costs. By using information on trade flows, Sexton, *et al.* (1991) studied a market which was linked by unidirectional trade and developed a switching regime model in which arbitrage

conditions may be violated; transport costs are estimated endogenously. The most commonly used switching regime models are discussed herein below.

(i) The Error Correction Models

The error correction model (ECM) developed by Engel and Granger (1987) is an extension of the co-integration model that directly estimates the speed at which a variable returns to its equilibrium level, after a change in one or many independent variables. For instance, if two market prices P_t^i and P_t^j are co-integrated, then the equilibrium relationship between them can be specified as equation (3.14).

$$P_t^i - \beta p_t^j - \beta_0 = \varepsilon_t \quad \text{.....(3.14).}$$

where β_0 is a constant term and ε_t represents the error term. If the latter follows an autoregressive (AR) process, then equation (3.15) holds:

$$\varepsilon_t = \alpha\varepsilon_{t-1} + e_t \quad \text{.....(3.15).}$$

where e_t is the error term with mean zero and constant variance. Thus, the equilibrium relationship between P_t^i and P_t^j can be expressed as equation (3.16).

$$P_t^i - \beta P_t^j - \beta_0 = \alpha\varepsilon_{t-1} + e_t \quad \text{.....(3.16).}$$

where e_t is the error term and ε_{t-1} is the deviation from long run equilibrium called the error correction term (ECT). On the other hand, α refers to the measure of the response of P_t^i and P_t^j to deviation from equilibrium. Equation (3.16) implies that the long run relationship (co-integration) between the two prices, that is, P_t^i and P_t^j is a function of the autoregressive process ε_t.

The application of error correction models to price transmission studies have been extended to asymmetric error correction (EC), vector error correction model and switching vector error correction models (Ihle and Cramon, 2008). For instance, Ackah,

et al. (2012) investigated the nature of price transmission from world markets for rice, maize and groundnuts to domestic market in Ghana. They found significant and positive effects of world prices on domestic prices, with a complete pass-through for maize and rice in the long-run.

(ii) Threshold Autoregressive Models

The Threshold Autoregressive (TAR) models take into consideration the influence of transaction costs in spatial markets. However, they do not necessarily use actual transaction costs data in their estimations (Amikuzuno, 2010). The basic assumption in the TAR models is that prices will show a tendency to return to their long run equilibrium, if and only if, the price differentials between any two sets of prices exceed a certain threshold level (Goodwin and Piggot, 2001). A classical form of a TAR model is specified as equation (3.17).

$$\Delta P_t = \begin{cases} \{\alpha^1 \Delta p_{t-i} + \theta^1 \varepsilon_{t-1} if\ |\varepsilon_{t-1}| \leq c\} \\ \{\alpha^2 \Delta P_{t-i} + \theta^2 \varepsilon_{t-1} if\ |\varepsilon_{t-1}| \leq c\} \end{cases} \quad \text{.....(3.17).}$$

where Δ refers to the differencing operator, P_t refers to the vector of prices being analyzed, c denotes the value of the threshold giving rise to the alternative regimes and ε_{t-1} refers to the variable used to capture the behaviour of the threshold (Juvenal and Taylor, 2008). There are, however, a few problems that TAR models fail to address. For example, transaction costs may differ across sectors hence, the speed of arbitrage may as well differ across goods. Such a scenario creates unclear effects at an aggregate level as argued by Taylor, *et al.*, (2001) and Taylor and Taylor, (2004).

(iii) Parity Bound Models

The Parity Bound Model (PBM), which was introduced to price transmission and market integration analysis by Baulch (1997), takes transaction costs into consideration

and also permits reversal of trade flows to take place. Overall, these models analyze how markets are integrated during certain periods and not in other periods and also how transfer costs vary between periods. Thus, different regimes in the PBM model can be described in terms of the size of price spreads and the transfer costs as follows: Assuming $|P_{1t} - P_{2t}|$ is a price differential, C_{12} the transfer cost, U_{1t} and U_{0t} are additional error terms inside and outside the parity bounds, respectively.

Regime 1: $|P_{1t} - P_{2t}| = C_{12}$ is an efficient arbitrage in which the price difference between P_{1t} and P_{2t} is exactly at the parity bound, where as the transfer cost is equal to the market price differential.

Regime 2: $|P_{1t} - P_{2t}| = C_{12} - U_{1t}$. In this regime, the price difference lies inside the parity bounds. When this happens, transfer costs exceed the inter-market spread and trade will not therefore take place.

Regime 3: $|P_{1t} - P_{2t}| = C_{12} + U_{0t}$. The price difference lies outside the parity bound and the price spreads exceed the transfer costs leading to trade.

The original PBM model takes the form of a maximum likelihood function and is specified as in equation (3.18).

$$L = \prod_{t=1}^{r}[\lambda_1 f_t^1 + \lambda_2 f_t^2 + (1 - \lambda_1 - \lambda_2) f_t^3] \quad \text{.....(3.18).}$$

where λ_1 and λ_2 represent the estimable probabilities of the market being in regimes 1 and 2 respectively, 1- λ_1 - λ_2 represent the probability of the market being in regime 3.

(iv) Markov Switching Models

The standard markov-switching model is a non-linear time series model following Hamilton (1989). The equations in the model portray how the times series data behave under different regimes. Suppose y_t is unobservable state variable assuming the value of

0 and 1. A simple markov-switching specification of the autoregressive process for y_t in a two-regime case is:

$Y_t = \alpha_0 + \phi\, Y_{t-1} + \varepsilon_{1t}$ $s_t = 0$ if system is in regime 1

$Y_t = \alpha_0 + \alpha_1 + \phi\, Y_{t-1} + \varepsilon_{2t,}$ $s_t = 1$ if system is in regime 2

where $|\phi| < 1$ and $\varepsilon_{it,}$ i = 1,2 are i.i.d. random variables with mean zero and variance $\sigma^2_{\varepsilon\, i}$. This is a stationary autoregressive (AR(1)) process with mean $\alpha_0/(1-\phi)$ when $s_t = 0$ and switches to another regime 2, when $s_t = 1$ with the AR(1) process having a mean of $(\alpha_0 + \alpha_1)/(1-\phi)$. The model is characterized by two dynamic structures, provided $\alpha_1 \neq 0$ and depends on the value of the state variable s_t.

However, the switching regime models have some common drawbacks. According to Barret and Li (2002), they do not illustrate the speed of price adjustment. In addition, when trade data is not considered, the analysis suggests lack of market integration irrespective of its causes. A more fundamental problem associated with switching regime models is the interpretation that the regime changes depend on underlying distributional conditions (Fackler and Goodwin, 2001).

3.2.3 Import Demand Approaches to Price Transmission

3.2.3.1 Theoretical background

The traditional formulation of import demand model suggests an analysis of import demand relations based on the consumer theory of demand. In this model a household chooses the bundle of consumption goods that maximize his/her utility, and then allocates the chosen bundle between domestically produced and imported goods.

According to Bobić (2010), the theory suggests two basic trade models: the perfect substitute model and the imperfect substitute model. The perfect substitute model

assumes that there is perfect substitution between domestically produced and foreign goods. This assumption implies that at any given time period, each country can only either be an exporter or an importer of a traded good. The perfect substitute model is suitably analyzed using partial equilibrium tools, where the empirical relationships between international and domestic prices are examined, while assuming goods in question are homogeneous and trade in a particular good is assumed to take place in one direction.

The imperfect substitute model on the other hand, assumes that imported goods are not perfect substitutes for domestically produced goods. This condition reflects the fact that the goods market comprises a mix of domestic and foreign goods. Thus, it is neither filled completely with domestic nor foreign goods. Thus, the imperfect substitute model gives provision for cross-hauling of products where similar commodities are simultaneously exported and imported by the country due to the existence of product differentiation and aggregations. Algieri (2004) empirically confirmed that the imperfect substitute assumption holds for such products in the short and long run.

International trade literature on how changes in landed prices of imports affect domestic prices can be looked at from three broad perspectives: first, classical trade theories consisting of Adam Smith's theory of absolute advantage and Ricardo's theory of comparative advantage; second the neoclassical trade theories which argue that trade between two countries take place due to differences in factor endowments. A classic example of this is the Heckscher-Ohlin theory of trade; the third and latest are the contemporary new trade theories or the imperfect competition theories of trade which comprise increasing returns to trade and preferences for varieties (Bathalomew, 2008;

Xu, 2002). The classical trade theories are generally based on microeconomic analysis and focus on how the volume and direction of international trade are affected by changes in relative prices. The latter are in turn explained by differences in factor endowments. The basis for trade between countries according to Adam Smith's theory of absolute advantage is the differences in the productivity of labour, that is, a country exports the product in which it has a higher labour productivity[24]. Bahta and Jooste (2005) note that if each country could produce one or more commodities at a lower real cost than its trading partners, then each country will benefit from specialization in those commodities in which it can produce at lower real cost than another country. In addition, when countries are engaged in inter-industry trade based on comparative advantage, there seems to be weak synchronization, and the impacts of shocks may be relatively small. However, if trade is intra-industry in nature, or if trade takes place in differentiated products, greater trade integration is likely to strengthen synchronization, and shocks in one country are likely to have greater impacts in the trading partners' economies (Karimi and Tavakoli, 2010; Kose and Reizman, 2001).

On its part, the Ricardian theory is based on the principle of opportunity cost and says that a country will export the goods and services that it can produce at a lower opportunity cost in return for imported products that it would otherwise produce at a higher one (Pugel, 2012).[25] This is consistent with Feenstra's (2004) argument that it would still be mutually beneficial for both countries to trade even if one nation is less

[24] According to Adam Smith, all value was determined by and measured in terms of hours of labour. Thus, labour productivity is the units of output that a worker can produce in 1 hour or alternatively, the number of hours that it takes a worker to produce one unit of output.

[25] The opportunity cost of producing more of a product in a country is the amount of production of the other product that is given up and it exists because production resources must be shifted from the other product to this product.

efficient than the other in the production of both commodities, so long as differences in relative costs of production exist. The other framework explaining the basis for international trade is the Heckscher-Ohlin (H-O) model which comprises two countries trading with each other, two goods being produced and two factors of production. The H-O model predicts the pattern of trade based on differences in factor endowments, whereby each country will export the good that uses its abundant factor most intensively[26].

Two other theorems are embedded in the H-O model of international trade. One is the Stolper-Samuelson theorem developed in 1941 in which an increase in the relative price of a good will increase the real return to the factor used intensively in the production of that good and reduce the real return to the scarce factor (Bahta and Jooste, 2005; Feenstra, 2004). The other is the Rybcynski theorem of 1955, where an increase in a factor endowment will increase the output of the industry using it intensively, and decrease the output of the other industry through changes in commodity and factor prices. Overall, the gist of these theorems is that international trade has strong distributional consequences within an economy though price linkages and trade transactions make some people worse off and others better off.

In the Keynesian framework, relative prices of goods and services tend to be rigid while employment levels vary across sectors and between countries and the general idea is the relationship between income and demand for imports at the aggregate level.

[26] The HO model was published in 1991 by Flam and Flanders from the original separate article by Heckscher (1919) and Ohlin's dissertation (1924).

Under the new trade theories, there exist broader linkages between trade and income levels as well as the effects of economies of scale, product differentiation, and monopolistic competition on international trade (Krugman, 1980).

According to Bathalomew (2008), the imperfect competitive market effects on trade can be looked into from three perspectives: the Marshallian approach which assumes constant returns at firm level but increasing returns at industry level; the Chamberlain approach which assumes that an industry consists of many monopolistic firms and new firms are able to enter the market and differentiate their products from existing firms; and, the Cournot approach which assumes that a market with only a few imperfectly competitive firms where each takes the others outputs as given.

3.2.3.2 Econometric Approaches to Import Demand Models

(a) Compensating Variation

Compensating variation (CV) refers to the amount of money sufficient to compensate households following price changes and it enables the return to the initial levels of utility (Friedman and Levinsohn, 2002). This approach uses household survey data for the period prior to the on-set of price increases to compute budget shares of individual commodities or aggregates per household (W_{ih}). Then, it merges this data with price change data for selected consumption items (Pi) observed over a specified period of time. Given a price increment, the higher the budget share of a household for a given good or service, the higher the CV. The first-order approximation of CV index is shown in equation (3.19).

$$\Delta lnC^h = \sum_{i=1}^{n} W_i^h \Delta lnP_i \quad \text{.....(3.19).}$$

where, (i) refers to individual goods (or aggregates) in the commodity system, C is the consumption, P the price index, W the budget share, and (h) the household.

(b) Net Benefit Ratio

The Net Benefit Ratio (NBR) is a measure of the difference between the production ratio (PR) and the consumption ratio (CR) and is used to estimate the impact of an increase in food prices on household welfare in the short-run following Deaton (1989 and 1997)[27]. The ratio can be computed for individual commodity (i) or aggregates of commodities. The impact of welfare arising from food prices surges depends on several factors including the extent of price transmission, whether households are either net buyers or net sellers of the commodities being investigated, the share of consumer's budgets devoted to the items, the extent of own-consumption relative to market purchases, and the effect of price increases on real wages (Simler and Fox, 2007). The basic model equation is shown as equation (3.20).

$$\Delta W^h = \sum_{i=1}^{n} \Delta P_i^h \left(PR_i^h - CR_i^h\right) \quad \text{.....(3.20).}$$

where ΔW^{h} is the resulting change in welfare, expressed as a percentage share of total expenditures of household h, ΔP_i^h is percentage change in commodity (i) prices, PRi^{h} is the production ratio and CRi^{h} is consumption ratio.

(c) The General Equilibrium Models

(i) The SAM-Price Multiplier Model

A Social Accounting Matrix (SAM) is a representation of the economy capturing all transactions and transfers between sectors and institutions within an economy (Breisinger, *et al.,* 2009). The SAM provides the conceptual framework linking together

[27] The production ratio is expressed as commodity i sales divided by household (h) consumption expenditure, while consumption ratio refers to the ratio of the value of commodity (i) purchases divided by household (h) consumption expenditures

different components of a CGE model and furnishes much of the data as well. The external price shocks have both direct and indirect effects in a SAM. According to Pyatt and Round (1985), direct effects are those pertaining to the sector, while indirect effects are those on the other sectors and parts of the economy. These are grouped together into production and consumption linkages. The direct and indirect linkages are added to arrive at a measure of a shock's multiplier effect, or the extent to which a direct effect is amplified or multiplied by indirect linkage effects.

The SAM-price modeling framework is used considerably to examine the effects of various price shocks in Africa (Parra and Wodon, 2008). A distinguishing feature of this class of simple general equilibrium models is that changes in exogenous prices of a sector affect absolute prices of productive sectors, but leave quantities unaffected. Another characteristic of the SAM models is that they extend the standard Leontief input-output models by making at least one institution endogenous (Pyatt, 1988). This added feature renders analysis to be extended beyond the production accounts to include consumption accounts.

(ii) The Computable General Equilibrium models[28]

The CGE model is an economy-wide framework that shows how a specific change in the economy impacts other sectors, markets or institutions and focuses on issues related to resource allocation across different supply sectors, relative prices of goods and factors of production, and welfare levels of different income groups (Robinson, *et al*., 1999; Devarajan and Robinson, 2002: and Chumacero and Habel,

[28] CGE models differ from the SAM in the sense that the former consist of bahavioral equations which describe how an economy reacts to changes in policy, technology and/or external shocks. On the other hand, the SAM simply describes the flow of all economic activities/transactions of an economy in a given year in which economic agents (firms, households and government) are both buyers and sellers.

2005). CGE models constitute detailed sectoral breakdowns and used in the analysis of economy-wide effects of price changes in domestic and external markets (Wing, 2004). In these models, the distributional impact of any exogenous shocks to the model works through the market mechanism (Petersen, 1996).

When a firm changes its demand for factors, the factor prices including wages and non-labour incomes will be affected (Devarajan and Delfin, 1998; Hertel, 1990; Devarajan, *et al.*, 1990). Subsequently, the income levels and its distribution across various households will also be affected. The changes in the incomes of every household depend on the composition of the ownership of factors by the households, that is, unskilled labour, skilled labour, capital or land. Subsequently, household expenditures on various commodities will be changed. The latter affects distribution of income and expenditure, and works simultaneously in inter-related markets.

CGE models can be distinguished from each other from two broad approaches i.e. those based on the homogenous good assumptions and those that assume heterogeneity of products or that imported and domestic goods are imperfect substitutes that is, for example the Armington-style models (Zang and Varikios, 2006)[29].

The structural characteristics of CGE models differ in many ways in production and demand aspects. They differ in terms of size of production sectors, factors of production, households' levels of incomes, elasticity values, and functional forms and so on. CGE models can also be categorized into simple static 1-2-3 models, which refer to one country with two producer sectors and three goods, to more complex dynamic multi-sector and multi-country models (Devaragan, *et al.*, 1990).

[29] Under the Armington assumption, the same commodities are simultaneously exported and imported in the same country, that is, the commodities produced and imported by the same industry are not seen as being the same by consumers (Armington, 1969).

In CGE models, households seek to maximize their utilities (*U)* by choosing the levels of consumption (*c)* amongst a set of (*n)* commodities in the economy, depending on their levels of incomes, (*M),* commodity prices (*p)* and preferences. On the other hand, the household may also demand goods and services for purposes saving (*s),* which are assumed to be exogenous and constant. In this case, the agent's problem is thus shown in equation (3.21):

$$\text{Max } U(c_1, c_2 \ldots\ldots, c_n) \text{subject to } M \leq \sum_{i=1}^{n} p_i\,(c_i + s_i) \quad \text{.....(3.21).}$$

Equation (3.2.1) is an optimization situation and can be expressed as a set of demand functions defined by different preferences.

When the demand for all buyers equals the supplies by all sellers at prevailing prices in every market simultaneously, equilibrium is achieved. Thus, final consumption, demand for intermediate inputs and primary factors and savings are the building blocks for equilibrium or market clearance in CGE models. Hence, we have equation (3.22):

$$y_i = \sum_{j=1}^{n} x_{ij} + c_i + s_i \quad \text{.....(3.22).}$$

where y_i represents the value of gross output of industry i, x_i refers to the intermediate outputs, c_i and s_i represent consumption and savings, respectively. Furthermore, the quantities of primary factor (*f)* used by all producers must sum to the agent's endowment of that factor, (ν*f)*. This condition implies:

$$v_t = \sum_{j=1}^{n} v_{fj} \quad \text{.....(3.23).}$$

where ν refers to primary factor inputs.

When the value of output generated by producer (*j) is* equal to the sum of the values of the inputs of the (*i)* intermediate goods and (*f)* primary factors employed in

production, there is zero profit for the agent (Hertel, 1990). This condition is deduced by minimizing producer profits to zero and rearranging as in equation (3.24):

$$p_j y_j = \sum_{i=1}^{n} P_i x_{ij} - \sum_{f=1}^{F} w_f \, v_{fj} \quad \text{.....(3.24)}$$

There would be an income balance if the representative agent's income equals the value of producers' payments to her for the use of primary factors that she owns and hires out. Thus, we have equation (3.25).

$$m = \sum_{f=1}^{n} w_{fi} \, v_{fi} \quad \text{.....(3.25)}$$

The assumption made is that the endowment of the representative agent is fixed whenever a general equilibrium prevails.

Under zero profit conditions, the absolute value of producers' profits is minimized to zero in a general equilibrium. The excess demand functions that specify the per-unit excess profit, that is, excess of price over unit cost, (Δ^{π}) in each industry sector, can be written as equation (3.26):

$$\Delta_j^{\pi} = p_j - A_j \prod_{i=1}^{n} (P_i/\beta_{ij})^{\beta_{ij}} \prod_{f=1}^{F} (w_f/\gamma_{fj})^{\gamma_{fj}} \quad \text{.....(3.26)}$$

Similarly, the income balance condition can be re-written in terms of the excess of income over returns to the agent's endowment of primary factors, (Δ^{m}) as equation (3.27):

$$\Delta^{m} = \sum_{f=1}^{F} w_f \, v_f - m \quad \text{.....(3.27)}$$

According to Hertel (1997 and 2012), the supply of particular commodities equals their demand taking into account imports and exports in a general equilibrium framework. Similarly, the total revenue generated by a productive sector is exactly exhausted by payments to factors of production. With regard to households, the incomes accruing to particular household groups are entirely used up in consumption of goods and services, payment of taxes, transfers to other households or in savings, whereas total

government revenue from direct and indirect taxes is equal to government consumption expenditures, transfer to households plus government savings. The total savings (including foreign savings) equals total investments and finally the total current receipts of foreign exchange (including borrowing) equal total earnings.

As stated by Sen (1963), there are four possible macro closures in CGE models, namely 'Keynesian', 'Kaldorian', 'Johansen' and 'Classical'. In the Keynesian closure, full-employment of labour is not mandatory and employment is endogenous. In the Kaldorian closure, factors of production are not paid in equal amounts to their marginal value of productivity, whereas real savings are set to adjust to total investment targets through changes in income distribution. In the Johansen closure, public expenditure is endogenous and public savings fill the gap between exogenous investment and other sources of savings given the level of government revenue. Finally, in the classical closure, prices are perfectly flexible. There is mobility of factors and investments are endogenous and adjust in accordance with total available savings.

Bandara (1991) argues that the choice of a closure depends on how the CGE modeler views the functioning of the economy. Thus, when the modeler does not believe in planned investments or where there exists flexibility of factors and prices, he will adopt the classical closure. Likewise, if there exist structural rigidities in the economy, the Keynesian or Kaldorian closures are favoured. Detailed theoretical shortcomings and technical compromises of CGEs are reflected in previous studies (Robinson, 1989 and Hertel, 1990).

3.3 Empirical Literature Review

3.3.1 Literature on Partial Equilibrium Models

There is a large body of literature on price transmission and import demand elasticities in developed, developing and least developed countries. Resource literature predicts an ambiguous effect of commodity booms on long-run growth. Balassa (1983) studied responses to external shocks in Sub-Saharan Africa. Many countries make adjustments, including reductions in imports in the wake of declining economic growth rates. Furthermore, the magnitudes of effects of external shocks in an economy depend on its level of openness to the global markets (Rattsø and Torvik, 1998). The integration of markets is an indicator of the extent to which given products are tradeable in separate markets (Taylor and Taylor, 2004). Hence, the analysis of price transmission is necessary to inform trade policy and provide insights into how to respond to volatility of domestic prices (Minot, 2012).

The empirical studies by Deaton and Miller (1996) for Africa, which used vector autoregressive (VAR) models, found that higher commodity prices significantly raised household incomes in the short run. Furthermore, the study by Raddatz (2007) on external shocks and output variability in low income countries found that external shocks can only explain a small fraction of the output variance of a typical low-income country. It is notable that the purposes of these studies were not to estimate long-run effects of commodity booms. Hence, long run effects beyond the horizon of the VAR models remained unexplored in the literature.

Arndt, *et al*. (2008) carried out short-run net benefit ratio analysis for fuel and food price increases in Mozambique. The results indicate that urban households and those

in the southern region are more vulnerable to food price increases. In the overall, rural households, particularly in the north and central parts of the country, gained by virtue of being net sellers of agricultural products. The direction and magnitudes of the effects of a price increase depend on whether the household is a net buyer or a net seller of the commodity in question.

According to Abbott and Battisti (2011), there are variations in price transmission pattern elasticities among developing and less developed countries. For instance, the elasticities range from almost zero in China to virtually full transmission in Brazil. In the African continent, domestic market prices in countries like Nigeria and Ethiopia appear to be closely linked to those of world markets. On the contrary, other countries, especially those within the Eastern African region, show limited and/or lagged responses, suggesting that world market pressures get resistance from domestic market institutions. The study also identified certain patterns such as much greater price transmission for highly traded commodities like rice, compared to non-tradable ones like millet and sorghum, and higher price transmission rates for import dependent countries including rice in Burkina Faso, Niger, Malawi, Senegal, Mali and Uganda; maize in Uganda and Malawi; and, wheat in Ethiopia.

Benfica (2012) used the Compensation Variation method to assess the short-run effects of higher prices on different income groups in rural and urban areas of Malawi. The results indicated that urban households, particularly the poorest, are the most severely affected both in the aggregate and food consumption. In rural areas, relatively better off households are more negatively affected by overall price increases, but the poorest suffering the most with food price shocks. However, this model focuses

exclusively on the consumption side, and the magnitudes of the effects depend on the weight of the individual commodities in total household expenditures (budget shares) and the size of the price changes of those commodities that all households face.

Baltzer (2013) studied price transmission from international to domestic markets in 14 developing countries for maize, rice and wheat during the global food crisis in 2007/08. The results were grouped into four broad categories: (a) free market economies or well-integrated and open agricultural economies, that is, Brazil and South Africa exhibited relatively large degrees of price transmission; (b) exporting stabilizers, namely India and China showed reductions in price transmissions, while Vietnam exhibited strong pass-through of international prices despite export restrictions; (c) net importers, namely Bangladesh, Egypt, Kenya, Mozambique and Senegal showed mixed results. Bangladesh contained low domestic rice prices, while domestic prices in the rest of the countries rose rapidly and stayed high even after the crisis and (d) isolated countries or those poorly integrated in cereals markets (Ethiopia, Nigeria, Malawi and Zambia) also experienced rapid increases in domestic prices during the crisis contrary to expectations. The study attributes variations in the price transmission patterns across countries to divergences in application of price stabilization policies, public policy failures, incomplete market integration and coinciding domestic shocks.

Reviewing evidences of potential impacts of higher food prices in sub-saharan Africa, Wodon and Zaman (2008) found that the poor are likely to be significantly affected. For example, in West and Central Africa, a 50 per cent price rise in cereals could increase, in the short term, the share of those in poverty by 4.4 per cent. When potential gains for producers are factored in, the headcount index would still increase by

2.5 percentage points. This is in line with earlier results by Christiansen and Demery (2007) that higher food prices are likely to increase poverty levels in many African countries, even after countervailing wage changes and productivity effects are taken into account.

Most countries in Africa encountered commodity price increases which were relatively lower than the world market prices, except Ethiopia and Malawi (Minot, 2012; Baltzer, 2013). This suggests that other factors besides world market prices affected domestic prices. Similarly, Benson, *et al*. (2008) argued that domestic or regional factors were responsible for the rising food prices in Uganda. For instance, they can be attributed to spill-over effects from harvest shortfalls or higher prices in neighbouring Kenya, rather than by the global food crisis.

Minot (2012) examined the patterns and trends in food price volatility for 15 African countries, including Kenya during the crisis period 2007 - 2010. The study failed to find evidence of increased volatility contrary to views that food price volatilities increased during the crisis period. The results of the study further indicated that price volatility was lower for processed and tradable foods than for non-tradable foods; the volatility was lower in the bigger than in smaller towns. Finally; maize price volatility was actually higher in countries with the most active interventions to stabilize maize prices. The study recommended greater attention should be given to lowering the high level of food prices in the region, rather than lowering price volatilities. In addition, regional trade in food items can play an important role in reducing food price volatility; thus, price stabilization efforts on traditional foods may be counterproductive. The study,

however, only looked at food items unlike this thesis which also considers non-food items like fuel in the analysis.

Previous studies for the Eastern African region established that food prices often show a different pattern and fluctuate more than the world prices. For instance, the study by Karugia, *et al.* (2013) evaluated the price trends for staples in Kenya and other Eastern African countries, using a partial equilibrium method. The study established that domestic regional prices correlate more with each other than with world prices, and the influence of world price developments is relatively small compared to regional developments in maize, wheat and beans.

Mwega (1993) utilized an error correction model to estimate demand elasticities for aggregate imports and its components in Kenya over the period 1964-1991 and ascertained low elasticities for relative price and real income aggregate import demands in the short-run. The study argues that policies that directly increase export earnings and access to external capital inflows bring about larger impacts on import volumes than those that concentrate exclusively on aggregate demand and exchange rate management. However, the study assumes perfect import substitutability like previous econometric studies. The other limitation is the high level of aggregation of import categories in which food, beverages and tobacco are lumped together.

Leyaro (2009) analyzed the effect of commodity price changes on household consumption in Tanzania during the period 1990 - 2000. Using Deaton's method based on unit prices and household budget shares, the latter are used to evaluate the distributional impacts of the relative commodity price changes on consumer welfare in terms of compensating variation. The results indicate price increases reduced household welfare

especially the poor households in rural Tanzania. The study further shows that tariff reductions tend to offset welfare losses of all household groups, particularly the non-poor, and the urban poor who benefit relatively more.

Mutua (2013) investigated the distributional consequences of fuel taxes and estimated the welfare losses due to price increases using the compensating variation (CV) method with data from the National Energy Survey of 2009[30]. The study specifically looked into the pricing and taxation regime for various categories of fuel across households and compared welfare changes between 2003 and 2009. Households were disaggregated into three categories, namely low, middle and high income as well rural and urban households.

The major findings of the study were that domestic taxes, levies and other levies comprise about 26 per cent of the final price of fuels in Kenya. In addition, the low income households incurred the greatest welfare losses for kerosene (82.8 per cent) compared to the 21.2 per cent for the high income households. Transport fuels accounted for the highest losses for the middle income group (18.2 per cent). Besides, rural households experienced the highest losses (61.4 per cent) compared to urban households (22.2 per cent) for kerosene. For petrol motor, it is 3.5 per cent and 3.4 per cent for rural and urban households respectively. Overall, rural households had 74.9 per cent welfare loss compared to 33.2 per cent urban.

However, like other partial equilibrium methods, the compensating variation used in the analysis does not take into account the price linkages with other sectors and sources of incomes and substitutability of products by households. For instance, price

[30] The CV corresponds to the monetary resources that must be given to a household after a price change for it to maintain the same level of utility prior to the price change.

hike may reduce use of a commodity, hence utility, but the alternative commodity also gives a household some utility, thus the welfare changes may be under or over estimated. This may be the case for rural households who otherwise have wider choices for alternative sources of energy. It also lumps together the welfare analysis as the result of changes in domestic fuel prices due to changes in international prices, domestic taxes and inflation.

Besides, unlike this thesis which analyzes immediate or short run effects, the welfare changes were analyzed for the period 2003- 2009, which is a long time-frame. The weakness with the long period analysis is that it may not be possible to trace out the same households for which welfare changes are being measured.

Furthermore, it is not possible to directly compare the welfare losses for rural and urban households because of the large disparities in incomes between the two groups. Thus, although the rural households may get 79.4 per cent compensation of their original incomes, compared to 33.2 per cent for high income group, the latter's' package could in fact be higher in absolute terms. Finally, the study lumped households into two major groupings, namely urban and rural households. In reality, there exist income disparities even within the poor and non poor households.

With regard to social protection interventions, Mariara and Kiriti (2013) studied the role of social protection on the welfare of vulnerable groups in Kenya. The study established that social protection in the forms of Orphans and Vulnerable Children Cash Transfers (OVCST) and Old Persons Cash Transfer (OPCT) programmes reduced the veracity of economic shocks by households. Besides, the study highlights the inadequacy of the interventions both in terms of cash and coverage. However, the study focused on

the existing beneficiaries and does not take cognizance of the diversities of the beneficiary groups.

Ikiara (2013) looked into cash transfer as an instrument for food security in Kenya. The study noted that the existing cash transfer programmes are inadequate and unsustainable in addressing food insecurity among the vulnerable groups in Kenya. Unlike this thesis, the study only looks at vulnerability from the food security perspective disregarding the various causes and drivers of food insecurity. It also uses a qualitative approach and therefore unable to tease out the distributional consequences of economic shocks across various household categories.

3.3.2 Review of General Equilibrium Studies

CGE models have been applied to analyze a wide range of fields including fiscal policy and optimal taxation, trade policy, income distribution, sector development like agriculture and environmental issues (Chumacero and Habel, 2005). The approaches depend on the inter-relation between CGE and the micro model, and types of data used. Bourgignon, *et al*., (2006) and Davies (2004) present the application, advantages and disadvantages of these applications. So far, empirical studies focusing on the effects of global price shocks on household incomes and poverty in developing countries are few due to data limitations.

In Africa, Sahn, *et al*., (1996) analyzed the impact of adjustment policies on Kenya and other poor African countries using a CGE model. Their results showed that adjustment policies improve income distribution and do not adversely affect the poor where such policies are implemented and sustained. However, for Kenya, the percentage of the very poor increased from 10 per cent to 14 per cent between 1981 and 1992 and the

disparities in income levels also increased. In rural areas, the GINI ratio increased from 0.4 in 1981- 1982 to 0.49 in 1992. A major shortcoming of the study is that it assumed Walrasian conditions in which individual economic agents optimize behaviour in a market economy, which is not relevant in developing economies like Kenya.

Arndt, *et al*., (2008) analyzed the rising impact of world energy and food prices for rural and urban households in different regions in Mozambique, using a short-run net benefit analysis and a longer-term CGE analysis. The study assumed three closure rules to capture the macroeconomic dimensions of the price shock. The first closure was fixed government recurrent expenditure and fiscal deficit, whereby, public savings or investments, adjusts to align revenues with total expenditures. In the second is a savings closure, which maintains the balance in the overall savings–investment account. In this closure, the household and enterprise savings rates are fixed and investment adjusts to changes in incomes and fiscal deficit to ensure that the level of investment and savings are equal. The third closure is a flexible exchange rate which adjusts to maintain a fixed level of foreign savings. In other words, the external balance is held fixed in foreign currency. The study found that rural wages rise relative to urban wages, particularly in response to positive food price shocks. Thus, rural households are less affected compared to their urban counterparts. Overall, the study concludes from the analysis that energy price increases are the principal driver of poverty in both rural and urban zones in Mozambique. However, a major draw-back of the Mozambican model is that it assumes a Walrasian general equilibrium approach and ignores the presence of structural rigidities like missing or inefficient markets as well as immobility of some factors of production which exist in low income economies.

In Kenya, there are studies that explored the effects of Kenyan policies on household incomes using CGE models. For instance, the study by Tyler and Akinboade (1992) examined the allocative and distributional impacts of structural adjustment programmes on poor households. The authors carried out policy simulations to establish the effects of changes in exchange rates, investment and agricultural productivity. All the three policy simulations reduced poverty levels, but the income distributions remained fairly stable. However, the study primarily focused on medium to long-term measures and a rather outdated data set. On the contrary, this study focuses on the immediate effects of food and crude oil price shocks using relatively more updated data sets.

Furthermore, Semboja (1994) used a CGE model to evaluate the impacts of the second oil price shock of 1979 and subsequent energy tax policies on economic activities and the balance of payments in Kenya. The simulations indicated increases in energy prices and domestic energy consumption levels. In addition, the results showed that the terms of trade deteriorated, the balance of payments deficit increased, and growth in national income fell. However, the study was limited by the use of a single household model which falls short of being a good analytical tool for measuring income distribution effects of energy price increases.

Karingi and Siriwardana (2003) simulated the effects of the oil price shock and the coffee boom facing Kenya in the mid-1970s using the Kenya general equilibrium 1976 data base. The study used a combination of the negative terms of trade shock arising from the oil-price increases through a 12 per cent increase in world manufacturing import prices and a 25 per cent increase in world agricultural export prices, which represents the positive terms of trade shocks from the export boom as the reference experiment against

which evaluations were carried out. The study also quantified the effects of higher import tariffs and indirect taxes used by the government in tackling the disequilibrium effects of the external shocks on the Kenyan agricultural sector. Overall, the results indicated expansion of the economy due to the more than proportionate expansion of agricultural production and the positive impacts of nominal household incomes arising from higher export prices outweigh the negative impacts from high world import prices. In addition, rural households involved in agricultural production did not experience significantly larger increases in nominal incomes relative to their urban household counterparts.

However, many factors have since changed rendering the data set fairly outdated. In addition, unlike this thesis which evaluates both positive negative price shocks, their study uses one-way price shocks in the analysis. Finally, there have since been major policy shifts in Kenya's trade policy and limited flexibilities, especially with regard raising import tariffs.

Sanchez (2011) analyzed the welfare effects of escalating oil prices on oil-importing countries, notably Kenya, Bangladesh, El Salvador, Nicaragua, Tanzania, and Thailand for the periods 2002-2005 and 2007-2008. Nicaragua and Kenya, which have relatively high shares of oil in total imports estimated at 17 per cent and 20 per cent respectively, were adversely affected. From the results, oil price boom arising from the high import bills as well as higher production costs for exports, led to deterioration of the countries' trade balances. In addition, there were reductions in demand for labour, rising of unemployment and welfare losses in these countries. A major limitation of the study is the use of same elasticity values for all the six countries which are structurally different.

Tlhalefang and Obonye (2013) used a SAM framework to examine the welfare effects of higher prices of internationally traded energy and food commodities on economic sectors in Botswana. They found that the effects of these shocks are heavily concentrated on very few production sectors, namely; agriculture, electricity, non-diamonds mining, water and government sectors. However, the major limitation of a SAM model is that it does not spell out the behavioural relationships underlying the transactions values.

3.4 Overview of Literature Review

The above review of literature yields insights into mechanisms of transmission of prices into the domestic market from international markets, and the impacts of global price shocks within the domestic economy and household welfare. Under perfect competition, economic theory suggests that prices in the import region equal those in the export region, plus transportation cost (Fossati, *et al.*, 2007). The review further provides evidence about the extent and speed at which price changes are passed from international to domestic markets, the interdependence among prices and the indicators of the degree of market integration.

Different analytical tools for testing co-movement of prices have also been reviewed. The literature indicates that econometric techniques have evolved from static simple regression to dynamic models. However, all the empirical approaches reviewed rely on the application of market prices and transport costs to support the analysis. From the literature, domestic policy interventions strongly affect international price transmissions for agricultural commodities. However, empirical evidence is mixed depending on the methods and the data used.

The various models used in the analysis of market integration though building upon the limitations of preceding models, have their own limitations. The major shortcoming of the initial approaches is the non-stationarity of price series data which drift randomly rather than return to a mean value after shocks. Under these circumstances the best estimate of the future price is the current price. Secondly, static regression approaches assume instantaneous response to price shocks in each market to changes in other markets. These weaknesses are partly the source of diverse results from various studies. Besides, the econometric models and datasets for price transmission studies conducted in SSA vary and so their findings are often heterogeneous, highlighting several possible factors driving price transmission.

The consequence is that despite the overall usefulness of price transmission and market integration analysis, the high diversity in the findings and the conclusion and policy implications drawn from them represent a critical weakness. The literature attributes the differences in the results to factors related to variations in data notably sample sizes, data frequencies and periods of publications. In addition, there are differences in the products covered by the analysis; as well as specific models selected for the analysis.

The general shortcoming of partial equilibrium approaches is the assumption of perfect substitutability between domestic goods and imports. This assumption implies that two-way trade or cross-hauling at the commodity level does not take place. Thus, if a good is tradable, the “law of one price” holds and changes in world prices should be completely passed on to domestic prices. In addition, PE models ignore the activities and market-linkages amounting to abstraction from a real economy.

In consideration of the shortcomings of partial equilibrium, this study uses a general equilibrium approach to analyze how changes in international prices lead to changes in the demand for factors of production and final goods and subsequently, to relative changes in household incomes and expenditures. The CGE approach provides a comprehensive framework which takes into account economy-wide linkages and elasticity parameters which define behavioural response for all economic agents, including firms, households and the government, in reaction to external price shocks. The structure and description of the model are discussed in detail in the next chapter.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

This chapter presents the methodology used in the thesis. The modeling framework combines a CGE model and a Micro-simulation model. This combination allows for the study of the effects of macroeconomic policies at the household level. The models are integrated by a top-down approach whereby a policy change is simulated in the CGE model and transmitted into a Micro-simulation model which models household behaviour. The chapter consists of four sections: the rationale for the CGE Micro-simulation model; a description of the Kenya CGE Micro-simulation Model; hypothesis testing; and the model database and implementation.

4.2 Rationale for the CGE- Micro-simulation Model

The CGE-Micro-simulation framework was constructed to assess the effects of international food and crude oil price shocks in the Kenyan economy during the period 2007 - 2008. In the CGE framework, all markets, sectors and industries are modeled together with corresponding inter-sectoral linkages and economy-wide effects of market price changes (Robinson, 1989; Wing, 2004).

The choice of the CGE-micro simulation framework for studying the impacts of external commodity price shocks is motivated by the increasing interconnectedness and transmission of shocks globally coupled with the desire to establish the effects of these shocks across agents within the domestic economy. Thus, the model provides a comprehensive framework to analyze the effects of landed prices on domestic market prices and eventually how these changes affect wages, employment, government

revenues and expenditures and behaviour of households. The model is flexible and can be adjusted to suit relevant conditions depending on the structure and characteristics of an economy. The flexibility of the model allows for technological and behavioural specifications which apply to different agents, institutions and markets distinguished in the model. For instance, imported and domestically produced goods are treated as non-perfect substitutes for each other based on the Armington assumption. In addition, the model assumes a Linear Expenditure System (LES) utility function, which is characterized by splitting household consumption expenditures into subsistence and non-subsistence components. The LES is commonly used in cases where subsistence consumption expenditures constitute a significant portion of total household expenditures. In this framework, each household maximizes its subsistence expenditures subject to its total consumption expenditure constraints.

The CGE application allows for modeling of government expenditure policies including subsidies and transfer payments and their effects on household incomes and expenditures. The model also captures the interconnectedness between domestic and global economies, thus making it quite relevant in this particular analysis. In addition, it makes known the channels through which economic shocks and subsequent policy measures ripple through the various sectors of the economy. Furthermore, the integration of macro data with micro household income and expenditure survey data, allows for simulation of micro-level impacts of changes in import prices across various household categories in the domestic economy.

However, the model has some shortcomings which should be borne in mind when considering the results. First, the model has limitations associated with the level of

aggregation of baseline data and the calibration procedure which relies on data for a single year. Thus, whatever anomalies that exist within the selected year heavily influence the model. Secondly, the CGE models, in their origin and historical development, are Walrasian or represent a competitive economy. The Walrasian assumption ignores the presence of structural rigidities like missing or inefficient markets, as well as immobility of some factors of production which exist in low income economies. According to Khan (2004), neither the fully Walrasian nor the standard Keynesian model is likely to capture all the characteristics and attributes of a developing economy. The other draw-back relates to the difficulties in selecting appropriate parameter specifications and functional forms which reflect realities within the economy. Finally, the model may be prone to the Lucas critique like other models, in the sense that it may be naive to predict economic effects based on relationships calibrated using past data.

Despite the highlighted draw-backs, the framework adopted in this thesis offers a superior platform for analysis of economy-wide effects of international commodity price shocks within the Kenyan economy. In this study, the Keynesian assumptions, which correspond to the actualities of a developing economy, are considered. Furthermore, the validity of the simulation results rests on the propositions that the individual components of the CGE model are based on plausible economic relationships and equilibrium assumptions. Besides, the underlying SAM and micro data reflect the best possible economy-wide data presently available in Kenya. Hence, the results presented in this thesis can confidently be considered to reflect what might actually happen to the

economy given the global food and crude oil price shocks and policy interventions by the government.

4.3 The Kenya CGE Model

4.3.1 A Description of the Model

The Kenya CGE Model is constructed from the Global Trade Analysis Project (GTAP) model for global trade, production and consumption following Hertel (1997)[31]. The model captures trade between Kenya and the rest of the world, interactions within the economy and captures changes in the demand for factors and goods due to price changes. The CGE model encompasses trade and transport costs for marketed commodities and separately allows for consumption of home-produced goods. The model is integrated into the micro-simulation model, which takes into account the heterogeneity of households in terms of endowment of factors and patterns of consumption[32]. The production and consumption decisions are modeled under non-linear optimality assumptions and are based on profit and utility maximization conditions, respectively. The production function follows a constant return to scale (CRS) technology with nested constant elasticity of substitution (CES) production functions[33].

The factor market is assumed to employ factors of production up to the point where the marginal revenue product of a particular factor is equal to its wage income. In addition, the supply of factors is assumed to be fixed at national level and fully mobile across sectors in the economy. The system also allows for substitution between various factors of production.

[31] The graphical representation of the CGE is presented in Appendix A, while equations are in Appendix B.
[32] The micro-simulation model uses the 2005/2006 integrated household and budget survey data set.
[33] The CES was first introduced by Hicks (1932) and is a tool for analyzing the shares of capital and labor incomes in a growing economy. It assumes a constant-returns-to-scale technology and neutral technological change.

With regard to marketed production, producers allocate domestic output between domestic and export markets, given the relative prices[34]. It is assumed that there is imperfect transformability between domestically sold goods and exported ones expressed by a constant elasticity of transformation (CET). Similarly, there is imperfect substitutability between domestically produced and imported products or the Armington assumption. Hence, domestic firms decide on the sourcing of their imports, then based on the resulting import price, determine the mix of imported and domestic goods to consume or use in further production.

In this model, households receive their incomes from the factors of production employed through enterprises. They also receive income transfer payments from other institutions such as government and rest of the world. The payments include foreign remittances, foreign aid and household transfer payments. Households' incomes are spent on consumption, savings, income tax payments and transfer payments to other households and institutions. The households consume imported and home-produced commodities. LES demand function is used to allocate the consumption across commodities. The enterprises allocate incomes received to savings, payment of taxes and transfers to households.

On its part, the government receives taxes at fixed ad valorem rates and its consumption is fixed. The taxes which are charged on specific basis enter the model after conversion into ad valorem equivalents. In return, the government makes transfer payments to households and enterprises and the residual from government's income and

[34] The producer price of exported goods (called the export price) is the world price adjusted by the exchange rate, export taxes and transaction costs. On the other hand, the consumer price of imports (called import price) is the world price adjusted by the exchange rate and tariffs, plus the transaction costs per unit of import.

consumption is treated as savings. Given that government savings are flexible, the direct tax rates are fixed in order to bring about government sector closure in the model. This model provides flexibility in the treatment of government savings and spending, inter-regional transfers, such as remittances and foreign capital incomes, and modeling the impact of a policy on different categories of households within an economy (Walmsley and Minor, 2012). A flexible exchange rate is adopted in the model, whereas the consumer price index is regarded as numeraire.

The model has a balanced investment-Savings closure[35] in which shocks are distributed across the components of consumption and investment, while savings are determined by the balance identity of investments and savings. In addition, global investment flows respond to differences across countries in rates of returns, with the trade balance assumed to be endogenous. Capital formation is fixed (static model assumption) and there is uniform change in marginal propensity to save for selected institutions. Various types of labour are fully employed and mobile across sectors. Land is fully employed but only used in agriculture. Capital is also fully employed, activity-specific and does not move across sectors.

The underlying equation system of the Kenya CGE Micro-simulation Model has two kinds of equations. The first part encompasses the accounting relationships in the model whereby income receipts and expenditures of every agent in the economy are balanced at equilibrium. The other part consists of behavioural equations, which are

[35] A model closure refers to the choice of what is determined within the model (the endogenous variables), and what is considered external to the model (the exogenous variables). Mathematically, it amounts to ensuring that there are enough independent equations to explain the endogenous variables.

founded on microeconomic theory[36]. The latter embrace the behaviour of optimizing agents in the economy, including the demand functions.

4.3.2 The Elasticity Parameters in the Model

(a) The Armington elasticity of substitution

The standard Armington CES function depicts the existence of imperfect substitutability between imports and domestic market output, and among imports from different countries (Armington, 1969). Imported and domestically produced goods are said to be non-perfect substitutes when consumers consider them as being different from each other, in terms of tastes and or other attributes. This condition holds regardless of whether the goods are produced by the same industry in different countries or are produced by the same technologies (Zang and Varikios, 2006). In the Kenyan CGE model, the Armington elasticity of substitution and import share parameters determine the extent of price transmission from international to the domestic markets. Thus, when there is zero substitution between imports and domestically produced goods and or non importation of goods, then no international price transmission takes place in the domestic markets. Likewise, if there exists high substitution and high levels of importations relative to consumption of domestic produce, then price transmission from international to domestic markets will be high. In the latter case, world price shocks alter relative domestic prices, and affect resource allocations and economy-wide effects in the domestic economy (Petersen, 1996).

In the Kenyan CGE model, the basic idea about the Armington assumption is illustrated by equation (4.1).

[36] See details of the model equations in Appendix B.

$$\sigma = \frac{\delta\left(\frac{Q_d}{Q_m}\right)}{\delta\left(\frac{P_d}{P_m}\right)} \times \frac{\delta\left(\frac{P_m}{P_d}\right)}{\delta\left(\frac{Q_m}{Q_d}\right)} \quad \text{.....(4.1).}$$

In the equation, σ represents the substitution elasticity between two commodities; Q_d and Q_m represent the demand for domestically produced and imported goods, respectively, P_d and P_m represent respective prices, and (δ) represent their partial derivative. In percentage form, it is presented as equation (4.2).

$$\sigma = \frac{q_d - q_m}{P_m - p_d} \quad \text{.....(4.2).}$$

The prices P_d and P_m in the model are defined as equations (4.3), (4.4), (4.5) and (4.6).

$$P_m = P_{cif} + t_m \quad \text{.....(4.3).}$$

$$P_{cif} = P_{fob} + p_{marg} \quad \text{.....(4.4).}$$

$$P_{fob} = P_d + t_x \quad \text{.....(4.5).}$$

$$P_d = P_s + t_o \quad \text{.....(4.6).}$$

where P_{cif} represents the cost insurance freight price of imported commodity, t_m represents the power of the tariff on imported commodity, P_{fob} represents the free-on-board price of imported commodity, P_{marg} represents the price of the international transport margin, P_d represents the domestic price of the commodity, t_x represents the power of the tariff on exported commodity, t_o represents the power of the tax on production of domestic commodity and P_s represents the supply price of domestic commodity. When $P_{marg} = P_s = 0$, the value of the elasticity of substitution between the domestic and imported commodities (σ) can be determined from known changes in the taxes and prices at any two points in time.

According to Jones (2008), the import demand elasticities are estimated using the imperfect substitute demand framework. In such a framework, the demand function for

imports constitutes the level of money income of the domestic economy; the imported goods own price; and the price of domestic substitutes. Hence, the demand for country *i*'s imports from the rest of the world is represented by equation (4.7).

$$M_i^D = f(Y_i, PM_i, PD_i) \quad \text{.....(4.7).}$$

where M_i^D denotes the quantity of imports demanded by country *i*; Y_i represents the level of money income in country *i*; PM_i represents the domestic currency price paid by importers in country *i*; and PD_i, denotes the price of all domestically produced goods within country *i*.

Subsequently, the supply of country *i*'s imports from the rest of the world can be represented as equation (4.8).

$$M_i^S = g(Y, PM_{i\ i}^*, PD^*) \quad \text{.....(4.8).}$$

where M_i^S denotes the supply of imports from the rest of the world to country *i*; PM^* denotes the price of the rest of the world's exports; and PD^* the foreign currency price of all domestically produced goods in the rest of the world. In which case, the specified supply function is a positive function of the own price and a negative function of the price of domestically produced goods in the exporting country. At equilibrium, the demand for imports by country *i* equals the supply of exports to country *i* from the rest of the world as indicated in equation (4.9).

$$M_i^D = M_i^S \quad \text{.....(4.9).}$$

The supply and the demand for imports is a simultaneous equation system, and prices move to equate supply and demand in each time period. In trade theory, if PD^* is the border price of imports, then their tariff-ridden domestic price is stated as $(1+ t)\, PD^*$. Trade enforces some sort of relationship between the domestic price *PD* of goods that

compete with imports (1+ *t*)PD*. Perfect competition means that the relationship would be *PD* = (1+ *t*)PD *. Thus, the empirical estimation is provided as equation (4.10).

$$lnQ_{it} = \alpha_{it} + \beta ln[\mathrm{PD}^{*}{}_{it}(1 + t_{it})] + \varepsilon_{it} \quad \text{.....(4.10).}$$

where the subscripts *i* and *t* represent product categories and time respectively; *Q* represents the logarithm of imports measured in quantities; $\mathrm{PD}^{*}{}_{\mathrm{it}}(1 + \mathrm{t}_{\mathrm{it}})$ represents the logarithm of the tariff-inclusive price; and, ε_{it} the error term. Since the model is estimated in log-linear form, the coefficient β can be interpreted as the import price elasticity of demand. The null hypothesis is that β is negative. This suggests that as the tariff-inclusive price rises, the demand for imports fall. Equation (4.10) is used to calculate the elasticity of substitution parameters used in this thesis within the Kenya CGE Micro-simulation Model.

(b) The production function

The production function in this model follows a CRS technology with nested CES production functions. Producers choose cost-minimizing input combinations based on technical characteristics of production. Sectoral production is modeled as a Leontief function of value added and intermediate inputs of production. This assumption implies that the elasticity of substitution between intermediate inputs is equal to zero. Thus, changes in prices do not influence input quantities required for production when output is held constant. Further, to generate value added, labour and capital are combined using a CES aggregate function. The elasticity parameters in the production function are adopted from the standard GTAP model.

The factors of production, which are land, labour and capital, are assumed to be fixed in national supply and fully mobile across various sectors in the economy. Further,

the demand system allows for substitution between primary factors of production. In this model, producers demand labour and capital up to the point where the marginal cost of each of the factors is equal to the corresponding levels of their marginal revenue products. The final products are differentiated by country of origin. Finally, both final and intermediate demands for goods are satisfied by a nested composite demand function which consists of domestic output and imported products from various sources.

(c) The household utility function

The private household demand function in the model is described by a household linear expenditure system (LES). The latter depicts the minimum subsistence requirements of households given total consumption expenditures and posits that average propensities to spend vary with income levels (Williamson and Shah, 1981; Nganou, 2005). The household's consumption problem under this set-up is shown in equation (4.11).

$$MaxU_h = \sum_{c=1}^{n} \beta_{ch} ln(QH_{ch} - \gamma_{ch}) \quad \text{.....(4.11).}$$

subject to the budget constraint provided in equation (4.12).

$$EH_h = \sum_{c=1}^{n} PQ_c \, QH_{ch} \quad \text{.....(4.12).}$$

where $\sum_{c=1}^{n} \beta_{ch} = 1$ .....(4.13).

In equation (4.11), the subscript (c) represents the commodities for which sample data on prices, quantities, and income are available for the estimation of parameters. QH_{ch} is the quantity of the marketed commodity (c) consumed by the household. The parameters γ_{ch} and β_{ch} represent the marginal share of consumption spending for household (h) on marketed commodity (c) and subsistence requirement on each marketed commodity (c) for household (h), respectively;

In the equation (4.12), EH_h represent the household's income and PQ_c is the composite market price of commodity consumed[37]. The Lagrangian for this optimization problem is presented in equation (4.14).

$$Max\ L = U_h + \lambda(EH_h - \sum_{c=1}^{n} PQ_c\,.\,QH_{ch}) \quad \text{.....(4.14).}$$

Differentiating equation (4.14) with respect to QH_{ch} and rearranging yields equation (4.15).

$$QH_{ch} = \gamma_{ch} + \frac{\beta_{ch}}{PQ_c}(EH_h - \sum_{c=1}^{n} PQ_c.\gamma_{ch}) \quad \text{.....(4.15).}$$

According to equation (4.15), a household's spending on individual commodities is a linear function of the total consumption spending (or income) EH_h. Thus, from the demand function (4.15), household consumption has two components: the first is the subsistence consumption and the second is a share of the consumption on total household expenditure income. Hence, γ_{ch} represents subsistence quantities, while β_{ch} reflects the relative contribution of each commodity to household utility after subsistence has been achieved[38]. The LES estimations are consistent with the intuition regarding how the composition of consumption depends on budget shares as well as on expenditure elasticities and income ratios (Frisch, 1959). Generally, the estimated subsistence budget shares for luxuries tend to be smaller compared to the budget shares for staple food products, which are necessary for survival. This is an important characteristic for pricing policy formulation, because food in general and staple foods in particular, have a much larger share of the consumption basket of poor consumers than that of wealthier

[37] The composite price is the domestic market price paid by consumers. The composite price differs from the domestic demand price in that the former includes locally produced and imported goods, while the latter only includes locally produced goods.

[38] The expression in parentheses in equation (4.15) represents the residual income (supernumerary income), or luxury expenditures/usages. It is the remainder of income after subtracting expenditures on the subsistence minima.

consumers; thus poor consumers will respond more flexibly to price changes. This assumption is relevant in this study, in which households have been categorized into various income levels.

In addition, the LES specifications provide a more realistic model when the level of aggregation is quite high and when separate estimations can be done for separate income classes. According to Williamson and Shah (1981), consumer responses to price changes are relatively flexible in the case of luxury commodities, such as alcoholic beverages, poultry and eggs, and non-agricultural goods in the case of urban consumers, but inflexible, for "necessities" such as staple foods, meat, vegetables and legumes. However, the major limitation of the LES specifications is the imposition of constant non-negative marginal budget shares across all consumers, which is a rather strict assumption that is unlikely to hold across all commodities or consumers.

4.4 Data and Model Implementation

4.4.1 Data Sources

The data sources used in this thesis include the following: the social accounting matrix (SAM) constructed from the GTAP version 8.1 data base of 2008; the 2005/2006 Kenya Integrated Household Budget Survey (KIHBS) data collected by the Kenya National Bureau of Statistics (Government of Kenya, 2007b), the World Bank's World Integrated Trade Solution (WITS) and previous studies. The SAM contains detailed bilateral trade, transport and protection data characterizing sectoral linkages for Kenya and the rest of the world during the year 2007. The SAM was modified for the present study by aggregating the global economy into 11 regions, taking into account the major global suppliers of food and energy products to Kenya.

There are 14 sectors[39] in the CGE model selected on the basis of a mix of factors, including contributions to GDP, income generation, importance in the consumer food basket and trade intensity. On the activities side, the matrix includes payments and receipts for the 14 sectors. Similar sectoral detail follows in the commodity accounts, which makes the mapping between activities and commodities easier. Factor accounts in the baseline data include labour, land and capital. These are disaggregated into nine different categories; namely, land, agricultural workers, unskilled rural and urban labour, skilled labour, professional labour, agricultural capital, non-agricultural capital, and natural resources. Land is used only in agriculture. In this model, agricultural capital is capital used within the food and agricultural sectors, while non-agricultural capital is employed in non-food and non-agricultural production activities. Agricultural workers are employed in farming activities. Unskilled rural labour is employed in value-added food and agricultural industries, while unskilled urban labour is employed in non-agricultural occupations. Natural resources are endowments used in the "other agricultural and natural resource" production activity. Other institutions in the SAM include enterprises, government and the rest of the world account.

The main data source for the micro-simulation model is the 2005/06 KIHBS data, which sampled 13,430 households over a one-year period (Government of Kenya, 2007b). The household accounts are broadly distributed into rural and urban household types. The households are further split into six rural and urban household types, each

[39] The 14 sectors are grains; fruits and vegetables; livestock; other agriculture; meat; vegetable oil; dairy products; other food products; beverages and tobacco; textiles and apparel; energy; other manufacturing; transport and communications; business services and other services.

comprising hardcore poor, non-hardcore poor and non-poor households[40]. The KIHBS data is also used to develop shares applied to the CGE model, to disaggregate the income and expenditure of the six household types.

Additional data, including trade elasticities, production elasticities and household demand elasticities were also used to fully run the CGE-Micro simulation model. In modeling trade, it is assumed that domestically produced and consumed commodities are imperfect substitutes of similar imported commodities and the import elasticities are econometrically estimated. The data for estimating import elasticities for the period 2007 - 2009 was obtained from the World Bank's World Integrated Trade Solution (WITS) database. For each of the products, data on import quantities, average tariffs and unit prices are generated with the latter two used to construct the tariff-inclusive price. The data is interacted to generate elasticities for each of the broader product classifications using equation (4.10). Subsequently, these are further aggregated into 11 commodity or goods sectors, identified in the SAM. The estimated elasticities determine the degree of price transmission between international and domestic prices in the CGE model[41].

The production elasticity parameters used in the CGE model are drawn from the GTAP model and other CGE literature for African economies. These include factor substitution elasticities which lie between 0.3 and 1.2 especially for agriculture sector. The household demand elasticities or the LES income and price elasticity parameters are drawn from Williamson and Shah (1981)[42]. The latter are the latest available household

[40] According to KNBS (2007), the households whose overall monthly consumption expenditures fall below ksh 1,520 in rural and Ksh 2,913 in urban areas were considered overall poor. In addition, households were deemed to be hardcore poor if they could not afford to meet their basic food requirements with their total expenditure (food and non-food).

[41] The elasticity parameters for the services sectors (transport and communication services, business services and other services) are adopted from the GTAP model.

[42] See LES elasticity parameter estimates for urban and rural Kenya in Appendix E.

expenditure elasticities available for Kenya. For the other regions in the model, consumer demand is described by the constant difference of elasticities (CDE) demand system and adopted from the GTAP model (Hertel, 1997)[43].

4.4.2 Description of the Baseline Data

(a) Production and Consumption Patterns

Key production sectors in Kenya's economy are "other services", transport and communications, and "other foods," which include processed food products. About 12 per cent of Kenyan production is exported. The export share of production is highest in "other agriculture," which includes coffee and tea, forestry, fishing, and the other manufacturing sector. Furthermore, consumers spend 66 per cent of their budget on food items, primarily grains and fruits/vegetables (Table 4-1). The "other services" sector accounted for the biggest share of non-food household spending. These services include expenditures on utilities (water and electricity), education and health. Household dependence on imports in consumption is relatively low, at 11 per cent overall. However, imports account for notably large shares of household consumption of oil, vegetable oils and other manufactured products.

[43]The CDE function is a generalization of the CES function in which the elasticities of substitution vary with the cost shares. The differences of the elasticities of substitution, however, are constant. See Hanoch (1975).

Table 4-1: Structure of Consumption and Production in Kenya

Sector	Share in total household consumption spending	Import share of household consumption spending	Sector share in total industry value added	Export share of production
Grains	11.1	1.9	5.4	1.7
Fruits/Vegetables	18.6	2.2	4.7	13.7
Meat/livestock/poultry	4.8	0.4	1.3	1.3
Other agriculture	8.6	5.2	8.3	39.6
Vegetable oils	0.5	77.8	2.6	1.0
Dairy	4.0	1.8	3.3	7.9
Other foods	9.2	0.0	1.5	3.6
Beverages/tobacco	9.2	1.9	13.1	5.0
Textiles/apparel	5.2	20.3	9.3	3.7
Crude oil	3.5	56.9	0.9	21.5
Other manufacturing	11.3	58.3	6.2	22.7
Transport/communication	2.6	17.6	16.5	18.7
Business services	4.2	7.5	8.0	3.1
Other services	18.4	1.8	18.9	12.9
Total	**100.0**		**100.00**	

Sources: Government of Kenya, 2007b and author's calculations.

(b) Household Incomes by Source

To disaggregate the income and expenditure of the six household types in the baseline model, KIHBS data is used to develop shares that are applied to data on the single household. This helps preserve the equality of aggregate household income and expenditure in the original balanced Kenya CGE database. Three types of shares are developed. KIHBS data on occupations and income by household members are used to develop sectoral labour employment shares and households' factor ownership shares. Results indicate the diversity of labour income sources, with many rural households drawing income from non-agricultural employment and some urban households receiving income from agricultural employment (Table 4-2). Data is not available on households'

ownership of land and capital. A larger share of these returns is assumed to accrue to non-poor households relative to poor and hard-core poor households.

Table 4-2: Sources of Kenyan Household Factor Income, by Household Type, 2007

Factor income source	Rural hardcore poor	Rural poor	Rural non-poor	Urban hardcore poor	Urban poor	Urban non-poor
Land	7.9	8.1	3.6	0.0	0.0	0.0
Natural resources	0.0	0.0	0.8	0.0	0.0	0.7
Rural unskilled labour	6.3	7.6	6.7	3.5	1.2	1.8
Urban unskilled labour	2.6	10.0	14.0	58.6	47.3	20.9
Agricultural labour	33.5	25.3	24.2	2.4	3.4	1.8
Skilled labour	0.1	1.1	2.2	1.8	5.6	7.8
Professional labour	0.1	0.6	2.6	0.2	1.8	14.6
Agricultural capital	49.7	47.3	46.0	0.0	0.0	0.0
Other capital	0.0	0.0	0.0	33.5	40.6	52.5
Total factor income	100.0	100.0	100.0	100.0	100.0	100.0

Source: Government of Kenya, 2007b and author's calculations.

(c) Household Expenditures

The KIHBS sampled 13,430 households over a one-year period. Results from the 2005-06 KIHBS show that 46 per cent of Kenyans are absolutely poor, and 19.1 per cent are hardcore poor (Government of Kenya, 2007b). The distribution of income and expenditure within each classification of households (hardcore poor, poor and non-poor) is wide. Table 4-3 reports the mean level of annual total expenditure of surveyed households, their un-weighted per-capita expenditure, and the standard deviation in per capita expenditure within each household type.

Table 4-3: Expenditure by Kenya Households per Annum

Household	Mean household expenditure (Kenyan shillings)	Average number of Persons per household	Average per capita expenditures by household (Kenyan shillings)	Standard deviation
Rural				
Hardcore poor	42,482.7	7	6,531.01	2,527.42
Poor	74,619.41	6	12,311.50	2,917.57
Non-poor	134,527.10	5	31,647.95	23,423.81
Urban				
Hardcore poor	61,629.68	6	10,082.83	3,857.93
Poor	105,720.10	5	21,737.95	6,047.03
Non-poor	300,608.90	4	97,172.94	37,045.25

Source: Government of Kenya, 2007b.

(d) Household Expenditures by Commodity

KIHBS data on households' expenditures by commodity is summed over the households within each of the six types, to develop budget shares for each of the 14 commodities in each of the six consumption baskets (Table 4-4). Notably, expenditures on food comprise a larger share of total expenditure in poor than in non-poor households, and in rural than in urban households. The value of food expenditure accounts for the value of home-produced and un-marketed foodstuffs.

Table 4-4: Budget Shares in Kenyan Household Expenditure (Percent)

	Rural			Urban		
Sector	Hardcore poor	Non-hardcore poor	Non-poor	Hardcore poor	Non-hardcore pool	Non-poor
Grains	24	12	12	13	10	3
Fruits/vegetables	18	19	15	14	11	5
Meat/Livestock	5	6	6	3	5	3
Other Agriculture	2	2	1	1	1	1
Vegetable oil	4	4	2	3	2	1
Dairy	8	9	7	6	5	3
Other proc. Foods	11	11	7	9	7	3
Beverages, tobacco	3	3	3	2	2	2
Textiles, apparel	6	7	11	5	6	6
Energy	4	4	4	5	6	4
Other manufacturing	4	5	5	4	4	6
Transport, communication	2	3	7	2	4	10
Business services	1	1	0	0	0	2
Other services	11	16	20	35	38	53
Total food	73	66	54	50	43	20
Total	100	100	100	100	100	100

Source: Government of Kenya, 2007b

4.4.3 The CGE Model Closure Rules

The purpose of this study is to capture the likely effects of exogenous trade shocks in order to explore the role for complementary policies. Therefore, the closure rules imposed closely mimic Kenya's economic conditions, allowing the adjustment to macro shocks to be spread more evenly across the different components of consumption and investment. They are described as follows:

a. The Savings-Investment (capital account) closure

The CGE Model employs a balanced savings-investment closure in which adjustment to shocks is distributed across the components of consumption and investment. The savings rate for households is fixed and investment demand is scaled, thus investment spending is determined by the sum of private, government and foreign savings.

b. Foreign trade and current account closure

A flexible exchange rate regime is assumed while global investment flows respond to differences across countries in rates of returns, with the trade balance assumed to be endogenous. The current account is fixed at the year 2007 level to allow for maintenance of a specific balance of payments[44]. The real exchange rate is the equilibrating variable of the external balance with fixed foreign savings to maintain current account balance. Thus, an increase in foreign savings leads to a fall in exports as outputs are channeled to domestic markets and imports rise as consumers switch to imported commodities, leading to a new equilibrium in the external balance at the new exogenous higher level of foreign savings.

c. Government account closure

The government collects taxes, makes and receives transfer payments and purchases goods and services. In this model, government consumption expenditures, both consumption and transfers, are assumed fixed in real terms. Government revenue is determined by fixed tax rates, while government savings is determined residually by the

[44] This is because the Social Accounting Matrix data base used in the CGE model is benchmarked to the year 2007.

gap between government revenue and government consumption expenditures. The internal balance is fixed at the 2007 level.

d. Factor market closure

For the factor market, all production factors are assumed to be fully employed, whereas labour is mobile across sectors with wages to clear markets[45]. Finally, the model experiments adapts the model closure to specify fixed world prices in major global suppliers of food and crude oil products, which allow for the experiments to define changes in global energy and food prices.

4.4.4 Other Assumptions

In addition, the following apriori assumptions are made in determining transmission of prices between international and domestic prices, and examining the effects of exogenous trade shocks in the CGE model.

a. Levels and Diversity of Import Elasticities

The aggregate import demand elasticities are fairly elastic, but differ across industries. However, the import demand elasticities in the agricultural sector are expected to be smaller compared to the others, given that agriculture constitutes the largest share of the Kenyan economy.

b. Price Shocks, Household Demand and Industry Output

The higher the import demand elasticities, the higher the degree of substitution, resulting in more demand for the domestically produced products in the event of increasing world market prices.

[45] It should be noted that any upward/downward movement in wages in the model results could also be interpreted as downward/upward changes in unemployment and underemployment as in the alternative, labour unemployment closure.

c. The Mobility of Factors among Sectors

The higher the factor mobility, the lower the price transmission and subsequent effects on the domestic market. This is because increasing domestic supply in the wake of rising international prices dampens the increase in domestic prices. However, the more immobile the factors are, the less this mechanism can work. Therefore, sectors that rely more on unskilled labour are likely to be affected more by international price changes compared to those that rely on skilled labour.

d. The Share of Domestic Factor of Production

Sectors could be differentiated according to their use of different factors of production, with different implicit price elasticities of factor supply. In case a sector relies heavily on an inelastic factor, price transmission is likely to be higher. This is because with increasing domestic production, the cost of production would increase more than it would if there was higher factor supply elasticity.

4.4.5 Description of Simulation Experiments

This study focuses on the analysis of the effects of global food and energy price shocks on Kenya's economy. The CGE model is calibrated to a 2007 base SAM. Ideally, the intention of the modeling effort is to gain insights into the transmission of international prices into domestic markets and subsequently analyze how changes in domestic prices affect production and consumption decisions by firms and households.

The exogenous price shocks are applied to Kenya's major import sources for these commodities based on world price scenarios experienced during the period 2007 – 2008 as shown in Table 4.5[46].

[46] The major sources for Kenya's imports are contained in Table Appendix D-6. From the table, it notable that major suppliers to Kenya for agricultural and food products are North America and the Rest of World.

Table 4-5: World Price Scenario during 2007 - 2008

Commodity	Percentage price increase	Percentage price decrease
1. Crude Oil	50	50
2. Fruits and vegetables	40	40
3. Grains	50	50
4. Meat	40	40
5. Other agriculture	40	40
6. Dairy	25	25
7. Other foods	40	40
8. Beverages	25	25

Source: FAO, 2008 and World Energy Outlook, 2008

Both positive and negative price shock simulations are carried in the study to ascertain the symmetry of the effects of the price shocks in markets and households. The initial simulations involve positive and negative exogenous shocks on oil and food prices separately. This is then followed by a combination of the food and oil price shocks to ascertain the net effects of the international price changes. The resulting effects of the combined simulation form the basis upon which economic policy response experiments are considered and tested.

The last three experiments describe possible government policy responses to external food and fuel price shocks: an elimination of import tariffs on food and energy, and compensating household transfer payments targeted to the most affected households. The two choices are made considering possible short term policy options at the disposal of policy makers in the wake of unpredicted shocks.

manufactured products are mainly sourced from the EU-25, East Asia and North America, whereas crude oil supplies are from Rest of World and evenly spread in North America, Latin America and Middle East and North Africa.

CHAPTER FIVE

STUDY FINDINGS

5.1 Introduction

This chapter presents and discusses the findings of the thesis in accordance with the stated objectives. The chapter contains estimations for elasticity of demand for imported food and crude oil products and the effects of international price changes on domestic market prices and household incomes. The import demand elasticity parameters play a crucial role in the CGE model in determining the substitutability between imported and domestic substitutes for Kenya when prices are shocked in the model. Specifically, section 5.2 presents the results showing the import demand elasticity parameters for various food and oil products. The elasticity estimates indicate the extent to which consumers substitute imported for domestic products in the wake of external price shocks given changes in demand and domestic firms' production. The magnitudes of the elasticity parameters are compared with those of previous studies which used different methodologies.

In section 5.3, the results showing the transmission of positive and negative price shocks to domestic market prices are presented and analyzed in terms of their magnitudes and directions across various sectors and household categories. The changes in domestic prices are central to the assessment of welfare since such changes influence consumers' consumption and/or expenditure decisions. The sub-section ends by reporting and discussing the results from combined international oil and food price shocks described in Table 4.5 in the previous chapter, which formed the basis for the choice of the policy response experiments.

The last sub-section presents the results of preferred policy response interventions following the resulting effects of positive combined international food and crude oil price shocks. These include elimination of tariffs on imported products and direct cash transfers to the households most affected by international price changes. The study results form the basis of the recommendations made herein.

5.2 Estimations of Import Substitution Elasticities

The import demand elasticities were estimated using equation (4.10) of this thesis and considered 11 goods sectors selected for the study. The elasticity parameters denote the degree to which foreign goods are substituted by domestically produced versions of the goods in domestic markets following international price changes. Table 5-1 reports the import demand elasticity estimates for the 11 sectors considered in the CGE model. If the elasticity estimate is between zero and one in absolute value, the demand for import can be described as inelastic. This implies that the demand for import is fairly unresponsive to changes in prices. If an elasticity estimate is greater than one, the demand for import can be described as being elastic or responsive to changes in market prices.

Generally, all the import demand elasticity estimates are significant and greater than unity. The elasticity parameters range from -1.19 for textiles and apparels to -2.78 for vegetable oils, with an average of -1.52. This implies that import demand in Kenya is fairly elastic and when international prices fall, import demand rises by a more than proportionate amount[47]. Thus, changes in international prices are likely to have effects on the country's trade balance. However, it should be noted that import surges are likely to

[47] It is however debatable as to whether the import elasticity estimates are large enough to imply for this possibility.

occur from price falls depending on whether the own price elasticities for demand for the products in the sector are elastic or not.

Table 5-1: Sectoral Import Demand Elasticity Estimates for Kenya

Sector	Sector Description	Import Demand Elasticity	t-ratios
1	Grains	-1.59	-22.06
2	Fruits and vegetables	-1.30	-4.47
3	Meat and Livestock	-1.20	-9.15
4	Other agriculture	-1.35	-7.86
5	Vegetable oil	-2.78	-4.06
6	Dairy	-1.20	-9.15
7	Other processed food	-1.35	-7.86
8	Beverages and tobacco	-1.41	-16.49
9	Textiles and apparels	-1.19	-14.91
10	Crude oil	-1.90	-7.83
11	Other manufacturing	-1.50	-8.95

Source: Author's calculations

The import demand elasticity estimates for the various sectors differ marginally across various sectors in accordance with the first hypothesis. Besides, the elasticity estimates are mixed and do not reflect diversity between agricultural and other sectors. The differences in elasticity of import substitution may be due to differences in the level of engagement of multinational presence in the sectors as found by Blonigen and Wesley (1999) and the level of product differentiation according to Feenstra and Hiau (2004).

The import demand elasticities for agriculture products are not smaller as expected. In fact, the sectors that exhibit highest elasticity estimates are vegetable oil, grains and beverages and tobacco. Besides, crude oil whose demand was expected to be inelastic, especially in developed countries, appears fairly elastic at 1.90. Although the latter can be considered to be fairly small, this can mainly be attributed to market distortions arising from government interventions in fuel imports and distribution that make import demand appear elastic than the market demand.

Furthermore, the elastic nature of the import elasticities can be attributed to homogeneity of the products in question. Generally, homogeneous products tend to have bigger import elasticities compared to heterogeneous products following Kee., *et al*., 2008. In addition, the elastic nature of agricultural products can be attributed to the fact that substantial amounts of agricultural imports are in the form of aid and depend on shortages realized from domestic productions.

The results are well within the range of previous econometric findings for Kenya and other developing countries (Table 5.2). For instance, Jones (2008) found the average import demand elasticity for Kenya as 1.148 while the average elasticities for the other Africa countries ranged between 1 and 1.53. In addition, the elasticity estimates in this study seem to be larger than those by Kee, Nicita and Olarreaga (2008), even though all the three cases demonstrate the elastic nature of import demand in Africa.

Table 5-2: Comparative Results for Import Demand Elasticities by other Studies

Study	Average price elasticity of demand for imports
Jones, 2008	-1.148
Kee, Nicita and Olarrega, 2008	-1.114
Faini, Pritchett Clavijo 1988	-1.48
Tegene, 1989	-2.12

Source: Various studies

According to Zang and Varikios (2006), import demand elasticities in econometric literature tend to take elasticity values in the range of 1 to 3, while pegged at relatively higher values in CGE models. The World Bank assumes import demand elasticity values of between 3 and 6, whereas the GTAP model assumes the values in the range of 1.9 and 5.2 as indicated in Appendix E (Table E-9).

5.3 Simulation Results for Exogenous Price Shocks

5.3.1 Oil Price Shocks

Two separate simulations are carried out in this experiment; the first simulation describes a 50 per cent increase in crude oil prices in the "rest of world" region, which is a large oil exporter in the global economy; and the second, is a 50 per cent reduction in the prices[48]. External price shocks affect oil market prices through the changes in demand for refined oil products including gasoline, diesel, kerosene and jet fuel etc. The results for both simulations are presented together and comparisons made regarding the direction and magnitude of the changes.

(a) Effects of exogenous shocks on local market prices

The results showing changes in domestic prices of selected goods and services are presented in Table 5-3. Being a net importer, the rise of an essential input like oil raises the cost of production of domestic firms and reduces its aggregate demand in the domestic economy. Consequently, the exchange rate depreciates, inflation rises and unemployment increases. In this case, the model transmits a 50 per cent increase crude oil prices to the domestic market prices, showing diversity in magnitudes and directions of the price changes for the various products as evident in Table 5-3.

A general observation is that the changes in domestic prices for all products are very small in absolute values. However, there are significant changes in the corresponding domestic product, in this case the oil products. The results indicate a 25.5 per cent increase in the domestic market price of oil following a 50 per cent increase in international market price.

[48] An increase in international prices is defined as a 'positive shock' whereas a decrease is a 'negative shock'

Table 5-3: Changes in Domestic Market Prices

Commodity	Positive price shock (%)	Negative price shock (%)
Grains	-1.46	1.66
Fruits and vegetables	-1.11	1.05
Meat and Livestock	-1.34	1.16
Other Agriculture	-0.70	0.45
Vegetable oil	-1.04	0.48
Dairy	-0.73	-0.03
Other processed foods	-1.44	1.18
Beverages, tobacco	-1.66	1.42
Textiles and apparel	-0.46	-0.54
Crude oil	25.51	-39.23
Other manufacturing	0.23	-1.64
Transport and communication	1.77	-3.86
Business services	-2.02	1.84
Other services	-0.39	-0.01

Source: Author's simulations

However, although the domestic prices increase in general, there is a less than full transmission of global price changes to domestic markets. This is mainly due to the relatively low elastic import elasticity of substitution for crude oil in the Kenyan market reported in Table 5-1.

The effects of external price shocks on domestic market prices are central to household welfare. Specifically, the increase in international prices leads to a more than proportionate decline in the domestic demand for crude oil products. Hence, although domestic prices increase, they do so at a lower rate relative to the increase in international prices due to depressed domestic demand. In addition, the relatively higher changes in domestic oil prices can be attributed to the higher trade share of the sector in comparison with other sectors. From the baseline data, the import share of household consumption spending of crude oil stood at 57 per cent, whereas the export share of production was 22 per cent.

Moreover, there is less than full transmission of international oil prices to domestic market due to government interventions and existing market distortions within the sector. For instance, Mutua (2013) established that domestic taxes, levies and other charges on petroleum products comprise about 26 per cent of the final domestic market prices in Kenya. Additionally, kerosene is subsidized due to consideration of welfare implications on the rural and urban households. The market distortions are largely attributed to the oligopolistic nature of the market for oil products as alluded to in previous chapters.

The effects on domestic prices for the other sectors are marginal and negative, except for transport and communications and other manufacturing sectors. Meanwhile, the transport and communication services and the other manufacturing sectors experience positive but less than full transmission of international price increases. This is because they are oil intensive sectors and have few domestic substitutes, hence higher domestic prices.

Contrary to expectations, the increase in international crude oil prices negatively affects the domestic prices of agricultural commodities, though the changes are marginal. The likely reason for this is that the rise in international prices strongly reduces aggregate demand in the economy given the elastic nature of the import demand elasticities. Consequently, domestic prices are pulled down as consumers cut down their expenditures. On the other hand, agricultural producers, especially for fruits and vegetables and other agriculture are motivated to produce more following the increase in producer prices which further depress domestic agricultural prices.

With regard to negative price shocks, the effects on domestic prices are in the reverse. In this case, domestic oil prices fall by 39 per cent following a 50 per cent reduction in imported prices. It is notable that the effects are asymmetric with the negative oil price shock having bigger effects in absolute terms compared to the positive shock of similar magnitudes. Similarly, domestic prices of textiles and apparels, manufacturing and transport and communications sectors fall marginally by higher magnitudes.

On the other hand, the effects on domestic prices for the other remaining sectors are mixed. The domestic prices of agricultural commodities increase marginally due to increased household demand, arising from improved disposable incomes. However, the domestic price changes are generally low, taking into account the relatively low level of correlation observed between international and domestic oil prices. The other potential reason is that there are very few alternatives to imported oil products in the Kenyan economy and therefore consumers have limited options of energy sources to choose from.

(b) Effects of international price changes on relative aggregate imports

Generally, an increase in international oil prices has a negative effect on the quantities of domestic imports, but the magnitudes of the changes on aggregate imports differ across sectors (Table 5-4). Apparently, the sectors with the highest import demand elasticities do not necessarily experience the biggest changes in aggregate imports. For instance, the biggest fall in imports occur in the other manufacturing sectors, crude oil, other agriculture and the other processed food sectors. From the baseline data, these sectors account for the biggest import share of household consumption spending and export shares of production.

Table 5-4: Changes in Relative Aggregate Imports

Commodity	Positive price shock (%)	Negative price shock (%)
Grains	-5.38	8.68
Fruits and vegetables	-5.84	10.94
Meat and livestock	-1.83	3.90
Other agriculture	-23.61	43.46
Vegetable oil	-3.67	5.38
Dairy	-1.41	2.53
Other processed foods	-14.72	26.05
Beverages and tobacco	-2.70	4.58
Textiles and apparel	-11.56	17.33
Crude oil	-59.80	81.21
Other manufacturing	-97.87	156.58
Transport and communication	-7.67	6.66
Business services	-12.31	13.01
Other services	-2.81	0.97

Source: Author's calculations

Furthermore, it is notable from the results that imports for oil and other manufacturing products drop by more than the 50 per cent following the 50 per cent increase in international prices. The relatively high reduction in oil imports can be attributed to very low share of oil in total industry value which was estimated at 0.9 per cent from the baseline data. This implies that the bulk of the oil imports are consumed as finished products in the form of gasoline, diesel, kerosene etc. The other reason can be attributed to presence of alternative markets from which to source these products, should there be major price changes in supply markets.

Subsequently, the same sectors are also subjected to the biggest upward adjustment in imports, when there is a 50 per cent fall in international oil prices. However, it is also notable that a drop in international oil prices has bigger effects on aggregate imports in absolute terms compared to a rise in the prices by similar levels.

(c) Effects of oil price changes on household demand and industry outputs

International oil prices affect household demand as defined in the behavioral equations in Appendix B-3. The results show that a 50 per cent increase in oil prices in the global market leads to a general cut-down in aggregate household commodity consumption. However, cut-down in household demand is very minimal due to lack of ready alternative sources of energy. In addition, fuel constitutes a small share of household direct consumption spending, hence the relatively small effects.

As shown in Table 5-5, the reduction in household demand is mainly pronounced in the demand for oil products, which reduced by 9.7 per cent. The marginal reductions in household demand is mainly attributed to cut-down in consumption of refined oil products namely, gasoline, diesel and kerosene which go into direct consumption as finished products. Retail pump outlets and road transport constitute the biggest share of consumption of petroleum products in Kenya.

Table 5-5: Change in Relative Aggregate Household Demand and Output

Commodity	**Household demand**		**Industry output**	
	Positive price shock (%)	Negative price shock (%)	Positive price shock (%)	Negative price shock (%)
Grains	-1.64	2.59	-1.08	1.79
Fruits and vegetables	-1.48	2.32	-0.65	1.13
Meat and Livestock	-1.47	2.27	-0.34	0.39
Other agriculture	-5.07	7.83	2.41	-2.63
Vegetable oil	-2.33	3.86	12.56	-15.90
Dairy	-3.31	5.35	-2.07	3.76
Other proc. foods	-1.20	1.86	0.34	-0.77
Beverages, tobacco	-2.18	3.41	-0.75	0.76
Textiles and apparel	-3.57	5.63	-0.65	2.25
Crude oil	-9.74	33.24	3.39	-24.40
Other manufacturing	-3.62	5.87	3.66	-6.85
Transport and communication	-3.97	6.42	-0.53	1.89
Business services	-2.83	4.17	-0.67	0.39
Other services	-3.58	5.42	-0.89	0.89

Source: Author's calculations

It is possible that consumers use alternative means of transport to minimize direct costs emanating from price increases. Oil intensive sectors also experience relatively higher reductions in demand, for example other agriculture (-5.1 per cent), transport and communication (-3.97 per cent), other manufacturing (-3.62 per cent) and textile and apparels (-3.57 per cent).

On the other hand, households demand for all product categories increase when international oil prices are reduced by 50 per cent. As is the case with previous scenarios, household demand for all commodities increase by bigger margins in absolute terms, compared to the case for positive oil price shocks. The biggest increases in household demand are in energy products (33 per cent), other agriculture (7.8 per cent) and transport and communication (6.4 per cent) sub-sectors. The large increase in household demand due to price cut-downs is a pointer to the welfare changes that domestic consumers experience in the events of oil price shocks.

There are mixed impacts on industry output when the global market oil price increases. Households consume less imported products and substitute to the cheaper alternative domestic products. This leads to the apparent increase in domestic production of alternative energy products by 3.4 per cent. The highest increase in output takes place in the vegetable oils industry, which expands by 12 per cent. According to the baseline, the industry's import share of household consumption of vegetable oils is 78 per cent. This may be explained by the fact that a rise in international oil prices leads to depreciation of the domestic currency against the US dollar which makes the imports relatively expensive. Subsequently, resources move towards production of vegetable oils

away from other sectors like grains, fruits and vegetables and meat whose production contract marginally.

On the other hand, manufacturing, transport/communications and other services, are the most oil-intensive sectors. Outputs of the latter two industries fall, but other manufacturing outputs rise by 3.7 per cent due to depreciation of the real exchange rate and an increase in the sector's exports. With regard to reductions in global oil prices, the imported products become cheaper leading to a shift in demand away from domestic products. Significant contraction in domestic industry outputs occur in domestic oil sector (-24.4 per cent), vegetable oil (-15.9 per cent) and the other manufacturing (-6.8 per cent).

(d) Effects on relative returns to factors of productions

The changes in returns to factors of production due to global oil price shocks are presented in Table 5-6. A 50 per cent increase in oil prices in the rest of the world leads to reductions in the returns to all factors, except for natural resources. The fall in factor returns arises from the fall in demand for imported oil products and subsequently reduced outputs in oil intensive industries. In that regard, the wages for professional labour, agricultural workers and skilled labour fall greatest, reflecting their employment in the oil intensive service related sectors. In contrast, the factor returns to natural resources increase.

An increase in oil prices reduces the demand for imported oil and leads to a shift in demand towards alternative energy sources. Subsequently, the return to factors used intensively in these sectors, notably natural resources, increase in accordance with the Stolper-Samuelson theorem.

Table 5-6: Changes in Relative Factor Returns due to Crude Oil Price Shocks

Factor	Percentage change in factor return (Positive price shock)	Percentage change in factor return (Negative price shock)
Land	-2.08	5.55
Natural resources	7.02	-8.50
Unskilled rural labour	-1.21	2.50
Unskilled urban labour	-2.62	3.98
Agricultural workers	-3.13	5.94
Skilled labour	-3.01	4.52
Professional labour	-3.27	4.69
Agricultural capital	-2.59	4.17
Non-agricultural capital	-2.81	4.29

Source: Author's calculations

At the same time, a negative oil price shock in the rest of the world leads to a rise in the factor returns in all sectors, except the natural resources. In this case, the wages for agricultural and professional workers and returns to land experience the highest increases. On the other hand, returns to natural resources factors decline, reflecting a shift in demand from locally produced alternative energy products to relatively cheaper imported oil products. The results on factor returns are consistent with the Stolper-Samuelson theorem.[49]

(d) Effects on relative household incomes

When there are changes in international oil prices, the aggregate domestic demand for the products change. Consequently, firms make changes in their production decisions thereby affecting the employment of factors of production and therefore incomes to various households and other factors of production. The relative changes in household incomes due to the oil price rise are presented in Table 5-7. Overall, there are very

[49] It is notable that the negative price shocks instigate bigger effects compared to positive price shocks.

minimal changes in household incomes for all groups arising from positive or negative international oil price shocks.

The results indicate that when there is a 50 per cent increase in global prices, there exists slightly higher reductions in urban household incomes compared to rural households, but effects are generally uniform. The urban non-poor household incomes experience the biggest declines among urban households, reflecting the relatively larger decline in real wages for professional workers and skilled labour, which are primary sources of their earnings.

Table 5-7: Changes in Relative Household Incomes

Household category	Positive price shock (%)	Negative price shock (%)
Rural Hardcore Poor (RHCP)	-2.85	3.91
Rural Poor (RP)	-2.78	3.70
Rural Non-Poor (RNP)	-2.74	3.50
Urban Hardcore Poor (UHCP)	-2.73	2.98
Urban Poor (UP)	-2.86	3.17
Urban Non-Poor (UNP)	-3.01	3.36

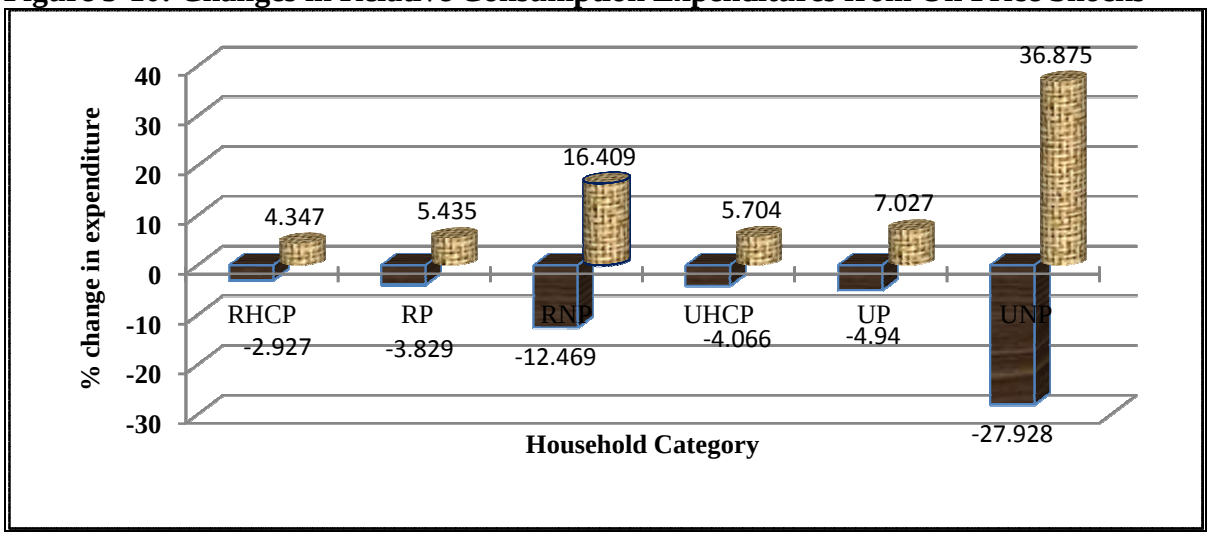
Source: Author's calculations

On the other hand, the rural hardcore poor experience the biggest declines among rural households, reflecting the relatively large decline in agricultural wages, which are their primary sources of income. Analogously, a 50 per cent reduction leads to an increase in the incomes of all categories of households. The effects are however relatively bigger than those from positive price shocks in absolute terms. The rural hardcore poor and the urban non poor households realize the biggest increase in their incomes. This is due to the high returns realized from land and agricultural capital for the rural households and non-agricultural capital from which majority of urban non-poor households draws their incomes.

(e) Changes in relative private consumption expenditures by household categories

Figure 5-1 shows the changes in households' consumption expenditures due to positive and negative oil price shocks in the rest of the world.

Figure 5-10: Changes in Relative Consumption Expenditures from Oil Price Shocks



Source: Author's compilation

Generally, positive price shocks lead to a decline in consumption expenditures across all household categories, whereas negative price shocks lead to a rise in the expenditures. The expenditures for rural non poor and urban non-poor households reduce by the biggest margins when there international oil price shocks occur just as is reflected in the effects on household incomes. This is because non-poor households draw their incomes largely from energy-intensive sectors. Thus, any shocks that affect the demand for oil products affect their incomes and subsequently, their consumption expenditures.

In addition, the budget shares for Kenyan household expenditures reflect relatively bigger share of expenditures by non poor households on other services, including utilities, construction and hospitality services. The price elasticity of demand for these services is generally elastic in nature and consumers reduce their consumption

or demand alternative services altogether. Besides, the provision or supply of these services are highly affected by changes in oil prices, hence their demand in the markets.

5.3.2 Agricultural and Processed Food Price Shocks

This experiment describes the world price scenarios for agricultural and processed food commodities shown in Table 4-5. Price shocks are applied by fixing and shocking prices in the major food exporting countries into Kenya. The results for the food price shocks are presented in two broad categories; positive price shocks and negative price shocks as discussed below.

(a) Changes in relative domestic market prices

The results indicate that positive global food price shocks marginally raise domestic prices for food and processed food commodities, but have minimal effects on non-food products as indicated in Table 5-8.

Table 5-8: Changes in Relative Domestic Market Prices

Commodity	Positive price shock	Negative price shock
Grains	3.98	-5.64
Fruits and vegetables	3.52	-5.05
Meat and Livestock	2.98	-3.82
Other agriculture	2.09	-2.68
Vegetable oil	2.07	-2.21
Dairy	1.77	-1.73
Other proc. foods	2.62	-3.00
Beverages, tobacco	2.28	-2.32
Textiles and apparel	0.20	-0.22
Crude oil	-0.01	0.01
Other manufacturing	0.23	-0.24
Transport and communication	-0.22	0.29
Business services	0.27	-0.26
Other services	0.62	-0.69

Source: Author's simulations

Similarly, negative price shocks marginally reduce domestic prices. However, the resultant effects are asymmetric in the sense that global price declines have relatively

bigger effects on domestic markets for food items compared to price surges. In addition, the results indicate that there are very limited effects of international price shocks on non-food items.

In general, the results imply that there is low transmission of prices to the domestic market or low integration between domestic and international markets for agricultural-related products. These results are consistent with previous studies, notably Karugia, *et al.*, 2013 which found that food prices in the Eastern African region show a different pattern and fluctuate more than the world prices. The cointegration results also suggest that domestic prices correlate more with each other than with world prices and the influence of world price developments is relatively small compared to regional price developments in maize, wheat and beans. Besides, Abbot and Battisti (2011) also established that domestic prices in the East African region show limited responses.

The weak relationships between international and domestic market prices in Kenya is mainly attributed to direct government interventions via trade policies, including changes in import duties, imposition of export/import bans and domestic policies such as taxes, subsidies and price controls. In addition, the domestic market prices are shielded from external price shock effects by high transaction costs arising from poor transport and communication infrastructure. According to FAO (2009) the operations of the National Cereals and Produce Board (NCPB) which maintains some influence in the grain sector through involvement in procurement of imported produce and subsequent release of food at predetermined prices.

(b) Changes in relative household demand and industry outputs

The results indicate increments in household demand for domestic products in all sectors, except non-food items when international food prices increase (Table 5-9). The largest increments in household demands are in dairy, other agriculture and grains sectors. Other sectors with notable increments in demand are vegetable oils, other agriculture, and textiles and apparels.

Table 5-9: Changes in Aggregate Household Demand and Output

Commodity	Household demand		Industry output	
	Positive shock	Negative shock	Positive shock	Negative shock
Grains	1.06	-0.97	2.16	-4.12
Fruits and vegetables	0.61	-0.41	1.71	-4.53
Meat and Livestock	0.41	-0.27	0.91	0.62
Other agriculture	1.22	-0.74	-1.81	3.19
Vegetable oil	0.88	-1.15	4.08	-3.30
Dairy	1.71	-1.72	1.24	-1.31
Other proc. foods	0.31	-0.22	0.38	0.66
Beverages, tobacco	0.73	-0.66	-0.09	0.00
Textiles, apparel	0.93	-0.65	0.03	-0.41
Crude oil	-0.05	0.44	-0.20	0.27
Other manufacturing	0.01	0.33	-1.35	1.09
Transport & communication	-0.10	0.42	0.16	-0.19
Business services	-0.45	0.74	-0.38	0.43
Other services	-1.02	1.54	-0.56	0.66

Source: Authors' calculations

Higher prices lead to increase in the returns to factors used in production of agricultural products including, agricultural labour, agricultural capital and unskilled labour. Subsequently, household incomes and consumption demands would increase. The reverse takes place when there is decline in international food prices. However, the effects on demand are very marginal given the low level of transmission of external to domestic prices.

With regard to industry outputs, a rise in international food prices results into reduction in demand for imported products and increased demand for domestic products. This puts upward pressure on domestic prices thereby stimulating domestic outputs in primary agricultural sectors, including grains, fruits, vegetable oils, meat/livestock and dairy products increase. At the same time, higher prices and factor returns in these sectors lead to a shift in employment of factors in their favour, resulting to a decline in outputs of the other agricultural and manufacturing sectors. The increase in international prices also leads to appreciation of the real exchange rate making imports cheaper relative to exports. These changes further influence household demand for imports versus domestic products and industry outputs. The substitution towards imports of other agricultural products for example sugar and forestry due to exchange appreciation causes their outputs to decline. In addition, a decline in exports demand causes outputs of the export-oriented "other agriculture" and manufacturing sectors to fall.

Conversely, reduction in international prices significantly depresses demand for outputs in the grains, fruits and vegetables and vegetable oils. This is due to increased demand for imported products, reduced demand for domestic products and returns to factors of production intensively employed in these sectors and subsequent shift of labour towards the other agriculture sectors.

(c) Effects on relative returns to factors of production

The changes in returns to factors of production following food price shocks are presented in Table 5-10. Global rise in food prices leads to significant increases in returns to land, agricultural workers and agricultural capital, gains that are driven by the increase in demand for and production of domestic food products. These factors are intensively

used in the production of agricultural commodities. A larger share of the earnings accrues to rural as opposed to urban households.

However, the returns to rural unskilled labour are negative, though negligible. This is due to the fact that the owners may not own land and are net buyers of agricultural products. In addition, the real returns to natural resources, skilled labour, urban unskilled labour, non-agricultural workers and professionals are significantly negatively affected, reflecting the declines in output of the industries in which they are mainly employed.

Table 5-10: Change in Factor Returns due to Food Price Shocks

Factor	Percent change in factor return (Positive shock)	Percent change in factor return (Negative shock)
Land	5.39	-9.42
Natural resources	-5.05	10.01
Unskilled rural labour	-0.07	1.07
Unskilled urban labour	-1.96	2.94
Agricultural workers	4.45	-7.04
Skilled labour	-1.92	2.47
Professional labour	-2.17	3.07
Agricultural capital	1.64	-0.61
Non-agricultural	-2.33	3.21

Source: Author's calculations

On the other hand, reduction of international food prices significantly increases the factor returns to natural resources, professional labour, unskilled urban labour and skilled labour portraying a shift of resources away from primary agricultural sectors, that is, land and other agriculture. Subsequently, there is contraction of output in the industries in which the latter factors are intensively employed leading to significant reductions in the returns to these factors. These results are also consistent with the Stolper-Samuelson theorem.

(d) Effects on relative household incomes

A positive food price shock raises the incomes of all rural households and reduces the incomes of urban households, mainly reflecting the importance of rising agricultural wages in household income streams (Table 5-11). The rural hardcore poor households experience the largest increase in incomes, followed by the rural poor and rural non-poor.

Table 5-11: Effects on Relative Household Incomes

Household category	Percentage change from base (Positive shock)	Percentage change from base (Negative shock)
Rural hardcore poor	5.06	-6.25
Rural poor	4.45	-5.37
Rural non-poor	3.89	-4.52
Urban hardcore poor	-0.03	0.12
Urban poor	-0.04	0.08
Urban non-poor	-0.27	0.37

Source: Author's calculations

Thus, higher international food prices generally benefit rural Kenyan households more than the urban households, reflecting the former's position as producers and suppliers of agricultural products. However, urban households realize marginal loss of incomes. The small reduction in the incomes of the urban households may be attributed to several factors. First, the urban households are net buyers of agricultural products. Thus, an increase in food prices reduces their disposable incomes, given the relatively low price elasticity of demand for food items. Secondly, the earnings from professional labour, skilled and unskilled labour and non agricultural capital for which majority of urban dwellers are employed reduce unlike those for agricultural labour, agricultural capital and land when food prices increase. In other words, nonfarm wages are not likely to be adjusted to the general price increases brought about by the food price increases. Third, urban households have to pay more to maintain adequate diets, hence eroding their disposable incomes. However, the changes in urban household incomes are marginal

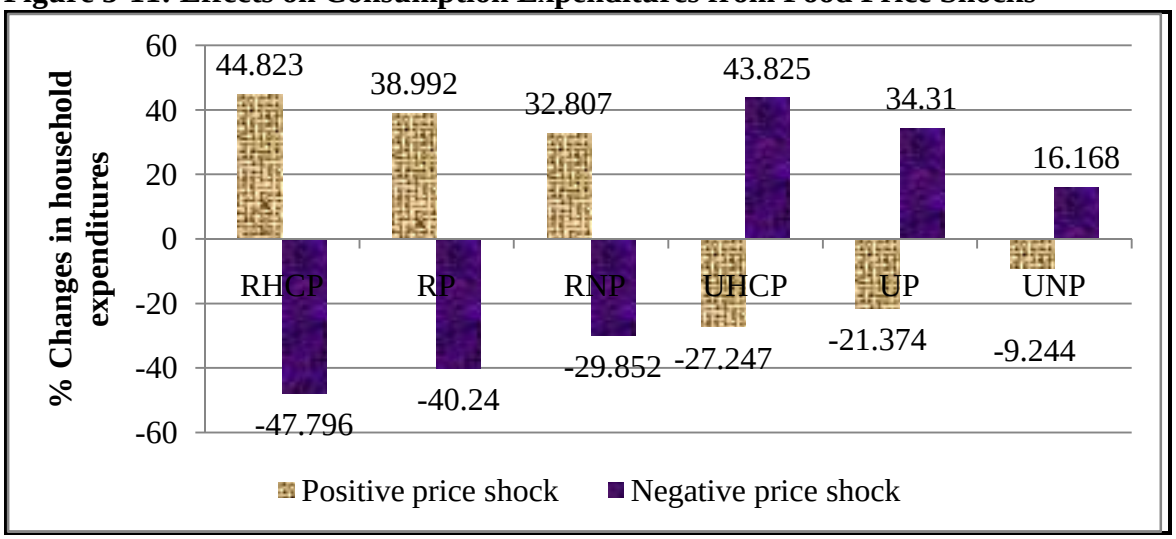
since their share of expenditures on food items are relatively low compared to their rural counterparts.

Conversely, reduction in international food prices significantly depresses the incomes for the rural households, compared to urban households. The incomes for rural poor, rural non-poor and rural hardcore poor are the most affected. This is mainly due to reductions of returns from agricultural labour, agricultural capital and land for which majority derive their earnings from. These results are consistent with previous studies by Arndt, *et al*. (2008) and Benfica (2012). These studies established that rural households' incomes rise in response to positive food price shocks as opposed to urban households.

(e) Effects on private consumption expenditures by household categories

International food price shocks affect rural and urban households' consumption expenditures in the opposite directions. As shown in Figure 5-2, a positive food price shock raises the consumption expenditures of all rural households, led by the rural hard core poor, but reduces the expenditures for all urban household categories. The rural households gain from the increased food prices as a result of higher returns of labour and profits and therefore higher disposable incomes and spending. From the results, the rural households mainly increase their consumption expenditures on other agricultural products including tea, sugar, vegetable oils and dairy products. On the other hand, urban households reduce their expenditures due to lower returns and since they are net buyers of food commodities. Similarly, urban households cut down their expenditures on vegetable oils, other agricultural products and other manufactured products. It is also notable that much of the changes in rural and urban household consumptions occur for vegetable oils, which has the largest import share of consumption spending.

Figure 5-11: Effects on Consumption Expenditures from Food Price Shocks



Source: Author's computations

5.3.3 The Combined Food and Oil Price Shocks Simulations

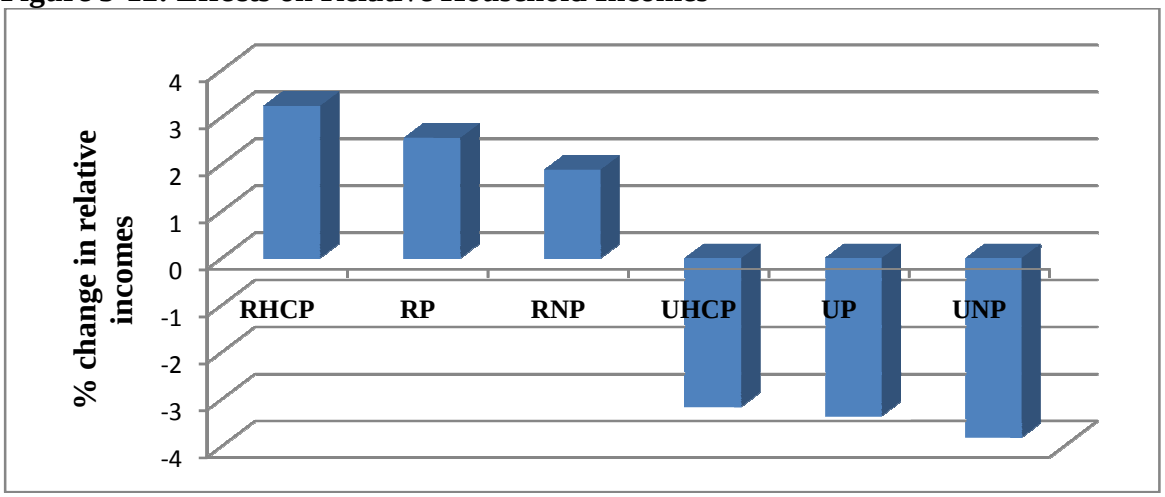
In this experiment, a combined positive food and oil price shock is carried out in accordance with the world price scenarios presented in Table 4-5. This is prompted by the fact that changes in international prices do not take place in isolation and the 2007 - 2008 episodes are a case in point. Besides, food and oil prices correlate with each other and the net effects are unpredictable. The effects on household incomes and demands are presented as follows.

(a) Effects on Relative Household Incomes

When there is a combined positive food and oil price shock, the relative incomes for urban households are reduced, while those for rural households increase (Figure 5.3). This is due to the fact that the erosion of rural household incomes are partially compensated for by the gains from rise in food prices as opposed to urban households whose incomes are depressed by both price shocks. The simulation results also indicate

positive effects on the incomes of all rural households, attributed to increased factor returns in the domestic agricultural sector.

Figure 5-12: Effects on Relative Household Incomes



Source: Author's computations

Further, a comparison of the results of the combined simulations is presented in Table 5-12. The results indicate that whereas positive oil price shocks depress rural household incomes, positive food price shocks raise their incomes by bigger margins and the net effects are that they gain when both shocks occur at the same time. On the other hand, the incomes of all urban households are depressed by both oil and food price shocks.

Table 5-12: Comparison of Effects of various Price Shocks on Household Incomes

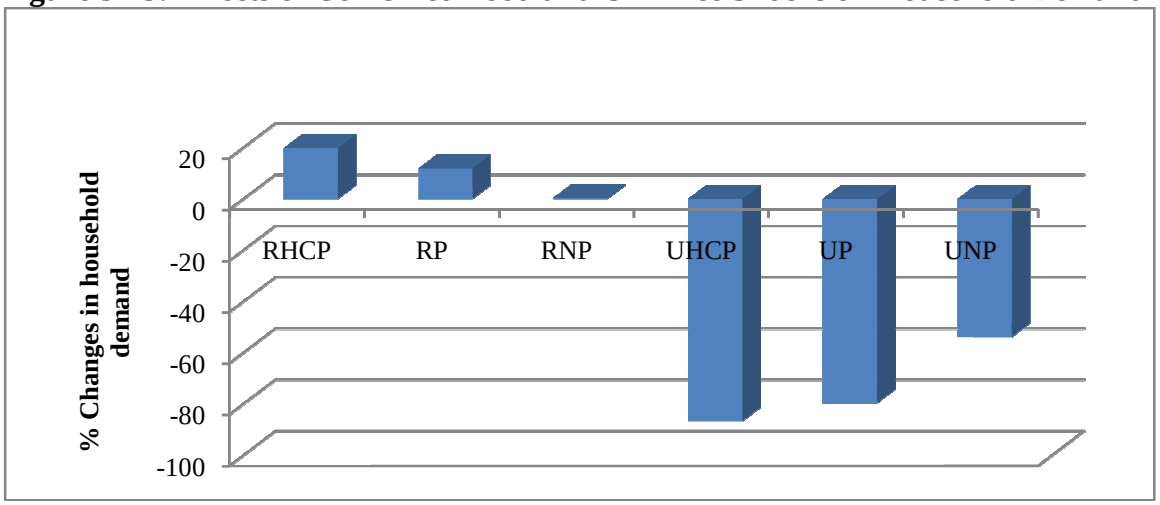
Household category	Effects of Oil Price Shocks	Effects of Food Price Shocks	Effects of Combined oil and Food Price Shocks
Rural hardcore poor	-2.85	5.06	3.24
Rural poor	-2.78	4.45	2.56
Rural non-poor	-2.74	3.89	1.88
Urban hardcore poor	-2.73	-0.03	-3.16
Urban poor	-2.86	-0.04	-3.36
Urban non-poor	-3.01	-0.27	-3.81

Source: Author's computations

(b) Effects on Household Demands

The effects of combined international food and oil price shocks on household demands are presented in Figure 5-4. The contraction in demand that would have been expected from the rise in oil prices for rural households is reversed by more than proportionate expansion of demand resulting from the rise in agricultural prices.

Figure 5-13: Effects of Combined Food and Oil Price Shocks on Household Demand



Source: Author's computations

However, although all the categories of rural households experience net positive household demand, the demand for specific commodities are mixed across the various households. For instance, the increase in household demand is mainly prominent for vegetable oils and energy products for all the categories of households as indicated in Table 5-13. It is also notable that the demand by rural hardcore poor households increases for all products, though by different magnitudes. On the other hand the household demands by rural poor households are largely positive but a few are negative. The household demands by rural non poor for most products are negative, though relatively small in magnitude with significant increases in demand for vegetable oils and energy related products.

Table 5-13: Effects on Demand by Product and household categories

	Rural Hard Core Poor	Rural Poor	Rural Non Poor	Total
1. Grains	0.27	-0.22	-0.92	-0.87
2. Fruits & Veges	0.44	0.05	-0.50	-0.01
3. Meat	0.31	-0.06	-0.61	-0.36
4. Oth Agriculture	0.96	-0.18	-1.82	-1.04
5. Vegetable Oils	5.38	4.73	3.80	13.91
6. Dairy	0.97	0.10	-1.15	-0.09
7. Other Foods	0.27	-0.01	-0.43	-0.17
8. Bev& Tobacco	0.71	0.14	-0.70	0.15
9. Text & Apparels	1.05	0.37	-0.61	0.81
10. Energy	5.27	4.85	4.24	14.36
11. Manufactures	1.91	1.38	0.63	3.92
12. Trans & Com	0.34	-0.17	-0.91	-0.73
13. Busi Services	1.28	0.75	-0.02	2.00
14. Other services	0.69	0.17	-0.58	**0.27**

Source: Author's computations

On the other hand, all urban households demand for all products substantially contract, except for vegetable oils (Table 5-14). The biggest reductions in demand are registered in non-agricultural sectors including, energy, other agriculture, transport services, other manufacturing and business services.

Table 5-14: Effects on Demand by Product and household categories

	Rural Hard Core Poor	Rural Poor	Rural Non Poor	Total
1. Grains	0.11	0.11	0.11	0.33
2. Fruits & Veges	-1.62	-1.48	-0.99	-4.10
3. Meat	-2.86	-2.65	-1.87	-7.37
4. Oth Agriculture	-11.53	-10.68	-7.57	-29.78
5. Vegetable Oils	3.05	3.19	3.71	9.95
6. Dairy	-4.23	-3.90	-2.70	-10.83
7. Other Foods	-2.83	-2.62	-1.84	-7.28
8. Bev& Tobacco	-4.45	-4.10	-2.82	-11.37
9. Text & Apparels	-10.15	-9.32	-6.28	-25.75
10. Energy	-12.07	-11.39	-8.92	-32.37
11. Manufactures	-9.44	-8.61	-5.56	-23.60
12. Trans & Com	-11.01	-10.19	-7.22	-28.42
13. Busi Services	-9.37	-8.53	-5.43	-23.33
14. Other services	-10.39	-9.57	-6.54	-26.50

Source: Author's computations

Generally, the results indicate that external positive food and oil price shocks affect households differently depending on whether they are rural or urban as well as their levels of incomes. The urban households are more adversely affected compared to their rural counterparts. Besides, the poorest households in both categories of households are the most severely affected. In that respect, the policy response experiments carried in the next section targets the most vulnerable household categories to the combined external shocks.

5.4 Policy Response Simulations

5.4.1 Introduction

In this section, two policy responses to the combined international positive food and fuel price shocks are simulated. The choices of the specific simulations are considered on the basis of the resulting effects of the combined food and oil price shocks on relative household incomes and demands. The first is a tariff reform scenario, in which tariffs are removed on all imported food and fuel products from international markets. Trade theory suggests that removal of tariffs can lower the domestic market prices of these commodities and reduce the burden on consumers. From the baseline data, the tariffs on imported oil products are already relatively low, averaging 3.4 per cent, across all import sources. In contrast, major food commodities are designated as sensitive products and therefore attract relatively higher tariffs in order to protect domestic industries or sectors.[50]

[50] The EAC customs union protocol and the Customs Management Act stipulates the tariff rates for the sensitive products as Milk (60%), wheat (35%), maize (50%), rice (75%), textile products (50%) etc.

The second policy response involves the provision of transfer payments to urban hardcore poor households, and to all urban poor, that are sufficient to maintain their pre-shock level of utilities.[51] Cash transfer payments are critical social protection strategies for reducing vulnerability of the population to economic, social and natural shocks and stresses. Unlike the existing transfers under the national social protection programme which target orphaned children and elderly persons, the analysis carried out in this thesis seeks to establish the extent to which the households adversely affected by the combined price shocks should be compensated to restore their income and consumption levels prior to the shocks. The other assumption is that rural households may be constrained to produce enough foods for own consumption and for sale to urban households at competitive prices. Besides, previous methods like subsidizing food prices are difficult to implement and prone to mismanagement or abuse by otherwise non affected households.

5.4.2 Temporary Tariff Reduction Interventions

(a) Effects on household demands

The results from the tariff policy experiment on household demands are presented in Table 5-15. Removal of tariffs lowers the purchasers' price of imported goods, relative to the purchasers' price of domestic substitutes. However, the extent to which it increases the demand for commodities depends on the elasticity of substitution between the imports and domestic substitutes, and the income elasticity of demand of households.

The results for tariff reforms indicate that removal of tariffs lead to marginal improvements in demand by households in all sub-sectors, especially for other

[51]In the combined price shock scenario, rural hardcore poor and rural poor households achieve a net benefit from the rise in food prices, despite the rise in energy prices. Thus, compensating transfers are therefore not needed.

agriculture, crude oil and other services. This shows that trade reforms play an important role in ameliorating, although not offsetting, the effects of significant terms of trade deterioration on household consumption. Due to the fact that domestically produced and imported food items are not perfect substitutes, there are relatively low effects on demand despite complete removal of import duties.

Table 5-15: Effects of Tariff Reduction on Household Demand on Commodities

Product	Change in household demand due to combined food and oil price shocks	Change in household demand with price shocks plus tariff reform	Net Change in HH demand due to tariff reform
Grains	-0.45	-0.33	0.12
Fruits and vegetables	-0.85	-0.56	0.29
Meat and Livestock	-1.09	-0.71	0.38
Other agriculture	-4.41	-1.55	2.86
Vegetable oil	-0.96	0.64	1.60
Dairy	-1.52	-0.63	0.89
Other proc. foods	-0.93	-0.45	0.48
Beverages, tobacco	-1.48	-0.83	0.65
Textiles and apparel	-2.93	-1.90	1.03
Crude oil	-11.14	-9.02	2.12
Other manufacturing	-4.19	-2.87	1.32
Transport, Communication	-4.76	-3.38	1.38
Business services	-3.85	-2.32	1.53
Other services	-5.44	-3.40	2.04

Source: Author's calculations

In terms of household categories, the results indicate that overall, tariff reforms lead to expansion of demand for urban households relative to rural households as indicated in Table 5-16. The increase in household demand is mainly on vegetable oils and other agricultural products, whereas this is spread for many products for the urban households especially other agricultural products, energy products, transport services, business services and other services including utilities and hospitality services. There is

however not much change for rural households with regard to household demands compared to the baseline scenario.

Table 5-16: Effects of Tariff Reduction on Household Demand on Commodities

Household category	Change in household demand due to combined price shocks	Change in household demand with price shocks plus tariff reform	Net Change in HH demand due to tariff reform
Rural hardcore poor	3.65	6.99	3.34
Rural poor	-4.21	1.44	5.65
Rural non-poor	-15.57	-9.26	6.31
Urban hardcore poor	-101.19	-63.77	37.42
Urban poor	-94.21	-59.17	35.04
Urban non-poor	-68.69	-45.05	23.64

Source: Author's calculations

(b) Effects on household Incomes

Generally, removal of tariffs on imported products provide greater benefits to urban than rural households. Ideally, the removal of tariffs tend to shift household demand from domestic to imported commodities, hence reducing domestic production and subsequently cutting down the income streams accruing to rural households (Table 5-17).

Table 5-17: Net Effects on Factor Earnings

Factor	Percentage change due to combined shocks	Percentage change due to combined shocks plus tariff reform	Net Percentage Change in factor returns
Land	6.10	4.79	-1.31
Natural resources	9.51	4.07	-5.44
Unskilled rural	-0.48	-0.93	-0.45
Unskilled urban	-5.46	-3.48	1.98
Agricultural	2.10	2.27	0.18
Skilled labour	-5.56	-3.90	1.65
Professional labour	-6.59	-4.71	1.88
Agricultural capital	-1.23	-1.14	0.09
Non-agricultural	-6.29	-3.70	2.59

Source: Author's calculations

Specifically, reduced demand for domestic products induces reduction of the demand for primary factors of production and lowers the factor returns (labour) employed in the rural areas, hence depressing incomes and household demand for the rural compared to the urban households.

Given the sizes of the assumed shocks in the model, these results take place because rural household incomes decline relative to the incomes of urban households in this scenario (Table 5-18). This is attributed to the dominating effects of agricultural price reductions following removal of tariffs relative to energy price changes for rural households.

Table 5-18: Net Effects of Price Shocks and Tariff Reforms on Household Incomes

Household category	Percentage change due to combined change in shocks	Percentage change due to combined change in shocks plus tariff reform	Net Percentage Change in HH incomes due to tariff reform
Rural hardcore poor	3.24	1.56	-1.68
Rural poor	2.56	1.05	-1.51
Rural non-poor	1.88	0.55	-1.34
Urban hardcore poor	-3.16	-2.49	0.67
Urban poor	-3.36	-2.60	0.76
Urban non-poor	-3.81	-2.94	0.86

Source: Author's calculations

Overall, the removal of tariffs keeps prices and hurt the farmers who constitute rural populations. At the same time, it is expected that producer prices decrease as more maize is supplied into the domestic market from external markets. Under the circumstances, farmers should respond to lower producer prices by increasing production, where as the government should encourage export of domestic supplies by farmers so as to enable them maintain or increase their incomes. Thus, the government should not impose export bans during food price escalations as such an intervention may hurt domestic farmers and rural populations.

5.4.3 Simulations of Cash Transfer Payments

In these experiments, the combination of food and oil price shocks and cash transfer payments is carried out. The unilateral cash transfer payments are made to the most affected households without exchange of goods or services, which increase the budget deficit and crowd-out savings available for private investments according to the model closure. The CGE model solves endogenously the size of the compensating transfer required to maintain the initial utility of households.

(a) Effects of cash transfer payments to urban hardcore poor households

The first income transfer experiment involves a cash transfer programme limited to urban hardcore poor households, which is the most vulnerable group to the combined food and crude oil price shocks as depicted in section 5.3.3. The results indicate that there are real consumption gains by the urban hardcore poor households as expected. In addition, all rural households also experience some positive gains which are linked to increased demand for agricultural commodities by urban households (Table 5-19).

Table 5-19: Consumption Effects of Transfers to Urban Hardcore Poor Households

	RHCP	RP	RNP	UHCP	UP	UNP
Grains	0.16	0.13	0.10	0.01	-0.00	-0.00
Fruits and vegetables	0.13	0.11	0.08	1.90	-0.06	-0.05
Meat and Livestock	0.13	0.11	0.08	3.01	-0.10	-0.07
Other agriculture	0.40	0.33	0.25	12.04	-0.38	-0.29
Vegetable oil	0.24	0.20	0.16	1.92	-0.05	-0.04
Dairy	0.32	0.27	0.21	4.67	-0.14	-0.10
Other proc. foods	0.10	0.09	0.07	3.03	-0.09	-0.07
Beverages, tobacco	0.21	0.17	0.13	4.96	-0.15	-0.11
Textiles and apparel	0.28	0.24	0.19	11.88	-0.31	-0.21
Crude oil	0.15	0.13	0.10	8.84	-0.24	-0.17
Other manufacturing	0.21	0.18	0.14	11.72	-0.32	-0.22
Transport, communication	0.22	0.19	0.15	11.65	-0.29	-0.19
Business services	0.23	0.19	0.16	12.11	-0.30	-0.19
Other services	0.21	0.18	0.15	11.82	-0.30	-0.20

Source: Author's calculations

Increased demand for domestic agricultural produce enhances domestic production, demand for and returns to primary factors, namely land and labour. These results are consistent with the findings of the earlier study by Mariara and Kiriti-Nganga (2013) that cash transfers in Kenya generally reduced the probability of experiencing economic shocks by households. From the baseline data, a transfer payment of US$ 99.6 million (or approximately ksh. 9.9 billion) is required for one year, to maintain their current initial level of utilities. According to Government of Kenya (2011), the overall cost of providing cash transfers to targeted households at a cost of Ksh 1,000 per person costs ksh 12 billion per annum.

(b) Effects of cash transfers to all urban poor households

In the second experiment, the cash transfer programme is extended to cover all urban poor households, that is, the urban hardcore poor and the urban poor. Given the sizes of the price shocks assumed in the experiments, this would require US$228.6 million, distributed as US$103.2 million and US$125.4 million for urban hardcore poor and urban poor households, respectively[52]. The results are presented in Table 5-20.

The results indicate that cash transfers induce an increase in the real consumption of all household categories, except for the urban non-poor whose situation worsens marginally. The negative effects on urban non-poor households reflect the fact that the latter would give up part of their incomes for redistribution to the poor through the cash transfer programme. The changes are however very minimal because share of urban household expenditures on food items is relatively small from the baseline data.

[52] The sizes of the compensating transfers are endogenously solved in the CGE model.

Table 5-20: Consumption Effects of Transfers to all Urban Poor Households

	RHCP	RP	RNP	UHCP	UP	UNP
Grains	0.35	0.29	0.22	0.01	0.01	-0.00
Fruits and vegetables	0.28	0.24	0.18	1.88	1.75	-0.10
Meat and livestock	0.29	0.24	0.18	2.99	2.78	-0.16
Other agriculture	0.86	0.72	0.54	11.97	11.12	-0.64
Vegetable oil	0.51	0.44	0.34	1.92	1.78	-0.09
Dairy	0.69	0.59	0.45	4.66	4.33	-0.23
Other proc. foods	0.22	0.19	0.14	3.02	2.80	-0.16
Beverages, tobacco	0.45	0.38	0.29	4.94	4.59	-0.25
Textiles and apparel	0.61	0.52	0.41	11.92	11.08	-0.47
Crude oil	0.33	0.29	0.22	8.85	8.22	-0.38
Other manufacturing	0.45	0.38	0.30	11.75	10.92	-0.48
Transport, communication	0.47	0.41	0.32	11.72	10.90	-0.42
Business services	0.49	0.43	0.34	12.18	11.33	-0.43
Other services	0.47	0.40	0.32	11.87	11.04	-0.45

Source: Author's calculations

In terms of utility from private consumption, the net effects across various household categories are presented in Table 5-21. From the table, cash transfer payments to all urban poor households generates higher consumption utilities to all poor rural and urban households compared to the transfers to only the urban hardcore households. However, the consumption utilities of the urban non-poor households worsen. This is due to the increased budget or public expenditures directed towards the cash transfer programme.

Table 5-21: Net Effects of Transfers on Utility from Private Consumption[53]

Household category	Percentage change from transfer to urban hardcore poor	Percentage change from transfer to all urban poor	Net Percentage Changes
Rural hardcore poor	3.53	3.89	0.36
Rural poor	2.80	3.10	0.30
Rural non-poor	2.10	2.35	0.25
Urban hardcore poor	3.26	3.35	0.09
Urban poor	-3.37	3.33	6.71
Urban non-poor	-3.81	-4.01	-0.20

Source: Author's calculations

[53] Utility is measured from the final behavioral equations for households in Table Appendix b-3.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

6.1 Introduction

This chapter consists of six sub-sections including the summary and conclusions, policy implications, contributions, limitations and areas for further research. The second sub-section outlines the summary and conclusions drawn from the research findings. It briefly explains the research problem, justification and methodology used in the study. In addition, the transmission of world food and oil market price into domestic markets as well as the effects of the combined food and oil price shocks on different households is highlighted. The third sub-section covers the results of alternative policy measures for consideration by policy makers in wake of similar occurrences. The implications to policy emerging from the study results are presented in sub section three. These include issues that should be given priority in the wake of increased episodes of international price shocks. In sub-section four, the contributions of this thesis to economic literature and economic policy are elucidated.

The next sub-section recognizes the key constraints encountered in the process of undertaking the research and which amount to limitations which should be considered even when synthesizing or interpreting of the findings.

The last sub-section recommends areas for further research in light of the study limitations including areas that are considered critical but lie outside the scope or require more detailed analysis on their own.

6.2 Summary and Conclusions

6.2.1 Research Problem and Methodology

This thesis is an attempt to shed light on the linkages between international food and crude oil price shocks and the domestic market prices and the resulting effects on the welfare of rural and urban households in Kenya. Commodity price shocks have considerable effects on household welfare and the poorest segments of society are vulnerable to food price escalations due to their large shares of food in consumption baskets. Understanding the effects of price shocks is critical, especially for Kenya whose economy is increasingly integrating into the global economy, yet it has little or no influence over world food and crude oil market prices. So far, the findings of previous studies on the effects of external price shocks in Kenya are ambiguous and depend on the methodologies and data used. This is further confirmed by lack of clear and effective government interventions in against external price shocks in the past.

In that regard, this thesis has used a CGE model which captures economy-wide linkages in the economy. The results provides deeper insights into the transmission of international prices to domestic markets and the behavioural responses by firms, factors of production and households to these changes in respect of food and crude oil products in Kenya. In so doing, important assumptions regarding the elasticities of substitution between imported and domestic goods, the CGE model closures and assumptions related to behavioural relationships are all considered in the model.

The thesis also analyzed the effects of global food and oil price shocks on rural and urban households' welfares in Kenya. The choice of the CGE model was motivated by the comprehensive framework it provides for carrying out an economy-wide analysis

and the short time period that the data allowed. Most importantly, the model disaggregates households into six categories, namely rural hardcore poor, rural poor and rural non-poor and urban hardcore poor, urban poor and urban non-poor. External price shocks affect household welfare through changes in the streams of incomes and consumption patterns. The effects depend on several factors including the extent of transmission of external price changes to the domestic market, economic status of households, sources of household incomes, substitutability between domestically produced and imported products among others.

Several simulations were carried out to establish the magnitude and symmetry of the effects on domestic market prices demand by consumers and producers and across household categories. Specifically, scenarios involving actual positive and negative food and crude oil price shocks were experimented separately and then jointly and the results interpreted. In addition, policy response simulations targeting the most affected households were done to provide an indication of the most effective measures for government to undertake when dealing with possible future trade shocks. In order to realistically establish effects of trade shocks in the economy, it is important to know the substitutability between imports and domestically produced commodities in the domestic market. The study estimated import demand elasticities for various products for use in the CGE model in order to carry out realistic simulations.

6.2.2 Effects of exogenous food and crude oil price shocks in Kenya

There have been mixed effects of external food and fuel price shocks in Kenya since independence. During the 1976-1979 coffee booms, coffee farmers earned windfall incomes and the economy experienced gains in savings, investment and GDP growth

rate. Both rural and urban households benefitted from the income gains. On the contrary, the global food price escalations observed during the period 2003 - 2008 adversely affected Kenya's economy. In response to the crisis the government used direct market intervention measures, including lowering import duties, banning of food exports provision of agricultural input subsidies and price controls. In addition, social protection programmes including the school feeding and cash transfer payments to vulnerable populations were enhanced. However, the programmes did little to stimulate private investments in agricultural production and effectively cushion the vulnerable groups from the adverse effects of the food price surges.

With regard to oil price shocks, the major fluctuations in global oil prices were largely attributed to disruptions in production and supply by major oil producers and consumers in global markets. At the macro level, the oil price shocks adversely affected Kenya's foreign exchange reserves, worsened fiscal deficits, increased inflation rates thereby severely constraining productivity and economic growth rates. This led to high cost of living and more households being entangled in the poverty trap. This is despite the efforts to subsidize the retail prices of kerosene and diesel largely consumed by the low income groups and in the transport sector, respectively. The government also sets maximum wholesale and retail prices for fuel products in the bid to ensure fair consumer prices.

The analysis of the substitutability between domestically produced and imported products established that that the aggregate import demand elasticities for food and crude oil in Kenya are fairly elastic, with coefficients slightly greater than unity. This implies that when international prices fall, the demand for imported products rises by more than a

proportionate amount. This means that changes in international prices for oil and food items are likely to have effects on the country's trade balance. In addition, the findings confirm that import elasticities are not uniform across sectors, either due to differences in the levels of product differentiation or involvement of multinationals in a particular sector.

In order to establish the levels of transmission of exogenous food and crude oil price shocks to domestic market prices and effects on household demands and incomes, experiments involving positive and negative price shocks were carried out. The results indicated less than full transmission of external crude oil price shocks to domestic market prices but very low or negligible effects on domestic prices for other goods and services. Similarly, there are very low transmissions of world market food prices to domestic market. The results suggest very low integration between domestic and world market prices, especially for agricultural products.

On the effects on household incomes, the results indicate that households are affected differently depending on whether they are based in rural or urban areas, ownership of factors of production and demand or consumption patterns. Overall, the results show that positive oil price shocks negatively affect all households. However, urban households are affected more compared to their rural counterparts. This is attributed to the relatively bigger contraction of the real wages for professional workers and skilled labour which are primary sources of their incomes. The urban non poor and rural hard core poor households are the most affected by oil prices changes compared to the other household categories. On the contrary, the relative incomes of rural households increase with an increase in external food prices whereas those for urban households

decline. This is because rural households are producers and suppliers of agricultural products and therefore receive higher returns from land, agricultural labour and agricultural capital as well as directly from sale of agricultural produce. The rural hard core poor and poor households get the greatest benefits. The reverse effects take place in both cases for negative international price shocks. It is also notable that the magnitudes of the resulting impacts of the shocks are asymmetrical and mixed.

When food and oil price shocks are simulated jointly, rural households realize net gains while the incomes for urban households are negatively affected. This is because the erosion of rural household incomes arising from oil price escalations is partially compensated for by the gains from rise in food prices. On the other hand, urban household incomes are depressed by both food and oil price shocks.

6.2.3 Effects of Alternative Policy Responses to External Price Shocks

The simulation results to external food and oil price shocks revealed that households are affected differently depending on their role and position in the domestic markets. In that regard, additional simulations targeting the most affected households were carried to assess the resulting levels of compensations with a view to returning affected households to their initial consumption or income levels prior to such shocks. Specifically, two simulations involving policy responses targeting the urban poor and hardcore poor households, who are the most negatively affected by the combined simulations, are conducted.

The first simulation is a tariff reform scenario, in which import duties on food and crude oil products are removed. The purpose is to ease the pressure on domestic market prices for these commodities. The results indicate that, overall, tariff reforms provide

greater benefits to urban poor and non-poor households relative to the other categories of households. Removal of import duties tend to shift household demand away from domestic to imported products, hence depressing domestic production and subsequently the returns to intensively used factors in production. Hence, overall rural household incomes decline relative to urban incomes in this scenario, due to the dominating effects of agricultural price declines relative to oil price increases.

The other simulations involve analysis of the effects of cash transfer payments first to urban hardcore poor households and then to all urban poor separately. The unilateral cash transfers are made to the two categories of households without corresponding exchange of goods or services in amounts that are sufficient to maintain their pre-shock level of utilities. The results indicate there are real consumption gains by the urban hardcore poor as expected. In addition, all rural households also experience some positive gains which are linked to increased demand for agricultural commodities by urban households. This is because increased demands for domestic agricultural produce enhances domestic production, demand for and returns to primary factors, namely land and labour. However, the policy action leaves the urban poor and non-poor households worse-off, albeit marginally.

When the cash transfer programme is expanded to cover all the urban poor households, all household categories experience net gains in their consumption and incomes, except for the he urban non-poor. This is due to the anticipated redistribution of income from urban non poor to the other households following the implementation of the cash transfer programme. These results indicate food and crude oil price shocks affect rural and urban households differently. Overall, the urban poor households are the most

adversely affected especially the hard core poor and this reality should be reflected in short term government policy interventions to exogenous price shocks

6.2 Policy Implications

Based on the study results, the following policy measures are recommended to deal with international food and crude oil price shocks:-

6.2.1: The substitutability between domestic and imported food and oil products

Understanding how import flows react to changing economic situations is important in designing appropriate adjustment policies. The results in this study show that import demand elasticities for food and crude oil are fairly elastic. This implies that when world market prices fall, the demand for imports increases by more than proportionate amount. In other words, changes in international prices significantly affect Kenya's trade balance with the rest of the world, all else being equal.

The extent of the demand for imported products however depends on the price and income elasticities of specific products. For a poor country like Kenya, price and income elasticities for food products are fairly elastic. High costs of production make local products expensive relative to cheaper foreign imports. However, as incomes rise, local products become affordable leading to reduction in demand for imported products. Thus, improvements in household welfare are central to prudent management of the trade balance in the wake of adverse effect of trade shocks. Most importantly, increasing food production is equally pertinent since food supply constraints push domestic food prices up. This should be complemented with deliberate efforts to diversify the food production and consumption basket as well as investments in alternative energy sources. The aim

should be minimize domestic price volatilities and widen consumer choices for domestic products.

6.2.2: Market integration and Price transmission to domestic markets

Transmission of prices from one market to another reflects the extent to which the two markets are integrated with each other. It is also an indicator of the extent to which given products are tradeable in separate markets within or outside the country. Thus, when markets are not well integrated, changes in prices in one market or country may not affect the prices of similar products in another market. Transmission of prices is influenced by several factors, including the elasticity of demand for imports, physical distance between markets, tariff and nontariff barriers to cross-border trade, domestic trade policies (domestic tax regime, price controls, subsidies etc) and transaction costs.

The results in this analysis indicate relatively low transmission of world market price shocks for food and oil into Kenya's domestic markets. The results confirm that Kenya's trade on food products in world markets is very small or negligible and in fact much of the food imports into Kenya are in form of aid. Furthermore, previous studies have shown that food prices in the Eastern African region show a different pattern and fluctuate more than the world prices. They further suggest that domestic prices correlate more with each other within the region than with world prices and the influence of world price developments is relatively small compared to regional price developments particularly for grains. Thus, Kenya should align her food production and supply strategies with the regional initiatives in order to meet her food security requirements and stabilize domestic prices.

With regard to crude oil prices, one would expect full transmission of world market prices into domestic markets given that it is a necessity and it is used in production across many sectors. However, there exist strong government interventions in sector domestic taxations, subsidization of petroleum products and direct control of wholesale and retail prices for fuel products in Kenya. Government interventions cushion consumers from otherwise adverse effects during price escalations in world markets. On the contrary, they prevent consumers from reaping the full benefits of reduced prices when world market prices for crude oil fall. Thus, the government should take cognizant of the fact that taxation regime and other government interventions in the domestic oil sector influence the extent of such exogenous oil shocks directly affect domestic prices and household welfare.

6.2.3: Tariff Reform measures

Traditionally, removal of import duties reduces domestic market prices for imported goods and raise consumption expenditures by households, especially the poor households. However, it also worsens the economy's trade balance and fiscal deficits by encouraging imports relative to exports and lowering government revenues, respectively. Temporary removal of import duties helps lower domestic prices for imported products thereby making them affordable to poor households. This should be the case especially for food products designated as being sensitive to sustainable development of the economy. However, caution should be taken since greater food and crude oil product imports as a result of tariff elimination is likely to discourage domestic supplies and put pressure on the balance of payments. This risk is especially critical because rural households constitute the bulk of the poorest population in Kenya. In addition, export

bans should not be imposed while removing tariffs in order allow for exportations at relatively higher external market prices which can help raise earnings to rural farmers.

6.2.4: Targeted Cash Transfer Programme

One of the fundamental objectives of social protection programmes is to cushion individuals from adverse effects of economic shocks that may drive them into poverty. In that regard, there already exist such programmes in Kenya including cash transfer payments to orphaned and vulnerable children and old persons and which are deemed to complement other government interventions during previous episodes of trade shocks. However, the existing programmes do not take into consideration the fact that external price shocks affect households differently depending on their locations and sources of incomes. The results of this analysis indicate that in Kenya, urban poor households are the most affected by exogenous food and oil price shocks. This implies that enhancing the incomes of urban poor households through direct cash payments have bigger spiral effects in the economy and may reduce the degree of negative effects. By enhancing the purchasing power of urban poor households, aggregate demand and production in all sectors of the economy are expanded.

6.3 Contributions of the Thesis

This thesis has made the following contributions.. First, this is the first study to use the GTAP model modified for to analyze the effect of trade shocks in Kenya. The model, which is newly developed, captures trade between Kenya and the rest of the world and is based on plausible economic relationships and equilibrium assumptions.

Second, the results of the study contribute towards filling the knowledge gaps in relation to the behavioral responses of economic agents i.e. firms, households and the

government to exogenous oil and price shocks. In addition, the results shed more light on the welfare implications across various categories of households in Kenya.

The third contribution relates to the study findings and the implications to domestic policies. The results of the study provide deep insights into what happens when there is an external price shock across various sectors, factors of production and households. It is notable from he findings that that domestic food markets and not strongly integrated with world markets and that food prices are more influenced by regional food price movements. Hence, the long term solution to domestic food security lies within the domestic policies taking cognizance of what happens in regional markets. In addition, exogenous oil and food price shocks affect rural and urban households differently and therefore require targeted government interventions. Identifying and anticipating effects on poor households is important for policy formulation and planning, pro-poor and sustainable growth.

6.4 Limitations of the Study

The limitation of this study is that it is a static CGE rather than dynamic model. The static CGE used in this analysis presents reactions of the economy at one point and therefore the changes that are realized are relative to the baseline scenario. Dynamic models entail the process of adjustment and feedbacks into new equilibrium positions over time. In such a case, the dynamic elements may arise from such elements like capital accumulation, investment, external debt, inflation and trade deficits, among others. This was nonetheless not possible due to data limitations.

6.5 Areas for Further Research

This study has attempted to establish the effects of external oil and food price shocks in domestic prices and welfare. There is however, need to move further and establish the vulnerability of poor households to trade shocks by analyzing how households move below and above the poverty line as a direct result of such shocks. This would provide greater insights into the linkages between trade and poverty for Kenya and similar countries. Furthermore, it is well-known that model closure assumptions directly influence model results. A sensitivity analysis of our closure rules, particularly with respect to the balance of trade and foreign investment inflows, would also be an informative extension of this research.

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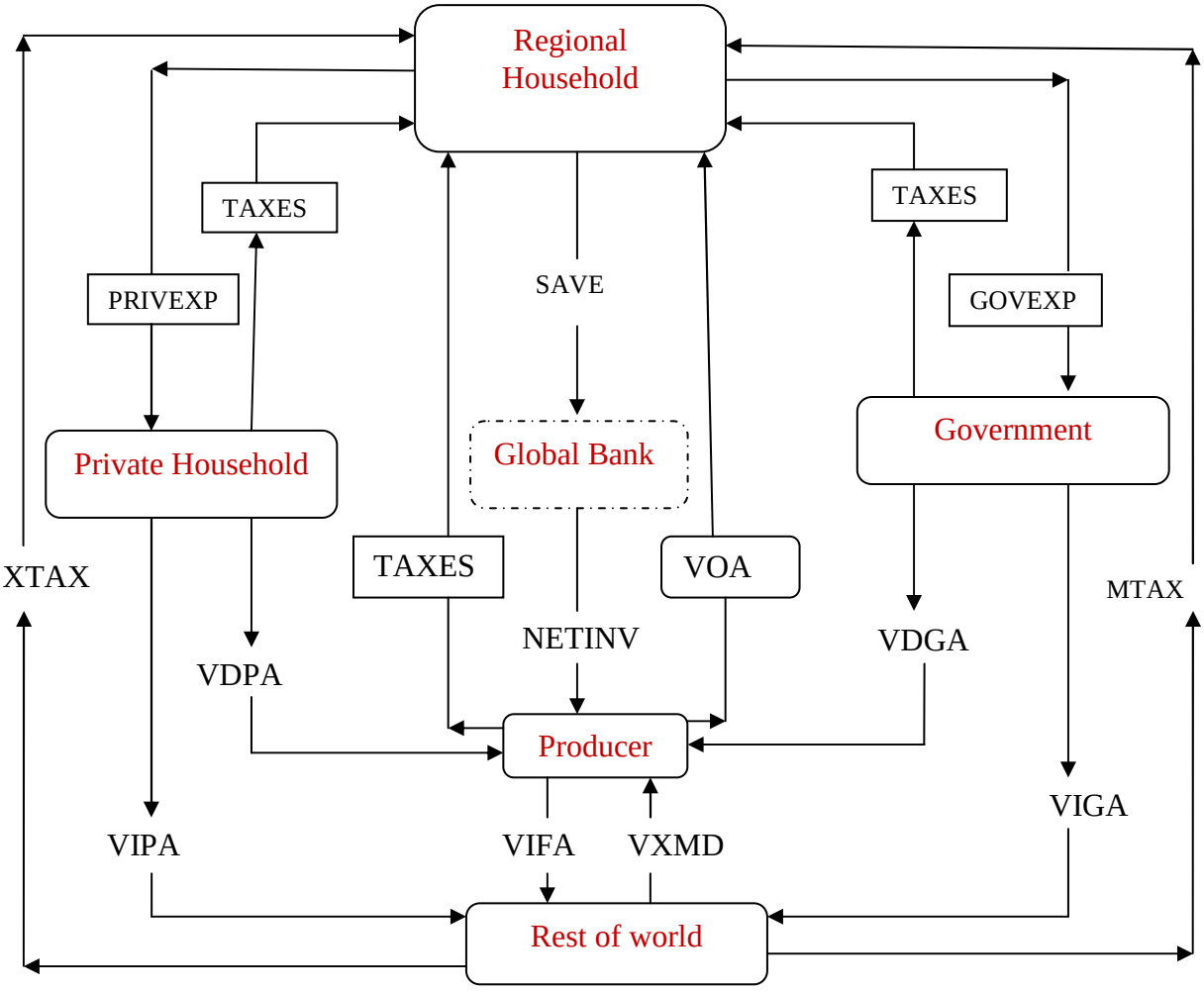
APPENDICES

Appendix A: Graphical Representation of the Kenya CGE Micro-simulation Model

The following graphical illustration explains the basic concept of Kenya CGE Model based on the accounting relationships of various economic agents, namely; the regional household, private households, firms, the government and the rest of world.

Figure Appendix A-14: Structure of the Kenya CGE Micro-simulation Model



Source: Adopted from Brockmeier, 2001

The Figure (see Appendix Figure A-1) is a representation of a regional open economy in which a single regional household collects all income from endowment factors (*VOA*) and taxes (*TAXES*). Subsequently, the regional incomes are distributed across three broad categories, namely: private household expenditures *(PRIVEXP)*, government expenditures *(GOVEXP)* and savings *(SAVE)* within a Cobb-Douglas utility framework.

In the above framework, producers receive payments from the sale of consumption goods to private households *(VDPA)* and the government *(VDGA)* and investment goods to the savings sector *(NETINV)*. They also receive payments from sale of commodities to the rest of the world (or exports), denoted by VXMD. In order to meet zero-profit optimality conditions, the receipts by all agents must be precisely exhausted on expenditures on primary factors of production and domestically produced intermediate inputs (*VDFA)*, on imported intermediate inputs (VIFA), imported primary factors of production or endowments (*VOA*), and tax payments to the government.

In the third component of the accounting relationship of the demand function, the government and private households spend their incomes on domestically produced commodities denoted by *VDGA* and *VDPA*, respectively. They also incur expenditures on imported commodities, denoted as *VIPA* and *VIGA*, respectively. Additionally, the government and private households pay import duties on imports to the regional household.

The fourth component of the final demand comprises the regional household's demand for savings, denoted as *GLOBAL Bank*. The latter intermediates between global savings and regional investments by assembling a portfolio of regional investment goods

and selling the same to households to satisfy their demand for savings. The final accounting relationships constitute the rest of the world (ROW). The latter is the source of imports into the domestic or regional economy and a destination for exports (*VXMD*). The rest of the world derives import payments from private household consumption (*VIPA*), government households (*VIGA*), and firms (*VIFA*). The payments received are spent on imports from the regional household (*VXMD),* and on import taxes (*MTAX*) and export taxes (*XTAX*) paid to the regional household.

If all markets in the multi regional model are in equilibrium, all firms earn zero profits, and all households are on their budget constraint, then global investment must equal global savings and Walras' Law will be satisfied.

Definition abbreviations in Appendix Figure A-1

VOA - Value of output at agents prices
TAXES - Taxes
PRIVEXP - Private expenditures
GOVEX - Government expenditures
SAVE - Savings
VDPA - Value of Private household expenditures on domestic goods
VDGA - Value of Government Expenditures on domestic goods
NETIV - Net Investments
VXMD - Value of exports
VDFA - Value of purchases of primary factors and intermediate goods by firms
VIFA - Value of imported intermediate goods
VIPA - Value of imported goods by private households
VIGA - Value of imported goods by government
VXMD - Value of exports from regional household
MTAX - Import tax
XTAX - Export tax

Appendix B: Representation of the Equations of the Kenya CGE Model

The Accounting Relationships in the CGE Model

The basic accounting relationships in the CGE model are illustrated within the context of general equilibrium conditions in various markets. For example, Table Appendix B-1 portrays the various accounting relationships and market clearing conditions. Equation B1 is the market clearing condition for tradable commodity supplies. In this equation, VOM (i, r) refers to the value of output at market prices of commodity (i) in region (r) and it equals the sum of value of domestic sales at market prices (VDM) and the value of exports of (i) from (r) destined for (s) (VXMD (i, r, s)) and taking into account the international transport margin denoted by VST (i, r).

Table Appendix B-0-1: Accounting relationships in the CGE model

$$VOM(i,r) = VDM(i,r) + VST(i,r) + \sum VXMD(i,r,s) \quad \text{(B1)}$$

$$VIM(i,r) = \sum VIFM + VIPM(i,r) + VIGM(i,r) \quad \text{(B2)}$$

$$VDM(i,r) = \sum VDFM + VDPM(i,r) + VDGM(i,r) \quad \text{(B3)}$$

$$VOM(i,r) = \sum VFM(i,j,r) * qfe(i,j,r) + VOM(i,r) * endwslack(i,r) \quad \text{(B4)}$$

$$\text{qoes(i, j, r)} = \text{qfe(i, j, r)} \quad \text{(B5)}$$

$$VOA(j,r) * pfe(j,r) = \sum VFA(i,j,r) * pfe(i,j,r) + \sum VFA(i,j,r) * pf(i,j,r) + VOA(i,j,r) * profitslack(j,r) \quad \text{(B6)}$$

$$VT * pt = \sum VST(i,r) * pm(i,r) \quad \text{(B7)}$$

$$PRIVEXP(r) * yp(r) = INCOME(r) * y(r) - SAVE(r) * [psave + qsave(r)] - \sum VGA(i,r) * [pg(i,r) + qg(i,r)] \quad \text{(B8)}$$

Source: Adopted from Hertel, 1997

The next two equations represent equilibrium conditions in the domestic market for tradable goods, either imported from region 'r' (VIM), in the case of Equation B2, or produced domestically (VDM), in the case of equation B3. Equations B4 and B5 refer to the market clearing conditions for non-tradable, endowment commodities, whereas

equation (B6) is the pure zero profit condition. In the equation, (pf) refer to firms' prices for composite intermediate inputs and (pfe), the endowment commodities. The inclusion of the profit slack (j, r) permits fixing of output and elimination of the zero profit condition for any sector (j) in any region (r). Equation (B7) refers to the zero profit condition for the international transport sector, whereby the total value of transport services (VT) equals the total value of transport services exports (VST). Equation (B8) ensures complete disposition of the regional income through deduction of savings (SAVE), government spending (VGA) and private household expenditures (PRIVEXP(r)).

The price linkages in the model are largely dependent on applied tax rates. The latter are defined as the ratio of Agents' prices (VOA (i,r)) to Market prices (VOM(i,r)). The tax rates drive the wedge between the two types of prices. For instance, the power of the ad valorem tax given by TO (i,r) = VOA(i,r)/VOM(i,r). Thus, when TO (i,r) > 1, then firms or households actually receive a subsidy.

Behavioural equations for firms

The equations that describe the firm behavior are portrayed in Table Appendix B-2. The general equilibrium assumption that prices for all commodities exist and all the agents, producers and consumers, take these prices as given is central in describing the behaviour of agents (Jehle and Reny, 2011).

In this framework, the production function is of a constant return to scale (CRS) technology and production is assumed to take place at levels based on a nested constant elasticity of substitution (CES) function. Thus, primary factors of production are separated from intermediate inputs (Equation B9). The demand for intermediate inputs

and composite value added are used in fixed proportions. This means the elasticity of substitution σ_T is equal to zero, that is holding output constant, prices do not influence input quantities, and as a result, the quantity shares $\frac{X_n}{X_i}$ remain constant (Petersen, 1996). On the other hand, primary factors of production are assumed to substitute for one another according to the constant elasticity of substitution (CES) as indicated in Equations B10 and B11. The degree of the elasticity of substitution between primary factors of production determine the ability of the economy to alter the mix of outputs in response to changes in relative prices, or changes in the endowment of these factors.

The coefficients and composite demand prices are defined in Equation B12. The optimality conditions require that producers demand labour and capital at the point where the marginal cost of each of these factors equals their corresponding marginal revenue product.

Table Appendix B-0-2: The final behavioral equations for production

CES Production function

$$QO_{p.r} = \left[\left(\delta_{va,p,r} QVA_{p,s}\right)^{\frac{\sigma_{p-1}^T}{\sigma_p^T}} + \sum_i \left(\delta_{t,p,r}.\, QF_{t,p,t}\right)^{\frac{\sigma_{p-1}^T}{\sigma_p^T}} \right]^{\frac{\sigma_p^T}{\sigma_p^T - 1}} \quad \text{.....(B9)}$$

Derived Demands

$$\mathrm{QVA_{p,s}} = \mathrm{QO_{p,r}}.\, \mathrm{S_{va,p,r}} \left[\frac{\mathrm{PVA_{t,p,r}}}{\mathrm{PS_{p,r}}}\right]^{-\sigma_p^T} \quad \text{.....(B10)}$$

$$\mathrm{QF_{t,p,s}} = \mathrm{QO_{p,r}}.\, \mathrm{S_{t,,p,r}} \left[\frac{\mathrm{PVA_{t,p,r}}}{\mathrm{PS_{p,r}}}\right]^{-\sigma_p^T} \quad \text{.....(B11)}$$

Coefficients $S_{t,p,r}$ are cost shares and $PS_{p,r}$ is the price index given as

$$PS_{p,r} = \left[S_{va,p,r}\left(PVA_{p,r}\right)^{(1-\sigma_{va})} + \sum_t S_{t,p,r}\left(PF_{t,p,r}\right)^{(1-\sigma_t)}\right]^{\frac{1}{1-\sigma_T}} \quad \text{.....(B12)}$$

Definition of subscripts:
r- region of origin
s- region of destination
p - produced commodities
t-trade commodities
va - value added
Variables:
QO - Value of output
QVA - Quantity of value added
QF - Quantity of primary factor
S - Cost shares
PVA - Value added
PS - Price Index
PF - Primary factor
Parameters:
σ_p^T- Elasticity of substitution between intermediate and value added

Source: Adopted from Hertel, 1997

The behavior of Households

The final behavioural demand equations are presented in Table Appendix B-3. The regional household behaviour is governed by an aggregate utility function that allocated expenditures across three broad categories: private consumption, composite government purchases and savings as presented in Equation B13. Equations B14 and B15

determine the changes in real expenditures on savings and government activities based on changes in household incomes and commodity prices. The savings and government slack variables ('qsave' and 'ug, respectively') are incorporated in the equations to allow them be specified as exogenous variables.

Table Appendix B-0-3: The Final Behavioral Equations for Households

Aggregate Utility

$INCOME(r) * u(r) = PRIVEXP(r) * up(r) + GOVEXP(r) * [ug(r) - pop(r)] + SAVE(r) * [qsave(r) - pop(r)]$.....(B13)

Regional Savings

$qsave(r) = y(r) - psave + saveslack(r)$.....(B14)

Government Purchase

$ug(r) = y(r) - pgov(r) + govslack(r)$.....(B15)

Demand for Composite Goods

$pgov(r) = \sum \left(\frac{VGA(i,r)}{GOVEXP(r)}\right) * pg(i,r)$.....(B16)

$qg(i,r) = ug(i,r) - [pg(i,r) - pgov(i,r)]$.....(B17)

Composite Tradeables:

$pg(i,s) = GMSHR(i,s) * \text{pgm(i, s)} + [1 - \text{GMSHR(i, s)}] * \text{pgd(i, s)}$.....(B18)

$qgm(i,s) = qg(i,s) + \sigma_D(\text{i, s}) * [\text{pg(i, s)} - \text{pgm(i, s)}]$.....(B19)

$qgd(i,s) = qg(i,s) + \sigma_D(\text{i, s}) * [\text{pg(i, s)} - \text{pgd(i, s)}$.....(B20)

Private Household Demands

$yp(r) = \sum_{i \epsilon TRADE}[CONSHR(i,r) * pp(i,r)] + \sum_{i \epsilon TRAD}[CONSHR(i,r)] * up(r) + pop\ (r)$.....(B21)

Composite Demands

$qp(i,r) = \sum_{i \epsilon TRAD} EP(i,k,r) * pp(k,r) + EY(i,r) * [yp(r) - pop(r)] + pop(r)$ .....(B22)

Composite Tradeables

$pp(i,s) = PMSHR(i,s) * ppm(i,s) + [1 - PMSHR(i,s)] * ppd(i,s)$.....(B23)

$$ppd(i,s) = qp(i,s) * \sigma_D\ (i,s) * [pp(i,s) - ppd(i,s)] \quad \text{.....(B24)}$$

$$qpm(i,s) = qp(i,s) + \sigma_D(i,s) * [pp(i,s) - ppm(i,s)] \quad \text{.....(B25)}$$

Definition of Subscripts:
i-commodity
r- region of origin
s- region of destination
Variables:
CONSHR - Budget share
EP - Uncompensated price and income elasticity
GMSHR- Share of imports in government tradeable commodity
GOVEXP- Government expenditures

gslack -	Government slack variable
pg -	Government consumption prices
pgd -	Price of domestic in government
pgm -	Price of imports in government consumption
pgov-	Government household expenditures
pop -	Population
pp -	Private consumption price
ppd -	Private consumption price for domestic good
ppm -	Private household price of imports
qg -	Government household demand for commodity
qgd -	Government household demand for domestic good
qp -	Private household demand for commodity
qpd -	Private household demand for domestic good
qpm -	Private household demand for imports
ug-	Government utility
up -	Private household utility
yp -	Regional private consumption expenditure
yph -	Private consumption expenditure by household
VGA -	Value of Government purchases at Agent's prices

Parameters:

σ -	Elasticity of substitution

Source: Adopted from Hertel, 1997

Both government and private demands are composite demands. Regarding government demands, the expenditure allocations across composite goods is done based on changes in real government spending through Equations B16 and B17. The former establishes the government price index (dgov), which in turn provides the basis for conditional demand (dg). Once the demand for composite has been established, a price

index is established in Equation B18 then allocated between imported goods (Equation B19) and domestically produced goods (Equation B20). Analogously, Equations B21 to B25 describe the case for private demands.

Equilibrium Conditions

Table Appendix B-4 presents equations describing market clearing conditions.. The table presents the market clearing conditions for tradables, factors of production (endowments), the zero profit conditions, the income - expenditure balance and the savings - investment balance.

The market clearing condition for tradables in value terms is given by Equation B26. The left hand side of the equation represents supplies of tradable commodity i and the right hand side represents the various sources of demand, that is, by firms, private households and government. It represents the market clearing condition (supply equals demand) when a market price is allowed to adjust to correct any imbalance between supply and demand.

Equations B27 and B29 represents the market clearing conditions for mobile endowments in terms of quantities and values. On the other hand, Equation B30 represents the sluggish endowment market clearing condition. In the equation, the demand for endowment i by firm in sector j, QFE (i,j), is determined by the CES assumption made on the firm's technology. Quantity supplied, QOES (i,j), merely equals quantity demanded, QFE(i,j).

The zero-profit marketing clearing condition is shown by Equations B31 and B32. The left hand side represents the value of outputs and the right hand side represents the value of inputs, both primary factors and value added used in production. The profit slack

in the equation in the equation preserves the general equilibrium nature of the model and is always equal to zero. .In this case, a firm facing exogenous input and output prices uses a given technology to choose output level.

Equation B35 is the income-expenditure (household budget) balance, in which the total expenditure equals net income. Total expenditure in Equation B33 is the sum of private and public expenditures and savings, whereas total income (Equation B34) is the sum of factor income and net taxes, less depreciation.

The last market clearing condition is the savings-investment balance presented in Equation B36. The left hand side of the equation is the supply of net investment goods and the right hand side is the demand for savings. The WALRASLACK variable is introduced to reflect the excess of investment supply over savings demand.

Table Appendix B-0-4: Equilibrium Market Clearing Conditions in CGE Model

Tradable Market Clearing Condition

$$VOM_i = \sum_i VFM_{ij} + VPM_{ij} + VGM_{ij} \quad \text{(B26)}$$

Mobile Endowment Market Clearing Condition

$$QO_i = \sum_j QF_{ij} + ENDWSLACK \quad \text{(B27)}$$

$$dQO_i = \sum_j dQF_{ij} + dENDWSLACK \quad \text{(B28)}$$

$$VOM_i = \sum_j VFM_{ij} \quad \text{(B29)}$$

Sluggish Endowment Market Clearing Condition

$$QOES_{ij} = \sum_j QFE_{ij} \quad \text{(B30)}$$

Zero Pure Profit Condition

$$VOA_i = \sum_j VFA_{ij} + VFA_{kj} + PROFITSLACK_j \quad \text{(B31)}$$

$$VOA_i\, ps_i = \sum_j VFA_{ij}\, pfe_{ij} + VFA_{kj} pfe_{kj} + VOA_{ij} profitslack_j \quad \text{(B32)}$$

Income - Expenditure Balance

$$EXPENDITURE = \sum_i VPA_i + \sum_i VGA_i + SAVE \quad \text{(B33)}$$

$$INCOME = \sum_i VOA + NETAXES - VDEP \quad \text{(B34)}$$

$$INCOME = PRIVEXP + GOVEXP + SAVE \quad \text{(B35)}$$

Investment-Savings Balance

$$VOM(\text{cgds}) - VDEP = SAVE + WALRASLACK \quad \text{(B36)}$$

Definition of Subscripts and Variables
Subscripts:
i - primary commodity
k - intermediate input
j - industry/sector
Variables:
ENDSLACK - Slack variable in endowment market clearing equation
GOVEXP - Government expenditures
NETAXES - Net taxes
PROFITSLACK - Slack variable in the zero-profit equation

QF - Demand for commodity i in industry j
QFE - Quantity demanded of endowment i in industry j
QO - Industry output of commodity i
QOES - Supply of sluggish endowment i used in industry j
VDEP - Value of depreciation of capital stock
VFA - Value of firms' purchases at agent prices
VFM - Value of firms purchases at market prices
VGM - Value of government purchases at market prices
VOA - Value of output at agent prices
VOM - Value of output at market prices
VPM - Value private household purchases at market prices

Parameters:

cgds - Capital goods
ps - Supply price of commodity i
pfe - Firms price for endowment commodity

Source: Adopted Hertel, 1997

Appendix C: Aggregation of regions used in the CGE model

Table Appendix C-0-5: Aggregation of Regions in the CGE model

Region	Countries in the region
1. Kenya	Kenya
2. Oceania	Australia, New Zealand, Samoa, Cook Island, Fiji, Kiribati, Marshall, Federated States of Micronesia, Nauru, New Caledonia, Norfolk Island, Northern Marian Islands, Niue, Palau, Papua New Guinea, Solomon Island, Tokelau, Tonga, Tuvalu, Vanuatu and Wallis and Fatuma.
3. East Asia	China, Hong Kong, Japan, Korea, Taiwan, Macau, Mongolia, Korea, Democratic Republic.
4. South East Asia	Cambodia, Indonesia, Lao, Myanmar, Malaysia, Philippines, Singapore, Thailand, Vietnam, Brunei, Timor.
5. South Asia	Bangladesh, India, Pakistan, Sri Lanka, Afghanistan, Bhutan, Maldives.
6. North America	Canada, USA, Mexico, Bermuda, Greenland.
7. Latin America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Guyana, Suriname
8. EU - 27	Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom, Switzerland, Norway.
9. MENA	Iran, Turkey, Iraq, Israel, Jordan, Kuwait, Lebanon, Palestinian Territory, Oman, Qatar, Saudi Arabia, United Arab Emirates, Yemen, Egypt, Morocco, Tunisia, Algeria, Libya.
10. Sub Sahara Africa	Ethiopia, Madagascar, Malawi, Mauritius, Mozambique, Tanzania, Uganda, Zambia, Zimbabwe, Rwanda, Sudan, Seychelles, Botswana, South Africa, Lesotho, Swaziland, Namibia.
11. Rest of the World	Rest of the world

Source: Author's aggregation

Appendix D: Bilateral Imports at World Market Prices

Table Appendix D-0-6: Bilateral Imports at World Market Prices, 2007 (US$)

Commodity	Oceania	East Asia	SEAsia	South Asia	N. America	Latin America	EU_25	MENA	SSA	RestofWorld	Total
1 Grains	1,487.2	2,245.0	5,848.3	4,398.6	28,707.4	9,203.3	16,538.6	864.3	724.5	8,444.1	78,461.1
2 Frt_Veg	2,588.5	6,359.8	5,219.7	2,819.0	36,024.0	29,649.5	37,612.3	5,333.3	5,058.1	11,676.0	142,340.3
3 MeatLstk	11,921.6	4,716.2	2,521.2	1,373.3	23,617.6	18,339.8	62,056.4	961.1	1,640.4	4,038.3	131,185.8
4 OtherAg	7,346.8	5,457.4	11,058.4	6,812.8	15,536.0	23,407.9	34,190.8	1,667.2	13,120.5	15,333.1	133,930.9
5 VegOils	599.6	801.6	20,837.1	2,509.5	6,285.3	18,626.2	14,452.0	1,091.1	619.2	4,999.5	70,821.1
6 Dairy	8,673.5	407.6	891.1	457.4	3,214.0	2,011.8	42,871.2	565.6	278.8	4,556.4	63,927.2
7 OthFoods	5,256.0	28,605.6	24,470.2	5,444.7	36,414.9	22,592.7	128,130.1	3,919.1	7,189.5	26,551.3	288,573.9
8 BevTob	4,192.0	3,129.3	1,912.6	434.1	10,805.7	6,881.4	70,010.7	619.6	1,910.0	5,526.6	105,422.0
9 TexApp	2,051.8	220,048.0	40,362.0	50,398.1	28,800.4	15,644.0	160,399.9	13,727.9	5,223.8	44,873.5	581,529.4
10 Crudeoil	65,764.4	75,176.4	113,851.2	37,124.3	188,012.7	181,194.4	192,486.1	162,872.6	169,415.4	889,048.8	2,074,946.3
11 OtherMfg	73,975.3	2,248,977.8	538,470.2	94,228.2	1,338,227.4	209,004.8	3,715,522.8	35,730.4	82,412.9	618,050.3	8,954,599.9
12 TransComm	21,717.7	177,261.9	62,011.1	18,117.5	113,202.3	39,264.5	442,946.1	26,367.5	14,526.2	113,638.8	1,029,053.6
13 BusServ	11,218.1	100,869.9	48,600.5	50,107.1	191,396.9	26,983.8	607,067.5	12,556.0	7,578.2	103,780.1	1,160,158.2
14 OthServices	11,345.6	56,563.6	16,677.6	6,766.1	119,012.4	16,074.3	190,001.9	8,814.7	9,414.4	64,346.6	499,017.2
Total	228,138.1	2,930,620.1	892,731.2	280,990.6	2,139,257.0	618,878.3	5,714,286.3	275,090.2	319,111.9	1,914,863.3	15,313,966.9

Source: Author's compilation and GTAP 8.1

Appendix E: LES Parameter Estimates for Kenya

Table Appendix E-0-7: LES Parameters for Urban Households in Kenya

	Marginal Budget Share	**Subsistence Expenditure**	**Expenditure Elasticity**	**Own Price Elasticity**
	b	pc	η_i	e_{ij}
Wheat bread	.0097	60.1	0.390	-.197
Wheat flour	.0033	10.6	0.626	-.306
Rice	.0045	10.8	0.769	-.377
Maize	.0000	158.4	0.000	.0000
Other grains	.0037	3.3	1.060	-.514
Fats and oils	.0093	67.8	0.339	-.172
Sugar	.0049	71.2	0.187	-.095
Bovine and meat	.0272	133.0	0.469	-.249
Poultry and eggs	.0116	18.3	0.987	-.486
Dairy	.0312	79.6	0.745	-.382
Fish	.0045	14.0	0.648	-.318
Vegetables	.0097	79.2	0.311	-.159
Legumes	.0008	40.0	0.061	-.031
Fruits and nuts	.0090	9.2	1.200	-.587
Coffee	.0007	2.2	0.679	-.330
Tea	.0007	20.0	0.102	-.050
Alcoholic beverages	.0140	31.0	0.813	-.404
Tobacco	.0028	28.6	0.255	-.126
Non-agriculture	.8524	701.7	1.320	-.952

Source: Adopted from Williamson and Shah, 1981

Table Appendix E-0-8: LES Parameters for Rural Households in Kenya

	Marginal Budget Share	**Subsistence Expenditure**	**Expenditure Elasticity**	**Own Price Elasticity**
	b	Pc	η_i	e_{ij}
Grains and roots	0.249	90	.71	-.443
Meat and fish	.078	26	.75	-.332
Fats and oils	.035	39	1.45	-.547
Dairy products	.190	105	1.90	-.753
Sugar and sweets	.050	109	1.01	-.402
Fruits, vegetables, beans	.059	177	.82	-.340
Other food	.059	102	1.15	-.455
Clothing	.133	156	1.42	-.584
Non-agriculture	.147	346	.968	-.447

Source: Adopted from Williamson and Shah, 1981

Table Appendix E-0-9: GTAP Substitution Elasticities

GTAP Commodities	Import Demand Elasticity (σ_D)	Own-Price Elasticities of Demand for SSA
Paddy rice	2.2	-0.0716
Wheat	2.2	-0.0724
Cereal grains	2.2	-0.0277
Non grain crops	2.2	-0.0260
Wool	2.2	-0.0983
Other livestock	2.8	-0.1276
Forestry	2.8	-0.2548
Fishing	2.8	-0.2767
Coal	2.8	-0.2565
Oil	2.8	-0.2534
Other minerals	2.8	-0.2540
Processed rice	2.2	-0.1295
Meat products	2.2	-0.1459
Milk products	2.2	-0.1386
Other food products	2.2	-0.2233
Beverages and Tobacco	3.1	-0.2152
Textiles	2.2	-0.2208
Wearing apparels	4.4	-0.2124
Leather	4.4	-0.2012
Lumber and wood	2.8	-0.2581
Pulp and paper	1.8	-0.2585
Petroleum and coal products	1.9	-0.2615
Chemicals, rubber and plastics	1.9	-0.2770
Non-metallic, mineral products	2.8	-0.2546
Primary ferrous metals	2.8	-0.2534
Non ferrous metals	2.8	-0.2534
Fabricated metal products	2.8	-0.2596
Transport equipment	5.2	-0.2188
Machinery and equipment	2.8	-0.2486
Other manufactures	2.8	-0.2129
Electricity, water and gas	2.8	-0.2620
Construction	1.90	-0.2535
Trade and transport	1.90	-0.3971
Other services (private)	1.90	-0.3063
Other services (Gov)	1.90	-0.2798
Ownership of dwellings	1.90	-0.2830

Source: Hertel, 1997