AGRICULTURAL EXPORT SUPPLY RESPONSE TO PRICE AND NON-PRICE VARIABLES: A CASE OF HORTICULTURAL SUB-SECTOR IN KENYA

Njenga Peter Miring'u

K96/10655/2008

A THESIS SUBMITTED TO THE SCHOOL OF ECONOMICS IN FULFILMENT FOR THE AWARD OF DOCTOR OF PHILOSOPHY IN ECONOMICS OF KENYATTA UNIVERSITY

FEBRUARY, 2015

DECLARATION

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

Signature:_____ Date: 14-02-2015

Njenga Peter Miring'u
M.Phil (Econs), PGDE, B.A.
Reg. No: K96/10655/2008

We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

Signature:_____ Date 19-02-2015

Prof. Martin N. Etyang
School of Economics
Kenyatta University
Nairobi, Kenya

Signature:_____ Date: 20/2/2015

Prof. Jane Kabubo Mariara
School of Economics
University of Nairobi
Nairobi, Kenya

DEDICATION

Dedicated to my children.

ACKNOWLEDGEMENTS

Thanks to my Almighty God take precedence for the strength and care He accorded me throughout the study period. Sincere thanks go to my supervisors; Prof. Martin Etyang, and Prof. Jane Mariara, for their critical and effective supervision. Without their knowledge and dedication, I would have found the task overwhelming. I would also want to thank Prof. Nelson Wawire, Dr. Diana Muchai, Dr. Susan Okeri, Dr. Paul Gachanja, Dr. Tom Kimani, Prof. Almadi Obere, and all my fellow PhD students in the School of Economics for their encouragement and moral support. In addition, I thank Kiroga Francis (brother), Njiiri Evelyn and Mwangi Stanley (Pareto efficiency manager) for their enormous moral, spiritual and monetary support during the study period.

I am lost for words in trying to adequately express appreciation to my wife, Nyambura for her support and encouragement while this study was under way, an enterprise not always conducive to domestic tranquility. Here, I can only say thanks a lot and be blessed.

And to my children, Dominic, Christine, Mark, Emmanuel and Christopher who missed fatherly love, I say *poleni sana.* It was only for a short time.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

OPERATIONAL DEFINITION OF TERMS

Agricultural export supply: This is the proportion of agricultural output produced in a given country which is exported to other countries.

Agricultural export supply response: The supply response would entail the elasticities with respect to factors which would affect agricultural exports.

Deregulation: This is a situation when prices of goods and services are determined through forces of demand and supply. There is no government regulation.

EurepGap: This is a code of practice imposed on foreign countries by European countries to be met in order for them to export horticultural produce to Europe.

Foreign Direct Investment: Refers to resource transfers from the official sector in the form of grants and loans at concessional financial terms to developing countries. In addition to financial flows, technical co-operation is included in aid.

Horticultural export supply: The total exports of horticultural commodities in a country during a given period of time.

Kenya-Gap: A code of practice with local adaptations to small-scale farmers to achieve certification of the EurepGap.

Kenya's Horticultural Sector: This includes fruits, fresh vegetables and flowers production and marketing.

Kenya Vision 2030: Country's development blueprint covering the period 2008 to 2030. It aims to transform Kenya into a newly industrializing, middle-income country providing a high quality life to all citizens by the year 2030.

Long run: Refers to the period over which the effect of a change in a variable in the system is fully exhausted.

Short run: Refers to the period over which the effect in a variable in the system is not fully exhausted.

ABBREVIATIONS

ADB	African Development Bank
ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag
CPI	Consumer price Index
EU	European Union
EUREPGAP	Europe Good Agricultural Practices
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
FPEAK	Fresh Produce Exporters Association of Kenya
GDP	Gross Domestic Product
HCA	Horticultural Council of Africa
HCDA	Horticultural Crops Development Authority
H-O	Heckscher-Ohlin
ICO	International Coffee Agreement
LDCs	Least Developed Countries
MPL	Marginal Product of Labour
N-S	North-South
R&D	Research and Development
SAP	Structural Adjustment Programme
S-S	South-South
SSA	Sub Saharan Africa
UK	United Kingdom
USA	United States of America
UNCTAD	United Nations Conference on Trade and Development

ABSTRACT

Kenya has a long history of growing horticultural crops for both domestic and export markets. The climatic conditions are highly varied supporting the growth of a wide range of horticultural crops. The horticultural sector currently ranks as one of the economy's fastest growing sectors and is ranked as the second leading foreign exchange earner after tea. The sub-sector is a major source of livelihood to smallholder farmers and has been identified as a key 'driver' towards the realization of "Vision 2030" which envisages Kenya as a middle income economy and a semi-industrialized country by the year 2030. Although horticultural exports have been contributing to increased rural incomes and reduction of rural poverty in Kenya, horticultural exports remain a small fraction of Kenya's overall export sector. This produce is far from saturating world demand. The understanding of the responsiveness of horticultural export supply to changes in price and non-price factors is crucial for formulating a sound horticultural export specific policy package. The key issue is how urgently Kenya should increase horticultural exports supply and make such an increment sustainable. This study investigated the effect of price and non-price variables on horticultural export supply in Kenya and also drew policy implications from the findings. Time series secondary data for the period between 1973 and 2010 was used. The study used the autoregressive distributed lag (ARDL) estimation procedure which tested for the existence of a non-spurious long-run relationship between price and non-price factors and horticultural export supply response. Diagnostic tests were also carried out. The Error Correction Term lagged once was negative and statistically significant indicating high speed of adjustment. In the long-run, the empirical findings show that horticultural export supply responds positively to agricultural credit, classified road network, foreign direct investment, trade openness and EurepGap. The horticultural exports had elastic response on all factors apart from that of foreign direct investment which was inelastic, otherwise all were statistically significant. Coefficients for relative producer price and income per capita were statistically significant and had negative effect on horticultural export supply. This study recommends that more data and information on prices and market connections should be made available so as to make horticultural export suppliers to be well informed on any price fluctuation. There should be construction and maintenance of rural access roads. Embassies abroad and private companies should carry out promotions through trade fairs and exhibitions so as to maintain and improve on this low horticultural export supply response with respect to relative producer price. The study further recommends provision of appropriate credit packages for horticultural producers and dissemination of information on available sources of funding. Work permits should be provided to genuine foreign investors who are interested in horticultural export business. Government should also enhance the capacity of public research institutions. Monitoring and evaluation of trade flows should be encouraged. Where feasible, private sector players should be facilitated to undertake self-regulation and conform to international market requirements.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

1.1.1 Introduction

This chapter covers Kenya's economic performance and export performance before zeroing on horticultural exports in Kenya. Statement of the problem, research questions and objectives of the study are also presented. The chapter concludes with the significance, scope and organization of the study.

1.1.2 Kenya's economic performance

Kenya's economic performance has seen the best and worst of times. The decade after independence saw the economy grow by 6.6 per cent per annum (KAM, 2006). This phenomenon was mainly due to increased agricultural output and expansion of the manufacturing sector supported by adoption of import substitution strategies. However, in the 1970s, a series of external shocks, namely the two oil crises of 1973 and 1979, and the collapse of East African Community dealt a serious blow to the economy that saw the growth rates decelerate to about 5 per cent per annum. The only exception was

1976/1977 coffee boom which saw Gross Domestic Product (GDP) growth rate rising to 8.2 per cent in 1977 (Republic of Kenya, 1980). Misaligned real exchange rates, the fixed interest rate regime as well as poor commodity pricing undermined macroeconomic stability (Republic of Kenya, 1980). In addition, the drought and world recession experienced in the early 1980s, and the international debt crises worsened the domestic economic situation (World Bank, 1986).

To address the macroeconomic instability, the government introduced liberalization and deregulation of trade and exchange rate regimes as well as public and financial sector reforms. The implementation of these reforms led to a resurgence of growth, which averaged 5 per cent over the period 1986-1990 (Republic of Kenya, 1992). In the 1990s, poor economic performance was mainly as a result of declining donor support, poor weather and infrastructure, insecurity, depressed investments, declining tourism activities and poor performance of manufacturing sector. Overall, GDP growth declined further to 2.5 per cent between 1990 and 1995, and to 2 per cent between 1996 and 2000. The decline in economic performance was apparent in all sectors of the economy (Republic of Kenya, 2001).

The situation was not helped by poor governance that led to the neglect of utilities and inadequate investment in infrastructure. In spite of progressive

government reforms in trade and investment implemented in early 1990s, sectors like horticulture and manufacturing responded poorly, an indication of lack of competitiveness. The Kenyan economy started showing signs of recovery in 2003 after a subdued growth, and posted an impressive 5.7 per cent growth in 2005, compared to negative growth in 1997 and 0.6 per cent in 2002 (KAM, 2006 and World Bank, 2006). Among the key reasons attributed to the poor economic growth between 1997 and 2002 were: inadequacies in governance; poor investments in and maintenance of physical infrastructure; and El-Nino rains, which disrupted horticultural production and wreaked havoc on infrastructure (KAM, 2006). This trend was maintained in 2009 where agriculture contributed 24.4 per cent to GDP while horticulture contributed 17.6 per cent (Republic of Kenya, 2010).

The five major economic sectors that contributed the bulk of GDP were agriculture (including forestry); horticulture; manufacturing; wholesale and retail trade; and transport and communication in that order. The specific sectors' GDP contributions are presented in table 1.1.

Table: 1.1 Percentage contributions by key sectors to GDP (2005-2013).

Sector	2005	2006	2007	2008	2009	2010	2011	2012	2013
Agriculture	23.8	23.4	21.7	22.7	24.4	21.4	24.0	25.9	25.3
Manufacturing	10.5	10.3	10.4	9.8	9.5	9.9	9.6	9.2	8.9
Trade	9.2	9.3	9.7	10.2	10.0	10.2	10.6	10.2	10.2
Transport and communication	10.3	10.6	10.6	10.4	9.8	10.0	9.9	9.3	9.1
Horticulture	**17.1**	**16.9**	**15.8**	**16.6**	**17.6**	**15.9**	**18.1**	**17.9**	**19.4**
GDP growth rate	5.7	6.3	7.1	1.6	2.6	5.8	4.4	4.6	4.7

Source: Computed from various Economic Surveys and Statistical Abstracts.

The five key sectors combined contribution averaged about 70 per cent of the GDP rising to over 72.5 per cent by 2012 (Table 1.1). The GDP growth rate dropped from 7.1 per cent in 2007 to 1.6 per cent in 2008. The 2008 post-election violence, the food and fuel crisis, the global financial crisis and the 2009 drought almost caused Kenya's economy to stagnate. After recovering from four waves of economic shocks, Kenya's growth rate improved and reached 5.8 per cent in 2010, then dropped to 4.6 per cent in 2012 and increasing to 4.7 per cent in 2013. This was moderately strong recovery in view of the global economic crisis which exceeded growth in Sub- Saharan Africa (Republic of Kenya, 2014).

In summary, macroeconomic performance of the Kenyan economy has been fluctuating year after year. This is attributed to high oil and food prices as well as unfavorable weather conditions in some parts of the country during the years covered by the study. Weakening of the Kenya shilling in the foreign exchange market during the third quarter of 2011, for example exacerbated the downward economic situation by suppressing domestic demand (Republic of Kenya, 2012).

1.1.3 Export performance in Kenya

At independence, Kenya had a relatively sophisticated industrial base and a vibrant export sector in comparison with other East African countries. It had a strong foundation in trained personnel (supported by expatriates), which turned these sectors (industrial and export) into major engines of growth. In 1960, exports represented 40 per cent of Kenya's economic growth. This share of global integration was artificially high as it was also the result of Kenya's colonial status and the resulting exports to Britain. However, since mid-sixties, Kenya's exports declined more than expected representing only 20 per cent of GDP by mid-1980s, before partly recovering to 27 per cent of GDP by the end of 2000 (KAM, 2006). In 1970, Kenya's export share represented 0.12 per cent of global exports, but this continuously declined reaching only 0.04 per cent in 2008. Kenya's traditional strength in service exports eroded overtime,

declining from a global share of 0.12 per cent in 1970 to 0.06 per cent in 2000 before recovering slightly to 0.09 per cent in 2009. Kenya's export growth lagged behind the 3.8 per cent average for Sub Saharan Africa. Its share of exports in the region declined from 3.7 per cent in 1970 to 2.2 per cent in 2008 (World Bank, 2010).

In 2013, the trade deficit continued to widen, deteriorating from KShs. 856,740 million in 2012 to KShs. 911,029 million. During 2013, total exports declined by 3.0 per cent while total imports increased by almost an equivalent margin. This led to the deterioration of export-import ratio from 37.7 per cent in 2012 to 35.5 per cent in 2013 (Republic of Kenya, 2014).

1.1.4 Horticultural exports in Kenya

i). *Characteristics and contribution of the horticultural sub-sector in Kenya*

Horticultural sector in Kenya does contribute enormously to realization of the National Development Agenda through interventions in the following areas: wealth and employment creation, foreign exchange earnings, provision of raw materials for the agro-processing industry, enhancing nutrition and food security, and poverty alleviation just but to mention a few. Ideally, horticultural export activities stimulate growth in a number of ways including: production and demand linkages, economies of scale due to larger international

markets and increased efficiency, and embracing of superior technologies embodied in foreign-produced capital goods (Republic of Kenya, 2010)

Kenya has a long history of growing horticultural crops for both domestic and export markets. Kenya's ideal tropical and temperate climatic conditions make it favorable for horticulture production and development. The climatic conditions are highly varied supporting the growth of a wide range of horticultural crops. Horticulture in Kenya is mainly rain fed though a number of farms especially those growing horticultural crops for export use irrigation. The sub-sector is characterized by tremendous diversity in terms of farm size, variety of produce, and geographical area of production. Farm size range from large-scale estates with substantial investments in irrigation and high level use of inputs, hired labour and skilled management to small-scale farms, usually under one acre (Noah and Waithaka, 2005).

Kenya has seen increased growth in its exports of cut flowers for the last twenty years, with roses continuing to dominate the export market. The main market for cut flowers from Kenya is the European Union (EU), in particular Germany, Netherlands, United Kingdom, Sweden, Italy, Switzerland and France. The EU is the market that governs the quality standards of the Kenyan flower industry. These export standards are extremely high and specify

assortment and grading of the cut flowers. Kenya is currently ranked the largest supplier of cut flowers to the EU (HCDA, 2012). The horticultural export is far from saturating world demand, especially in European, Chinese and other Asian countries' markets (Waitathu, 2010). But the question still remains whether factors responsible for this performance are known and to which magnitude. It is also interesting to know whether such growth is sustainable.

Horticulture is a compound name for numerous fresh farm products broadly classified as fruits, vegetables and cut flowers. The main flowers exported from Kenya include Roses, Carnations, Statice, Alstroemeria, and a variety of summer flowers. Under the vegetables category, French beans, snow & snap peas, Asian vegetables (such as karella, chillies, aubergines and okra) dominate the export list. Mangoes, avocadoes, passion fruit, are the most important export fruits (HCDA, 2012).

In 2009, the sub-sector had employed approximately 4.5 million people countrywide directly in production, processing and marketing while another 3.5 million people benefited indirectly through trade and other activities. Up to 80 per cent of this population lived in the rural areas with poverty level of up to 56 per cent. Flowers form a major part and account for about half of Kenya's fresh horticultural exports. The cut flower industry provides direct

employment to an estimated 50,000 Kenyans with a further 70,000 employed in related industries (HCDA, 2012). The sub-sector generated in excess of U.S dollars one billion in foreign earnings and traded seven million tonnes of horticultural produce in the domestic market in 2010 (HCDA, 2011). The sub-sector is a major source of livelihood to smallholder farmers and has been identified as a key 'driver' towards the realization of 'Vision 2030" which envisages Kenya as a middle income economy and a semi-industrialized country by the year 2030. The horticultural sector currently ranks as one of the economy's fastest growing sectors and is ranked as the second foreign exchange earner after tea (Republic of Kenya, 2011). The horticultural export is far from saturating world demand, especially in European, Chinese and other Asian countries' markets (Waitathu, 2010). This means that Kenya produces below potential.

ii). *Performance of horticultural exports in Kenya*

Kenya had steadily increased her production and share of the world market for fresh fruits, vegetables and cut flowers by 2005 (Waitathu, 2010). Figure 1.1 shows the value of horticultural exports supply in Kenya during the study period:

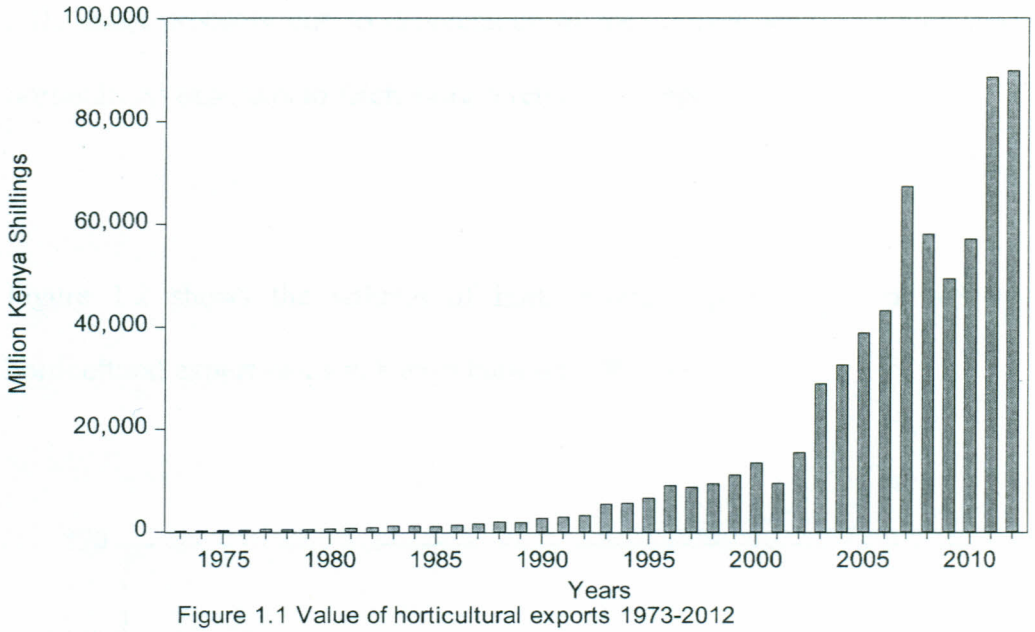

Figure 1.1 Value of horticultural exports 1973-2012
Source: Author's computation based on appendix table A1

The value of horticultural exports was very low before 1980 (figure 1.1). The value however started rising in 1985 which was the year of structural adjustment policies in Kenya, but picked momentum following liberization of early 1990s. There was also a sharp increase between 2003 and 2005. This could be attributed to a new government regime which opened up foreign marketing offices abroad to market Kenyan products. There was a sharp drop in 2007 and 2010. This drop could be due to post election violence that led to forceful displacement of both skilled and unskilled labor from horticultural growing areas. This drop could also have been attributed to shift of horticultural investment to other competing countries and an increase in the number of non-tariff barriers to trade between 2007 and 2009. There was a substantial increase in the value of horticultural export supply in 2011 and

2012 most probably due to depreciation of the Kenyan shilling which made horticultural exporters to fetch more foreign exchange.

Figure 1.2 shows the volume of horticultural export supply of selected horticultural export crops in Kenya between 1995 and 2012.

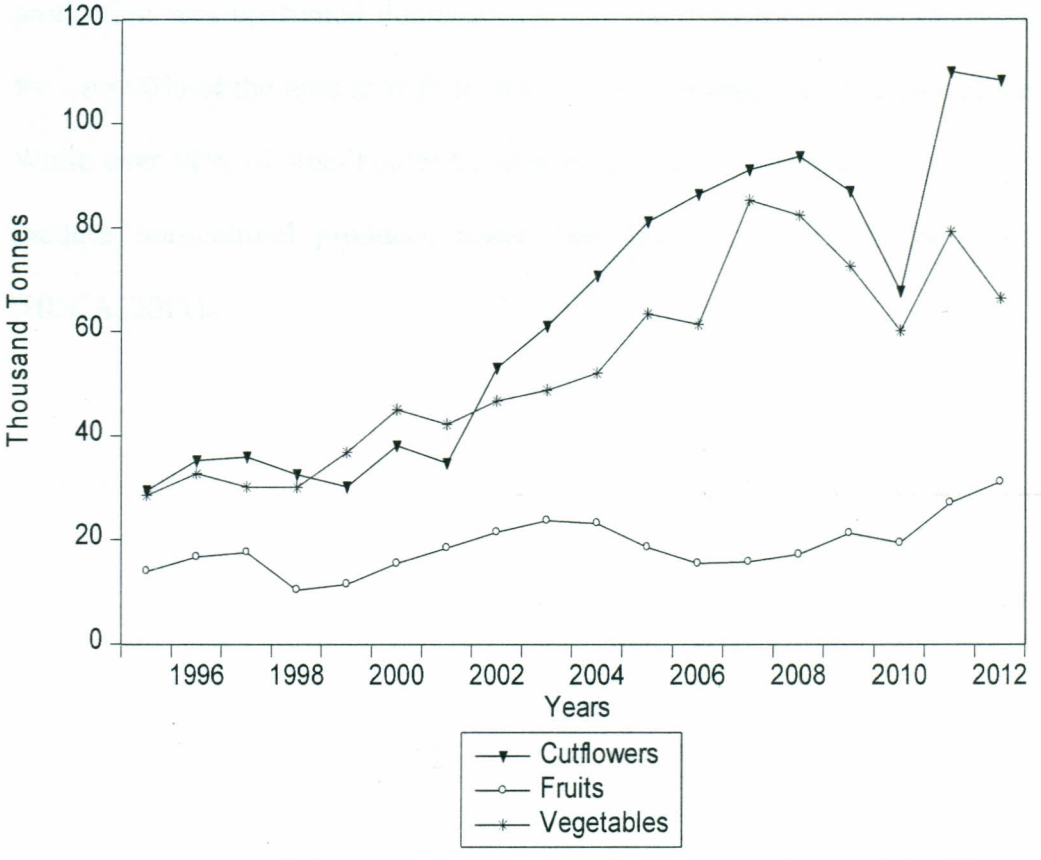

Figure 1.2 Volume of individual horticultural produce exports 1995 - 2012
Source: Author's computation based on Appendix V, Table A8

The figure reflects fluctuating growth rates in fruit, vegetable and cut flower exports. These products make up more than 95 per cent of horticultural exports in Kenya (HCDA, 2010). The trend shown indicates that cut flower export is the leading crop in horticulture industry in Kenya. But the volumes of flowers from Kenya to international markets declined by 30 per cent between 2008 and 2010, back to the situation in year 2006 when the industry exported 80,000 tonnes (Republic of Kenya, 2010). In 2010, over 90% of all fruit and vegetable production was consumed domestically, and the domestic market accounted for over 90% of the total growth in quantity of fruit and vegetable production. While over 90% of smallholder farmers in all but the arid regions of Kenya produce horticultural products, fewer than 2% do so directly for export (HDCA, 2011).

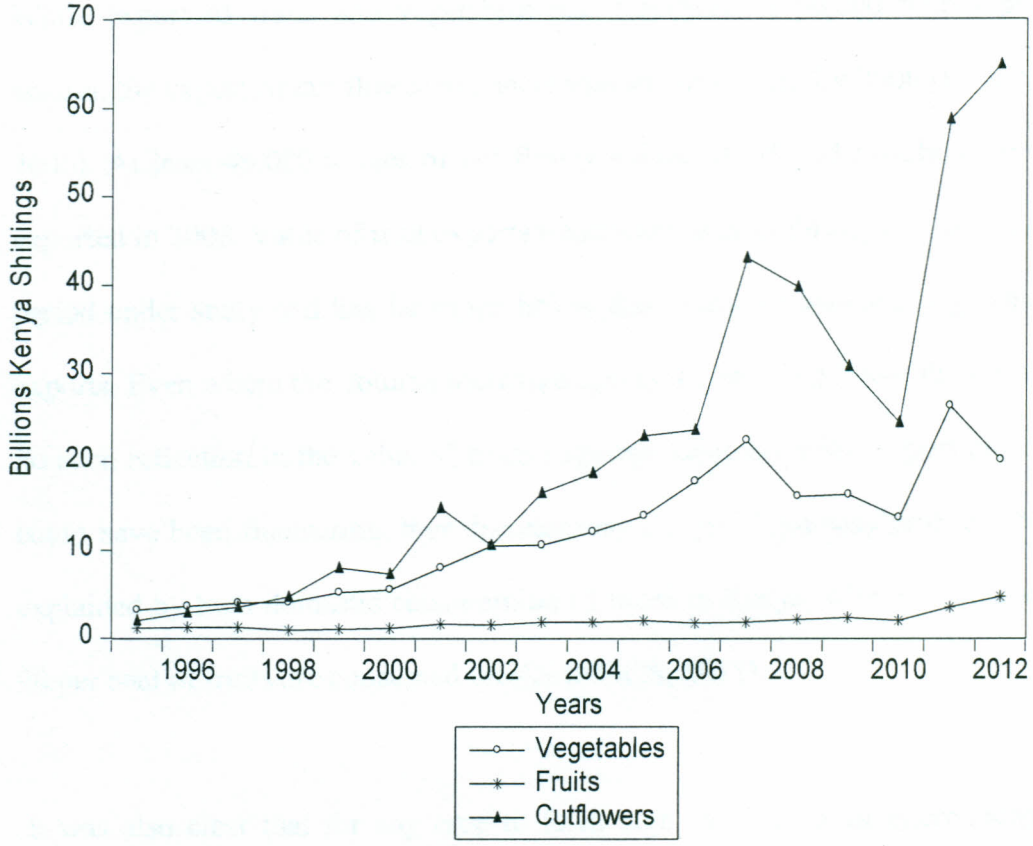

Figure 1.3 Value of individual horticultural produce exports 1995 - 2012
Source: Author's computation based on appendix A9

From figure 1.3 it is clear that the trend of value of cut flowers export portrays a similar trend to that of volume of vegetable exports. Vegetable export trends tend to overtake that of cut flowers between 1998 and 2001 which could have been brought partially by drought as average annual rainfall was very low and vegetables require less water to thrive. Cut flowers exports however surpassed that of vegetable exports after 2002 when rain fall was favorable.

While export of fruits and vegetables had stabilized at 60,000 tonnes per annum, the export of cut flower had increased by 40 percent by 2006 (HCDA, 2006). At least 49,000 tonnes of cut flower valued at US$ 112 million were exported in 2006. Value of fruit exports trend was constant throughout the time period under study and lies far much below that of cut flowers and vegetable exports. Even where the volume increased (between 2002 and 2004) there was no such reflection in the value of fruits exported suggesting that export prices could have been fluctuating, thus discouraging exports. This may probably be explained by high domestic consumption of fruits in Kenya, where more than 90 per cent of fruits are consumed locally (HDCA, 2011).

It was also clear that for any crop to fetch high earnings from international markets more volume of goods had to be exported. This suggests that horticultural export prices may have been very low. This was also supported for example by volume of fruit exports that increased between 1998 and 2003 but there was no notable change in value of fruit exports trends during the same period. The volume for cut flowers increased in 2008 but was reciprocated by a decline in the value of cut flower exports. It is also important to note that although Kenya exports fruits, she imports citrus fruits, apples, pears and grapes from South Africa, Egypt and other countries (Republic of Kenya, 2010). These imports could have a major impact on the local market and adversely affect local production.

iii). *Challenges facing horticultural export supply*

Kenya's horticultural export expansion had been aided by the country's preferential duty-free access to EU markets under the Lome Agreement. If this agreement is not renewed, or if other developing countries obtain similar benefits, Kenya can expect to face even stiffer competition in these markets. Kenya faces major competition in its horticulture industry from Cote d'Ivoire, Morocco, Ethiopia, Zimbabwe, South Africa and Cameroon.

Kenya received much attention from international agencies in order to comply with EU standards (EurepGAP) and stay on the export markets. The cost of certification is high due to lack of internal competition. Europe Good Agricultural Practices (EurepGAP) certification for the average Kenyan smallholder group of 45 growers would cost at least USD 20,000 (Busch, 2005). The Fresh Produce Exporters' Association of Kenya (FPEAK) negotiated with EurepGAP and created Kenya-GAP, a code of practice with local adaptations meant to include small-scale control points that captures small-scale farming concerns and conditions, and lowers the cost of certification as it is done by local certifying bodies. Kenya-Gap was in 2005 under benchmarking and technical review by the international EurepGAP steering committee (Busch, 2005).

Kenyan horticultural exports have been affected by the last decade global financial crisis and prolonged drought in East Africa. Horticulture, Kenya's leading foreign exchange earner was faltering in 2008. Eleven months after the industry registered an impressive performance of over Kshs.73 billion (US$1 billion) earned from exports for the period ending December 31, 2008, it was faced with two serious challenges: prolonged dry weather and low export demand due to the global down-turn, where foreign consumers' appetite for Kenyan products had declined drastically, and in addition, Kenya was yet to recover from the effects of the post-election violence which rocked the country in early 2008.

Floriculture, growth of flowers, is a highly specialized capital intensive industry. The infrastructure needed for the production of floricultural products is very expensive and the actual production per hectare is very high. Flowers are not covered by the food safety legislations and this makes it difficult for customers to determine the country of origin of the flowers they buy. This is an issue that raises concern and frustration among Kenyan flower growers, most of whom have signed the Kenya Flower Council Code of practice, which ensures the welfare of workers and good and safe agricultural practices (Denis *et al.*, 2006).

During the last decade, water levels in Lake Naivasha, where much of irrigation horticulture is practiced, had been falling to critical levels and water rationing had been imposed to control extraction. This really affected production of cut flowers negatively. Drought, combined with restricted spending by importers and a consequent glut of produce in the world flower market led to a year-on-year decline in income from cut flowers (HCDA, 2011).

Horticultural exporters have been subjected to a multiple number of taxes at both national and local level in the form of cess without providing the corresponding requisite services. This has contributed to a reduction of the net farm incomes and created distortions in marketing structures without necessarily improving the revenue for local authorities. The export of horticultural products has also faced restrictions due to poor packaging, damage during transportation, poor handling and inadequate quality control since use of modern science and technology in production is limited. Lack of horticultural policy and inadequate legal and institutional framework to facilitate continued growth, development and sustainability of the horticultural industry has also been a major challenge to the sector.

The main cause of low productivity in horticulture is inadequate credit to finance purchase, of inputs and capital investment. High interest rates make it

almost impossible for horticultural farmers to access credit. Related to credit is the cost of fertilizer and agro-chemicals which has escalated over the last five years making them unaffordable by many horticultural farmers and increasing the unit cost of production. This has resulted in low application of key inputs, hence declining soil fertility and subsequently reduced productivity. The level and effectiveness of extension services has been inadequate due to inappropriateness of the extension approaches, collapse of extension institutions and low budgetary allocations.

Underdeveloped rural roads and other key physical infrastructure have led to high costs for transporting horticultural products to the markets and farm inputs. This has continued to reduce competitiveness of the Kenyan horticultural produce. In addition, electricity in rural areas is expensive and often not available, reducing investment in cold storage facilities, irrigation, and agro-processing.

There is also wastage due to pre-harvest and post-harvest losses occasioned by pests and diseases and lack of proper handling and storage facilities continue to be extremely high. The domestic market also lacks an effective marketing information system and infrastructure. The dependence on external market outlets makes horticultural exports very vulnerable to changes in the demand

for horticultural products and unexpected non-trade barriers by foreign markets.

From the foregoing discussion, there may be need for a unified voice on some of the challenges in developing the horticultural sector, shared regionally by governments and producers, especially in policy advocacy at both international and national levels so as to come up with proper solutions.

iv). *Institutional framework of horticultural export supply in Kenya*

Government has made interventions in the horticultural sector, thus spurring sector's growth by encouraging private sector participation. It set up the Horticultural Crops Development Authority (HCDA) under the Agriculture Act in 1967 with the aim of developing and regulating the industry. HCDA offers technical and marketing services to the stakeholders in the horticulture industry (KAM, 2006). There were more than 60 companies in 2010 dealing in fresh vegetables, fruits and cut flowers both for export and domestic consumption. The companies are all privately owned and adhered to very high standards in handling their products. Through Fresh Produce Exporters Associations of Kenya (FPEAK), the companies assist each other in both technical and marketing aspects of the industry.

FPEAK aims at developing and implementing Kenya Good Agricultural Practices (Kenya-Gap) protocol. Kenya-Gap is responsible for sustainable agricultural practices that provide a universally acceptable standard, to which growers can be audited and certified against. Development of the protocol has involved wide stakeholder consultation through a National technical committee which has been instrumental in formulating the interpretation guidelines and quality management system model. This involve influence enactment of a facilitative environment for the horticulture industry, creating awareness in the horticulture industry on market requirements, changes and regulations and undertaking continuous identification of market opportunities (HCDA, 2012).

The Flower Council of Kenya (KFC) is another members' body that supports and lobbies for the flower growers and exporters. To ensure that Kenyan flower export growers remain in business, the Kenyan Flower Council (KFC), together with other players in the export sector, have embarked on a search for new markets in the US and Asia, including the Far East (Waitathu, 2010), in addition to the thriving European market.

Horticulture Council of Africa (HCA) network was established by member country national associations to address constraints the region is facing in maintaining competitiveness in the horticultural export market, especially in the European markets. Members of HCA are drawn from the major

horticulture exporting countries of the Eastern, Central and Southern Africa (ECSA) region. They include Kenya, Uganda, Zambia, South Africa, Burundi, Rwanda, and Ethiopia. The vision for the Horticultural Council of Africa has been developed to connect all members' national horticulture associations with a common aspiration and purpose. The development of the horticultural export sector in the region has been led mainly by the private sector. The mission for HCA is to promote growth of horticultural exports supply in the East, Central and Southern Africa Region through information sharing, collaborative research, environmental stability and collective bargaining (HCDA, 2006).

It is noted that the main reasons for the attention on horticulture was based on the fact that over the last 25 years, the value of horticulture exports supply from Southern and Eastern Africa had increased by over 50 per cent and currently contributes 18 per cent of the agricultural exports. Furthermore, experiences of countries like Kenya show how critical the sector has been in providing market linkages and related income earnings to small scale producers (HCDA, 2011).

In conclusion, although Kenya's horticultural sector has received a great deal of attention from international markets over the last twenty years, it faces a lot of challenges which have led to the low and relenting growth of its exports to Europe. This uninspiring growth has undoubtedly contributed to decreased

rural incomes and thus to increased rural poverty in Kenya. Again, despite this growth being notable, horticultural exports remain a small fraction of Kenya's overall export sector.

1.2 Statement of the problem.

The horticultural sector is one of the fastest growing and most vibrant agricultural sub-sectors in the Kenyan economy, recording an average growth of 15-20 per cent per annum over the period under study. The sub-sector contributes more than 10 per cent of total agricultural production and engages approximately 4.5 million people nationwide in production, processing and marketing while 3.5 million people benefit indirectly through trade and other activities (HDCA, 2011). The sub-sector contributes positively to wealth creation, poverty alleviation, gender justice and other aspects of socioeconomic development, especially in the rural areas.

The horticultural sub-sector in Kenya faces many challenges which include: inadequate legal and policy frameworks; low effectiveness of extension services; low application of modern technology; inadequate quality control systems; multiplicity of taxes; low availability of capital and limited access to affordable credit; inadequate market and marketing infrastructure; high cost, adulteration and low application of key inputs; pests and diseases; frequent

droughts and floods; lack of enough storage and processing facilities and poor infrastructure.

Policy interventions and strategies from the government and other stakeholders so far have failed to facilitate realization of targets for horticultural production and exports. The sectors' performance is still far below its potential. This denies the country the much needed foreign exchange and also limits other potential contributions from the sector. It is therefore important that strategies for enhancing and sustaining horticultural export performance and growth are designed. Design of such strategies can be informed by research into factors driving horticultural export supply. Yet there is a dearth of literature on horticultural export supply response in Kenya. Previous studies (for instance Were *et al.*, 2002, Maitha, 1970, Ng'eno, 1991, and Okore, 1987 among others) focus on supply response of other agricultural exports such as coffee and tea. We are not aware of any study that specifically focuses on horticultural export supply response. It is unlikely that policies for coffee and tea as well as general agricultural exports would fit the horticultural export, given the specificity of the sector. This study addresses this research gap, and seeks to understand the responsiveness of horticultural export supply to changes in relative producer price and non-price factors. This is crucial for formulating a sound horticultural export supply specific policy package.

1.3 Research questions

The study sought to answer the following questions:

i. What is the effect of relative producer price on horticultural exports supply in Kenya?
ii. What is the effect of non-price variables on horticultural exports supply in Kenya?
iii. What policy implications would enhance horticultural export supply response?

1.4 Objectives of the study

The general objective of this thesis was to investigate agricultural export supply response in Kenya with emphasis on horticultural sub-sector. The specific objectives are:

i. To investigate the effect of relative producer price on horticultural export supply in Kenya.
ii. To investigate the effect of non-price variables on horticultural export supply in Kenya.
iii. To draw policy implications for enhancing and sustaining horticultural export supply response from the findings.

1.5 Significance of the study

For many years now, the Kenya government has not implemented effective policies aimed at increasing her horticultural export supply. Some of those interventions have been reviewed and assessed in this study so as to get a better understanding of how the government can gainfully contribute to horticultural export performance. To the government of Kenya and horticultural export producers, the study findings and policy implications are of significance in as far as horticultural export supply response is concerned. Knowledge on the magnitude of both relative producer price and non-price variables on horticultural export supply response in Kenya can facilitate design of horticultural export policies. The current findings could also be used in comparative studies in other developing countries. This study also suggests areas for further research. The study further adds to knowledge which is useful as literature.

1.6 Scope and organization of the study

This study was limited to the analysis of horticultural export supply response to price and non-price factors in Kenya. Aggregate data for horticultural export and that of price and non-price factors for the period between 1973 and 2010 was used. The choice of period was dictated by availability of data which also

made it difficult to analyze individual horticultural crops export supply response.

The thesis consists of five chapters. Chapter one presents the introduction and background information, statement of the problem, research questions, objectives, significance, scope and organization of the study. Chapter two presents the literature review which includes theoretical and empirical literature. Chapter three presents the methodology that the study adopted, in terms of empirical modeling of horticultural export supply response, a description of the variables and the type of data used. Chapter four presents the findings of the study, while summary, conclusions and policy recommendations are presented in chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of relevant literature on the issues at hand. It starts with a theoretical literature section that reviews the existing theories and factors influencing export supply response. It then reviews empirical literature, which discusses studies related to export supply response both in Kenya and Sub Saharan Africa (SSA) in general. The chapter closes with an overview of the literature.

2:2 Theoretical literature

2.2.1 Introduction

International trade is a branch of economics, which, together with international finance, forms the larger branch of international economics. International trade is exchange of capital, goods, and services across international borders or territories (Mudida, 2003). In most countries, it represents a significant share of gross domestic product (GDP). Even though international trade has been present throughout much of history, its socio-economic and political importance has been on the rise in recent past. Industrialization, advanced

transportation, globalization, multinational corporations, and outsourcing are all having a major impact on the international trade system. Increasing international trade is crucial to the continuance of globalization. Without international trade, nations would be limited to the goods and services produced within their own borders (Meier, 1989).

International trade is in principle not different from domestic trade as the motivation and the behavior of parties involved in trade do not change fundamentally regardless of whether trade is across a border or not. The main difference is that international trade is typically more costly than domestic trade. The reason is that a border typically imposes additional costs such as tariffs, time costs due to border delays and costs associated with country differences such as language, the legal system or culture. Another difference between domestic and international trade is that factors of production such as capital and labour are typically more mobile within a country than across countries. Thus, international trade is mostly restricted to trade in goods and services, and only to a lesser extent to trade in capital, labor or other factors of production. Therefore, trade in goods and services can serve as a substitute for trade in factors of production. Instead of importing a factor of production, a country can import goods that make intensive use of the factor of production and are thus embodying the respective factor. An example is the import of

labor-intensive goods by the United States from China. Instead of importing Chinese labor, the United States imports goods from China that were produced with Chinese labor.

The same principle is applied in the case of Kenya where United Kingdom (UK) imports horticultural products from Kenya which are produced using labour-intensive technology. So, Kenya specializes in production of horticultural crops as labour is cheap and abundant, not forgetting good weather conditions, then exports to Europe, Asia and other foreign countries.

2.2.2 International trade theories/models

2.2.2.1 Introduction

Several different models have been proposed to predict patterns of trade and to analyze the effects of trade policies such as tariffs and how they influence exports. This section presents theories of international trade under which horticultural exports supply in Kenya can be analyzed.

i). The Ricardian model

This model focuses on comparative advantage, perhaps the most important concept in international trade theory and remains one of the long-term insights of economic theory. It was developed by David Ricardo in the early nineteenth century to provide intellectual support for the abolition of Corn Laws in Great Britain to promote the benefits of free trade in grain. In a Ricardian model, countries specialize in producing what they produce best (Krugman and Obstfield, 2009). Unlike other models, the Ricardian framework predicts that countries will fully specialize instead of producing a broad array of goods. The model does not directly consider factor endowments, such as the relative amounts of labor and capital within a country. The basis for comparative advantage in the Ricardian model lies in cross-country technological differences, as summarized by differences in the opportunity cost in production of goods.

The main merit of the Ricardian model is that it assumes technology differences between countries (Samuelson, 2001). The Ricardian model makes assumptions which include: Labor is the only primary input to production (labor is considered to be the ultimate source of value); Constant Marginal Product of Labor (MPL); Limited amount of labor in the economy; Labor is

perfectly mobile among sectors but not internationally; and there is perfect competition in input markets.

The Ricardian model is applicable in the short-run which implies that technology differs internationally. This supports the fact that countries follow their comparative advantage and allow for specialization. This theory has limitations in that: first, it is possible to have different terms of trade such that one country enjoys all the benefits of increased production while the other is made worse off. Secondly, even if the country has more of both goods after trade, one cannot be sure that all consumers would have more of both goods.

Samuelson (2001) suggested that the limitations highlighted above can be solved by describing more carefully some of the features of the model, through establishing relationship between prices and wages. Using these relationships, the impact of free trade on the price ratio and the effect of trade on the distribution of income can be explained. It is important to note that this study is based on the Ricardian theory of international trade where it was assumed that comparative cost advantage principle is used in Kenya. Kenya specializes in the production of agricultural products, where horticulture production is one of the main activities. Kenya has low opportunity cost in horticulture

production where she sells what she requires domestically and the rest is exported to other countries. Kenya imports those products where she has high opportunity cost of production.

ii). Heckscher-Ohlin model

In the early 1900s, an international trade theory known as factor proportions theory emerged, fronted by two Swedish economists, Eli Heckscher and Bertil Ohlin. This theory is also called the Heckscher-Ohlin theory (Bowen *et al.*, 1987). The Heckscher-Ohlin (H-O) theory stresses that countries should produce and export goods that require resources (factors) that are abundant and import goods that require resources in short supply. It was formulated as an alternative to the Ricardian model. This theory differs from the Ricardian theory since the former focuses on the productivity of the production process for a particular good. On the contrary, the H-O theory states that a country should specialize in production and export using the factors that are most abundant, and thus the cheapest. Note that a country should not just produce, as earlier theory stated, the goods it produces most efficiently but should consider the opportunity cost of production (Bowen *et al.*, 1987).

Despite its greater complexity, the H-O model did not prove much more accurate in its predictions. However, from a theoretical point of view, it did provide an elegant solution by incorporating the neoclassical price mechanism into international trade theory. The theory states that the pattern of international trade is determined by differences in factor endowments (Samuelson, 2001). It predicts that countries will export those goods that make intensive use of locally abundant factors and will import goods that make intensive use of factors that are locally scarce. The H-O model makes the following core assumptions: Labor and capital flow freely between sectors; the production of shoes is labor intensive and the production of computers is capital intensive (products can be different); the amount of labor and capital in two countries differ (difference in endowments); there is free trade; technology is the same across countries (long-term); and tastes are the same (Samuelson, 2001).

The problem with the H-O theory is that it excludes the trade of capital goods (including materials and fuels). In the H-O theory, labor and capital are fixed entities endowed to each country. In a modern economy, capital goods are traded internationally. Gains from trade of intermediate goods are considerable, as it was emphasized by Samuelson (2001). The H-O theory is preferred to the Ricardo theory by many economists, because it makes fewer

simplifying assumptions (Leontief, 1953). Leontief tested the validity of the H-O theory and found out that the USA's exports were less capital intensive than imports. H-O theory is not well adapted to analyze the North-South (N-S) trade problems. Third world countries care mostly about the income difference between North and South. This came to be known as the Leontief Paradox.

After the introduction of Leontief's paradox, many researchers tried to save the H-O theory, either by new methods of measurement, or by new interpretations. Leamer (1980) emphasized that Leontief did not interpret H-O theory properly and claimed that with a right interpretation, the paradox did not occur. Choudri (1982) found that, if Leamer was right, the American workers consumption per head would have been lower than the workers world average consumption.

H-O model assumes identical production functions between countries. Although this is highly unrealistic for specific cases, the theory is relevant to this study as it helps in international trade facilitation in general, especially where factors of production are mobile as in the case of Kenya's horticultural export supply. Again what matters most for horticultural export supply in Kenya is the difference in income between the North and the South so that trade can take place.

iii). Specific factors model

This model can be traced in the writings of Haberier (1936). In this model, labor mobility between industries is possible while capital is immobile between industries in the short-run. Thus, this model can be interpreted as a 'short run' version of the Heckscher-Ohlin model. The "specific factors" name refers to the fact that in the short-run, specific factors of production such as physical capital are not easily transferable between industries. The theory suggests that if there is an increase in the price of a good, the owners of the factor of production specific to that good will profit in real terms (Samuelson, 1971).

Additionally, owners of opposing specific factors of production (i.e. labor and capital) are likely to have opposing agenda when lobbying for controls over immigration of labor. Conversely, owners of capital and labor will profit in real terms from an increase in the capital endowment. This model is ideal for particular industries and for understanding income distribution but it is limited in that it is tactless for discussing the pattern of trade (Leamer, 1980). This study gives attention to this theory as it concentrated on short-run effects of

trade which helps in international trade facilitation although the scope of this thesis extends to long-run effects of trade.

(iv). New trade theory

New Trade Theory was initially associated with Paul Krugman in the late 1970s (Beason *et al.* 1996). The theory tries to explain elements of trade that comparative advantage-based models have difficulty with. These include the fact that most trade is between countries with similar factor endowment and productivity levels, and the large amount of multinational production (i.e. foreign direct investment) which exists. New Trade theory is often based on assumptions like monopolistic competition and increasing returns to scale. One result of this theory is the home-market effect, which asserts that, if an industry tends to cluster in one location because of returns to scale and if that industry has high transportation costs, the industry will be located in the country with most of its demand to minimize the cost (Samuelson, 2001). The greatest limitation of this theory is that, if the model does not apply to the concerned country then the theory collapses. The theory is relevant to this study to a lesser extent as horticultural exports are grown far away from their market destinations.

(v). Neo-Ricardian trade theory

Steedman (1979) criticized neoclassical international trade theory, namely the Heckscher-Ohlin model on the basis that the notion of capital as primary factor has no method of measuring it before the determination of profit rate (thus trapped in a logical vicious circle). This was a second round of the Cambridge capital controversy, this time in the field of international trade. The merit of neo-Ricardian trade theory is that input goods are explicitly included to the analytical framework. This is in accordance with Sraffa's idea that any commodity is a product made by means of commodities. The limitation of this theory is that the analysis is based on small country cases (Chipman, 1965).

Shiozawa (2009) emphasized that the Neo-Ricardian trade theory provides a general theory which includes trade of intermediates such as fuel, machine tools, machinery parts and processed materials. The traded intermediate goods are then used as inputs of production in the importing country. Capital goods are nothing other than inputs to production. Thus, in this trade theory, capital goods move freely from country to country. Labor is the unique factor of production that remains immobile in the country of its origin. The neoclassical Heckscher-Ohlin-Samuelson theory concentrated on production factors and finished goods only. It does not consider intermediate goods. Therefore, it is

the Neo-Ricardo trade theory that provides theoretical basis for the topics such as outsourcing, fragmentation and intra-firm trade. This theory has limitation in that capital cannot be freely transferable from one country to another as assumed therein. As this theory builds up on H-O theory, this study found it relevant in its application as it facilitates smooth flow of goods and services in international trade.

(vi). Imperfect substitute model

Building on the proceeding theories and models, Goldstein and Khan (1985) and Islam and Subramanian (1989) suggested that the basic assumption of the imperfect substitute model is that neither imports nor exports are perfect substitute for domestic goods. If domestic and foreign goods were perfect substitutes, a given country would be either an exporter or an importer. The model distinguishes between long-term and short-term fluctuations. Long-term changes are captured by a trend term (Islam and Subramanian, 1989). Short-term fluctuations in demand are transmitted from economic activity in the importing groups to exports of the exporting group. Short-term fluctuations in supply are transmitted from the domestic output of the exporting group (measured by deviations from trend) to their own exports. Price changes are measured by a weighted average of the real effective exchange rates of the

countries in the appropriate group. The effects of price changes on exports are assessed using both demand factors in the importing groups and supply factors in the exporting groups (Islam and Subramanian, 1989).

On the other hand, Goldstein and Khan (1985) revealed that the advantage of presenting the supply side as well as the demand side of the imperfect substitute model was to make it clear that the relationship between quantities and prices was simultaneous. Nevertheless, the majority of the time-series works on import and export equations have addressed the supply side only by assumption. The prevailing practice is the assumption that the supply-price elasticities for imports and exports are infinite.

In conclusion, the above theories/models are interrelated and one theory builds on another. It means therefore that there is none of the theories which can be rejected while addressing the horticultural export supply response as all the theories facilitate international trade in one way or another. However, the imperfect substitute model is a summary of all the others and therefore adapted in this study.

2.3 Empirical literature review

Empirical works on the determinants of export growth of agricultural products have taken different approaches. These are studies that have used various models to explain the causality or dynamic adjustment between the behaviour of some exogenous and endogenous variables, and the export growth in any economy or in a group of countries. This section reviews these studies starting with studies outside the country and later reviewing export supply of agricultural commodities in Kenya.

Goldstein and Khan (1985) took an explicit account of simultaneity relationship between the quantity of exports and their price by specifying models of export demand and supply and by estimating these models. The study used quarterly aggregate export data for eight industrial countries for the period 1955–1970. The study results indicated that export price elasticities of demand were considerably larger than those obtained by other researchers for the same group of countries. The study's income elasticities tended to be very similar to those obtained by Houthakker and Magee (1969), who found that income elasticities for U.S.A and U.K. exports were lower than those for other countries. Elasticities for Japanese exports were high relative to other industrial countries. The estimated dynamic models had been found to be stable.

Islam and Subramanian (1989) provided evidence on income and price elasticities of demand and supply of agricultural products from developing countries on the basis of a consistent and fully specified supply and demand model and statistical estimation procedures not frequently used in the estimation of agricultural export functions. Estimates of price and income elasticities of demand for aggregate agricultural exports for all developing countries taken together – as distinct from individual exporting countries – were found to be low. Moreover, export price as distinguished from non-price factors played a relatively insignificant role in increasing export supply. Hence, an attempt by all developing countries to expand traditional agricultural exports with low price elasticity of demand could not yield rising earnings for all, but in fact could result in falling export revenues.

Income and price elasticities of demand for such tropical commodities as tea, coffee, cocoa and bananas were also found to be low, except for new, non-traditional exports like pineapples. This indicated the importance of diversification of agricultural exports as a vehicle for future growth. Their study was on aggregate agricultural exports. This is relevant to this study but the study took the case of a small country and therefore used the supply side equation only. The current study analyzes an individual sub-sector rather than

aggregate agricultural supply response. It is also clear that the reviewed study never bothered with the adjustment effects, where the current study captures both the short-run and long–run adjustments.

Fosu (1992) undertook a quantitative measurement of the effects of the real exchange rate of the cedi on agricultural price and incentives on agricultural export performance in Ghana over the period of 1960-87. The author argued that the real exchange rate (RER) of a domestic currency does not influence the economy's agricultural exports directly. Instead, it influenced agricultural exports through its effects on the incentive structure. The study estimated a total of four agricultural export functions using the ordinary least squares method: an aggregated real agricultural export function; cocoa; coffee; and sheanut export equations.

The study showed that the response of agricultural exports to a change in the real exchange rate was inelastic. An increase in the production of a particular agricultural exports conferred larger elasticities on individual products than aggregate agricultural exports, the elasticity of which was equal to zero. Although the smuggling of cocoa to Cote d'Ivoire was found to exert a

negative effect on the volume of cocoa exports, it had no significant effect on aggregate agricultural exports.

The weak response of aggregate agricultural and sheanut exports to changes in the real exchange rate was due to lack of response to the relative prices. The inelastic response to changes in real exchange rate suggested that, larger changes were required to stimulate the desired increases in agricultural exports. That, coupled with the extremely low corresponding elasticity for aggregate agricultural exports suggested that reliance on changes in the real exchange rate to stimulate increased agricultural exports was not a fruitful policy. There was need to complement real exchange rate policy with effective measures to provide improved infrastructure at farm level, for the handling of agricultural exports for transport from production areas and at the ports, and for facilitating and advising exporters.

Finally, the study demonstrated that a 10 per cent increase in the price of cocoa relative to food price stimulated a 2.42 per cent increase in the volume of cocoa exports. However, volume of cocoa exports tended to respond negatively to its base capacity. That suggested the need to diversify exports away from over-dependence on it. It was suggested that the promotion of non-

traditional exports needed to be vigorously pursued. The author suggested that more studies needed to be done on other countries for comparative study although the reviewed study was silent on adjustments effects of short-run to long-run periods. The current study tries to fill-in this gap.

Mudlak and Larson (1992) investigated the relationship between domestic prices and world prices of agricultural commodities. They checked whether variations in world prices were transmitted to domestic prices and whether they constituted an important component of variations in domestic prices. Domestic prices were regressed on world prices in various forms, while taking into account the possible effects of exchange rates and inflation. The empirical analysis was based on data from the Food and Agricultural Organization of the United Nations for 58 countries for the period 1968 to 1978, and for the countries of the European Community from 1961 to 1985. The results showed that most of the variations in the world prices were transmitted to domestic prices and that they constituted the dominant component in the variations of domestic prices. The study ignored the adjustment effects over periods. This study is similar to their study although it concentrates on an individual crop analyses and also cares for the adjustment effects using ARDL approach.

Lukonga (1994) investigated factors underlying the performance of Nigeria's non-oil export. Ordinary Least Square (OLS) estimation procedures were used to obtain estimates for three commodities, cocoa, palm kernel and rubber. Cocoa yielded statistically significant price elasticities with the expected signs, indicating that the commodity responded positively to changes in relative prices. Overall, the results provided evidence of and support for the usefulness of pricing policy in eliciting export supply. The study denoted a weak relationship between agricultural output and export trends. It supported the view that domestic market conditions strongly influenced export behavior. It finally reflected poor performance with regard to lagged exports. The current study is similar to the reviewed study but differs in that adjustments over periods are addressed here and differs in that the current study estimates a single crop equation.

Ghura and Grennes (1994) investigated the effects of economy-wide distortions on aggregate trade in Sub-Saharan Africa. Using pooled time-series and cross-section data for 33 countries in the region during 1970 to 1987, they established that overvalued real exchange rates were common. They functioned as a tax on aggregate export supply and stimulated import demand. Aggregate export supply was found to be price inelastic. The Marshall-Lerner condition was met for the sample of countries considered. It was also

established that African trade responded significantly to external factors, including international prices and world income. Also, the behavior of the real exchange rate in Sub-Saharan Africa was consistent with the predictions of theoretical models. The study never addressed the adjustment effects over periods. So, the current study fills in this gap and estimates an individual export supply equation.

According to Sachs and Warner (1995) countries that have efficient customs and trade transport have been shown to export and import more. These factors reduce market access, as firms find it costly to get to international markets, as they cannot meet the tight turnaround times required to compete in higher-end markets. They also raise input costs, because suppliers face higher transport costs and handling charges, because domestic substitutes for importable inputs are higher, and because producer's inventory costs are higher, in that producers are forced to carry higher inventories on account of delays and uncertainties in importing inputs. Infrastructure conditions can be a deciding factor in market access and cost competitiveness, especially in landlocked countries where geography and poor transport infrastructure are often distinct competitive disadvantages.

Amin (1996) estimated the effects of exchange rate policies on prices of export crops and on Cameroon's agricultural export competitiveness. The author calculated the nominal protection coefficient (NPC) and the nominal protection rates (NPR) for the crops considered, which included cocoa and coffee. The study estimated the real exchange rate (RER) and the extent of over-valuation. It concluded that the agricultural sector was heavily taxed through a high level of intervention and over-valuation. The levels of real over-valuation were quite high, up to 77 per cent. Estimates showed that a 10 percent depreciation or RER stimulated about 1.0 percent increase of cocoa relative to the price of tradables. The study also specified three agricultural export models related to cocoa, coffee and aggregate agricultural export. The results from the OLS estimation showed that overall, the variables were not statistically significant at the 5% level, although they had the right signs. The response of cocoa and coffee to foreign income was fairly elastic for cocoa and fairly inelastic for coffee. For a better performance of the agricultural sector and the economy as a whole, the study recommended the removal of government interventions and an examination of the question of depreciation of the RER. This last point should include looking at major agricultural constraints, particularly the factors that have reduced agricultural exports, a preoccupation of the current study. The reviewed study again ignores the effects of adjustments over periods. The current study captures all the adjustments using the ARDL model.

De Mello (1997) argues that foreign direct investment (FDI) is an important factor affecting the export supply capacity of a country. There is consensus among development economists that FDI inflows are likely to play an important role in explaining growth of recipient countries. Increasing capital stock, FDI can contribute to a more efficient use of existing resources and absorb unemployed resources and thus increase a country's output and productivity. However, the author notes that the role of FDI in export promotion depends crucially on the motive for such investment: If the motive behind FDI is to capture the domestic market (tariff-jumping type of investment), it may not contribute to export growth. On the other hand, if the motive is to tap export markets by taking advantage of a country's comparative advantage, then FDI may contribute to export growth. Thus, whether FDI contributes to export growth or not depends on the nature of the policy regime.

Sekkat and Varoudakis (1999) empirically assessed the impact of exchange rate policy on the performance of manufactured exports for four North African countries over the period 1970 to 1992. The impact of exchange rate policy was examined through the effect of three indicators: real effective exchange rate (RER) changes, RER volatility and (model-based measures of) RER misalignment. Export supply equations were estimated for three manufacturing sectors (textiles, chemicals and food). Their results suggested that exchange rate management mattered for export performance. This was evidenced both by

the significant impact of changes in the real effective exchange rate and by the negative influence exerted independently by real exchange rate misalignment and volatility. The reviewed study overlooked the adjustment effects over periods. Although the study concentrated on manufactured exports, it is similar to this study which concentrated on horticultural export supply. It differs in that this study investigated a single equation on horticultural export crops in a single country case.

Balistreri and Hillberry (2002) focused on three predictions regarding welfare: the implied size of the transport sector; the price wedge imposed by distance and border related costs; and the degree of spatial variation in retail price indices. Through their examination, they found that the model's quantitative predictions were at odds with available evidence on the resource costs of transportation and the geographic dispersion of prices. After assessing the model's general equilibrium predictions, they concluded that the gravity model was unsuitable for welfare estimation analysis.

Additionally, they concluded that the theoretical model was too dependent on transport costs and their effects on consumer behavior. Under plausible parameterizations of the standard gravity model, they found that iceberg melt

(the cost of transporting a good that used up only some fraction of the good itself, rather than using any other resources) consumed over forty-five percent of output and transport markup was between fifty and eighty percent. Their tests of the model indicated large unobserved differences in the cost of living between the United States and Canada: Canadians bore a disproportionate share of distance and border costs and their consumer prices were more than twenty percent higher than in the United States. The study had a limitation of ignoring adjustment effects of short-run and long-run periods. The current study takes care of the adjustments and utilized the ARDL model instead of gravity model.

Edwards and Alves (2002) evaluated the extent to which the composition and level of manufacturing exports had responded to trade liberalization in South Africa. They found that the successes of these policies in generating export growth had been mixed. Exports of manufactures had increased but not enough to generate an export-led growth boom similar to those of East Asia and a few other resource-based export economies. Moreover, South African manufactured exports remained resource-based and the country had lagged others in diversifying into new and fast growing export sectors. The inability to re-structure exports towards these dynamic high technology products was one

explanation for the relatively poor export performance of South African manufacturing during the 1990s.

Edwards and Alves (2002) also investigated the determinants of South African manufacturing export performance. They used a variant of the imperfect substitution model and estimated export supply and demand functions using a panel of industry data from 1970-2002. The analysis found that South African manufacturers were on average price-takers in the international market and that exports were predominantly supply driven. Export growth was therefore not predominantly dependent on the economic prosperity of South Africa's trading partners or on their ability to compete in the export market on the basis of price. Furthermore, the study found that many of the constraints to export growth could be found in factors that negatively affected the profitability of export supply. The real effective exchange rate, infrastructure costs, tariff rates and skilled labour were found to be important determinants of export supply. The study ignored the effects of short –run and long-run adjustment effects.

This study uses a similar approach to Edwards and Alves (2002) but it did not estimate the demand functions as Kenyan horticultural exports take world prices as given. The study also focused on agricultural exports with reference

to horticultural export supply rather than manufactured goods. The current study takes care of adjustment effects.

Daniel and Sunday (2002) using supply function approach assessed the determinants of export supply of cocoa, coffee and bananas in Cameroon. The rationale was that Cameroon as a price taker in the market of these crops could only increase its export revenue by increasing export supply. The results showed that producer prices and not export prices were quite important in driving the export supply of cocoa and coffee. It was only bananas whose export prices were important (especially because of no producer prices). Improvement of the road infrastructure had a positive effect on export supply. Equally, more credit to crop exporters facilitated the purchase of the crops from farmers and thus increased exports.

The Structural Adjustment Programs (SAP) dummies showed a positive effect for the policies implemented, market deregulation, restructuring of productive activities and market-determined prices. Exports supply was also driven by natural factors like rainfall in the case of cocoa and coffee. The study again ignored the effects of short –run and long-run adjustment effects. The current study uses a similar approach to Daniel and Sunday (2002) but on Kenyan

horticultural exports supply response. The current study takes care of adjustment effects which were ignored by the reviewed study.

Musibau (2002) examined the determinants of export performance for a panel of 20 Sub-Saharan African countries using the export demand and supply function approach. The study applied dynamic panel data models based on fixed effects estimators. The study excluded oil and mineral exports and disaggregated exports into manufactures and agricultural export. Disaggregation allowed the study to isolate and analyze export behavior independent of fluctuations in international commodity prices and calculated reliable long-run price and income elasticity of exports.

Econometric evidence from the export demand equation revealed that relative prices and trading partners' earnings were important in explaining export performance in Sub-Saharan Africa (SSA). The exports of SSA had performed poorly because the demand for African exports had low elasticity in relation to changes in world income and in most cases were uncompetitive in the world market. The estimated long-run income elasticity ranged between 0.48 and 1.30 while the long-run price elasticity ranged between -0.01 and -0.17. Furthermore, the results from the export supply model revealed that trade

policy reforms had been beneficial to export performance, but the impact was limited. A one per cent reduction in average tariff rate raised merchandise exports by 0.02 per cent, manufactured export by 0.03 per cent and agricultural exports by 0.02 per cent.

Explanations for those results were over-dependence on a narrow range of unprocessed primary commodities, which were of declining importance in world trade; high trade costs; inefficient infrastructure; constrained productive capacity; and foreign market access constraints. In sum, the trade structure of most countries in SSA and supply side constraints had contributed to the dismal export performance witnessed. Moreover, exogenous factors such as world prices and earnings of trading partners appeared to be more important determinants of exports than a country's trade policies. Limitation for this study is that adjustment effects over the period are ignored. This study is similar to the above study only that it concentrated on supply side constraints of a single country using time series data on horticultural exports in Kenya.

Fuggaza (2004) investigated the major determinants of export performance in less developed countries. The study used quartile regression techniques on gravity trade theory and tested data series representing foreign market access

and supply capacity for a sample of 84 countries. Its main findings were that, in the aggregate, all regions had benefited from the greater integration of the world economy in the period 1985-1999. Access to extra-regional markets in particular had been a key factor in explaining export performance. Intra-regionally generated foreign market access had also been important in most regions, possibly underscoring the increasing significance of regional trade agreements. However, that was not the case for the Sub-Sahara African countries whose intra-regional trade declined in all periods except 1992-1995. In addition, African and Middle Eastern countries appeared to have faced severe supply capacity constraints over the last two decades, while their access to foreign markets had remained largely unchanged.

The study found that limitations on foreign markets access were major contributors to poor export performance. However, good performance in the second half of the 1990's also faced higher external constraints but were able to overcome them. Internal transport infrastructure captured by the percentage of the paved roads was an important supply capacity element and was found to have a significant and positive impact in raising performance, as did good macroeconomic environment. The contribution of foreign direct investment to capital formation was included in order to incorporate a technology related element, possibly linked to the structure of the external sector. The finding was

that FDI was significant and had a positive impact on export performance at all levels.

Foreign market access and supply capacity had to be considered equally important along the development process of the external sector. Simultaneous efforts to improve both supply capacity and foreign market access enhanced the performance of and the structural deepening of the external sector. The study overlooked the adjustment effects from short-run to long-run. FDI was a significant determinant at all levels of export performance. The current study captured FDI in form of monetary agricultural assistance and education services extended to horticultural sub-sector in Kenya.

UNCTAD (2005) asserts that real exchange rate affects export supply capacity. The real exchange rate can be an important element in determining export growth, diversification and international competitiveness of goods produced in a country. This requires close government supervision in any program to expand and diversify exports since its management can influence export performance over a large number of different product groups. A stable real exchange is conducive to export expansion. The real exchange rate is often

rendered uncompetitive in low income countries by poor economic management and turbulence in financial markets.

Hausmann *et al.,* (2006) suggested that low human capital and weak mechanisms for technology transfer and learning in low- income countries have been to hampering export growth. Changing trade opportunities will involve considerable learning costs. The nature of the learning process requires that firms have to do it themselves – opportunity, context, learning mechanisms, and incentives may be subject to external influence. Economists suggest that firms cannot learn simply by downloading a "blueprint' from the internet, as the general notion of "technology transfer" seems to imply. Much of the effective use of technology is not codified but is implicit or tacit and cannot be purchased from abroad. Learning is facilitated by an array of market, state, and community learning mechanisms, such as interactions with buyers and suppliers and direct foreign investors, in-firm and external training, hiring of employees from more advanced countries, hiring of technical consultants, linkages with state and private research and development (R&D) institutions, state extension services, and information from business networks and associations.

Meon and Sekkat (2006), using a panel of countries in the world, examined the extent to which different dimensions of the institutional framework affect exports of total manufactured and non-manufactured goods between 1920-2000. They observed that exports of manufactured goods were directly affected by the control of corruption, the rule of law, government effectiveness and the lack of political violence. This result did not hold for non-manufactured and total exports. Instrumental variable regressions confirmed that the control of corruption, but not the other dimensions of governance, robustly influenced manufactured exports. The limitation of this study is that it ignored adjustments over short-run and long-run periods. The current study is similar to the reviewed study but different in that the current study captured the adjustments over the period using ARDL approach.

Tyler (2007) found that access to finance at reasonable cost can be important for export development for the simple reason that firms find it easier and less costly to finance working capital needs (including trade financing) and investments in technical upgrading and new innovative activities. In low-income countries, where many firms are far from the technology frontier, financial market imperfections can be particularly important in a firm's ability to export. In an environment with financial market imperfections and credit constraints, firms cannot borrow more than a multiple of their current profits.

Profits are typically proportional to current productivity. The research and development costs of raising productivity and catching up with the technology frontier depend on the distance from the frontier.

Francois and Manchin (2007) examined the influence of infrastructure, institutional quality, colonial and geographic context, trade preferences and the pattern of bilateral trade on exports. They were interested in threshold effects, and so emphasized those cases where bilateral country pairs did not actually trade. They departed from the institutions and infrastructure literature in that respect, using selection-based gravity modeling of trade flows. They worked with a panel of 284,049 bilateral trade flows in the world from 1988 to 2002. They found that infrastructure and institutional quality were significant determinants of export levels.

Landlocked countries also did consistently worse. Their results supported the notion that export performance and the propensity to take part in the trading system depended on institutional quality and access to well-developed transport and communications infrastructure. Indeed, that dependence was far more important, empirically, than variations in tariffs in explaining sample variations in North-South trade, they concluded. The study ignored the short-

run and long-run adjustment effects. The current study fills in this gap using ARDL model.

Turning on Kenyan studies, there is a dearth of literature on horticultural export supply in Kenya. However, there are a few studies on aggregate agricultural supply response. Some of the studies which touch on exported crops in Kenya include: Maitha (1970) who used an aggregate production function of the constant elasticity of substitution (CES) type and a Fisher distributed lag to derive productivity equation estimated supply response of Kenyan coffee. The study suggested productivity rather than acreage or new plantings as the dependent variable, lagged price and time trend were his independent variables. The equation was estimated by ordinary least square method. The study obtained higher elasticities with respect to the aggregate supply as well as for the estates and smallholdings.

The short-run elasticities obtained from this study were 0.64, 0.66 and 0.64 while long-run elasticities were 0.96, 0.99 and 0.97 for industry, estates, and smallholdings, respectively. This study has limitation in that, the model is too simple and under specified. This under specification implies that either the price elasticity or the coefficient of the time trend is over estimated. The use of

a time trend to represent all the shifters informs us nothing about the relative importance of each of these factors in influencing productivity. Lele (1988) claimed that productivity of Kenya's coffee is price responsive, when factors that actually influence productivity of coffee in Kenya were not explicitly recognized in the model, cannot be substantiated.

Akiyama and Trivedi (1987) analyzed tea supply in Kenya. As a perennial crop, they used a framework that allowed for a distinction between the short-run and long-run dimensions of the producer supply decisions while at the same time recognized the role of technology and institutions. The expected price variable for Kenya was proxied with the average of auction prices. They found that the role of Kenya Tea Development Authority (KTDA) was highly significant in explaining the supply response of smallholder producers. The estimated short-run price elasticity for estates was higher, 0.26-0.86 than for smallholders which was 0.17-0.4. They argued that the difference in the magnitude of elasticities was due to the difference in the ease with which land may be acquired under the estate as opposed to smallholdings.

This can be criticized in that developments in Kenya could not support this since acquisition of land under smallholdings has become relatively easier and

smallholders' acreage has increased in the recent years (Republic of Kenya, 2012). Their model had a limitation in that it did not perform well in estimating supply response in Kenya estates and this was attributed to outliers between 1973 and 1976 and the need for more information on the special circumstances of estate producers in Kenya.

Jaeger (1989) analyzed the influence of prices, policies, natural disaster, and rainfall on export and food crop supply separately using a pooled cross-section time series model. Natural disaster was represented by the percentage of the population affected by disasters. Rainfall was proxied with the residual from estimating a regression trend line for cereal yields. The study showed that it is difficult to generalize that one factor will be the most important in all of SSA. However, the rainfall variable was highly significant in all of the equations and the coefficient ranges from 0.15 to 0.46. The price elasticities of export supply estimated from this model range from 0.1 to 0.3 while elasticities with respect to real effective exchange variable range from -0.1 to -0.25 and consistent across different types of crops. The study had found negative and insignificant price elasticity for Kenya and Malawi.

The limitation of this study is that, the estimation of an aggregate supply response for Kenya and Malawi without explicit acknowledgment of the dichotomy between estate production and smallholder production and within smallholders, commercial and subsistence producers, and the differences in the enticement structure they face, will produce elasticities that will be prejudiced and difficult to interpret. The current study, goes further to capture the adjustment effects both in the short-run and long-run.

Were *et al.,* (2002) analyzed Kenya's export performance. The study disaggregated total exports of goods and services into three categories: tea exports, coffee exports (which were treated as traditional agricultural exports) and other exports of goods and services. An OLS estimation model was specified along the standard trade models that incorporate real exchange rate and real foreign income as explanatory variables. An additional variable, investment as a proportion of GDP, was included as a proxy to capture the supply constraints. The study acknowledged the difficulty in obtaining reliable data and quantifying the non-price variables, which made econometric time series studies not to give robust estimates. Inconsistencies were noted in the tea equation where results indicated that there was no cointegrating long-run relationship. While the price effect on exports of goods and services was clear, the results for other explanatory variables were mixed.

Investment as a proportion of GDP which was used as a proxy for supply constraints was found to have a significant and positive impact on the export volumes of coffee but not for other goods and services. The authors acknowledged that non-price factors, which included costs of inputs, labour costs and access to credit, played a vital role in production and export supply response. However, they pointed out that comprehensive analysis of those factors required micro/sectoral studies, which was beyond their study. The study suggested that a detailed sectoral analysis would help to understand and appreciate the transmission mechanisms between macro level policies and farm-household behavior in the case of agricultural exports like tea and coffee. They argued that, if that gap could be filled, the actual price received by producers and the extent of disparity with the international prices would be established. This study aimed at filling this gap.

Maugu, et al., (2013) attempted to investigate the determinants of agricultural crop export supply for Kenya over the period 1963-2012. They used a disequilibrium model of agricultural crop. They found exchange rate to be a significant determinant of tea, pyrethrum and horticultural exports. It was insignificant for coffee export. GDP which was used to proxy productive capacity was significant for tea, coffee and aggregate exports. Dummy for El-

Nino variable was significant for coffee exports, and dummy for trade liberalization was significant for pyrethrum exports only. This study has a limitation in that the model used is lagged and cointegration analysis was not conducted or the tests for stationarity done. This makes these results biased. Adjustments effects are also absent. Correlation tests are also missing.

2.4: Overview of literature

From the literature review, it is clear that all theories of international trade are interrelated in one way or another as each theory builds on a preceding one. From the reviewed studies, it is clear that the majority of export supply investigations have concentrated on manufactured products using panel data. Previous studies have not arrived at a consensus on key factors behind agricultural export supply response but they converge to the point that single country analyses are vital as each country is unique in its own way.

Studies that investigate the determinants of export supply of agricultural commodities seem to concur that agricultural exports in less developed countries (LDCs) are highly responsive to price factors. It is also clear that agricultural export supply relationships have typically been handled by assumptions, the usual practice being the assumption that agricultural export

and import supply price elasticities facing any individual country are infinite. This means that unless idle capacity exists in the agricultural export sector, or more generally, unless agricultural export production is subject to constant or increasing returns to scale, it is unlikely that an increase in the world demand for a country's agricultural exports can be satisfied without any increase in the producer's price. This assumption was applied in this current study.

Real exchange rate, infrastructure cost, tariff rates, skilled labour, macroeconomic soundness, good quality institutions, control of corruption, the rule of law, lack of political violence, more credit and structural adjustment programs are all factors identified as influencing agricultural export supply. Some theories of agricultural export supply acknowledge that most econometric time series studies often fail to find robust estimates.

That notwithstanding, time series data remains one of the most widely used approaches for estimating agricultural export supply response and one can therefore argue that long-run elasticities derived from time series analysis are better measures of the long-run response. The current study uses time series data in its estimation of horticultural export supply response in Kenya following ARDL approach.

All in all, lessons learnt in one country may not necessarily be relevant in other countries. In the area of supply side policies, one country's size does not fit all countries. We are not aware of any study that specifically focuses on horticultural export supply response. It is unlikely that policies for coffee and tea as well as general agricultural exports would fit the horticultural export, given the specificity of the sector. This thesis addresses this research gap, and seeks to understand the responsiveness of horticultural export supply to changes in relative producer price and non-price factors. This is crucial for formulating a sound horticultural export supply specific policy package.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the methodology used in the study. Section 3.2 presents the research design, section 3.3 covers the theoretical framework while section 3.4 discusses model specification. Section 3.5 takes care of definition and measurement of variables, section 3.6 captures data type and sources of data, and section 3.7 covers the estimation technique. Section 3.8 presents cointegration analysis and finally diagnostic tests are presented in section 3.9.

3.2 Research design

The study empirically analyzes the responsiveness of horticultural sub-sector exports to both price and non-price factors in Kenya. The study adopted a quantitative research design which is a formal, objective, systematic process in which numerical data are used to obtain information about the horticultural exports in Kenya. It was used to describe variables, to examine relationships among variables, and to determine cause-and-effect interactions between variables (Creswell, 2003). The key task involved analyzing horticultural export time series data in Kenya for the period 1973 to 2010.

3.3 Theoretical framework.

This study analyses horticultural exports supply response following Goldstein and Khan (1985), and Islam and Subramanian (1989). These studies suggest that the basic assumption of the imperfect substitute model is that neither imports nor exports are perfect substitute for domestic goods. If domestic and foreign goods were perfect substitutes, a given country would be either an exporter or an importer. In addition, price differences for the same product in different countries (after conversion into a common currency) and also between the domestic and export prices of a given product in the same country do not allow imports or exports to be perfect substitutes.

Goldstein and Khan (1985) related the imperfect substitute model to the conventional demand theory in which the consumer was postulated to maximize utility subject to a budget constraint. The argument is that when the importer is a producer and when imports are intermediate goods that are inputs to the domestic technology, the demand for imports can analogously be derived by maximizing production subject to the producer's cost constraint. Under this scenario, the resulting import demand function has as its arguments: the price of imports, price of domestic (composite) inputs and the level of domestic gross output. The resulting demand functions for imports and exports

therefore represent the quantity demanded as a function of the level of income in the importing region, the imported good's own price and the price of domestic substitutes.

On the supply side, the producer is assumed to maximize profits subject to minimization of cost of inputs. This procedure yields an export supply function that depends positively on the price of exports, negatively on input prices and positively on productive capacity. Thus, the standard export supply function is presented in terms of the foreign market price relative to alternative prices in the domestic market and the economy's productive capacity to support export production (Islam and Subramanian (1989).

The model distinguishes between long-term and short-term fluctuations. Long-term changes are captured by a trend term (Islam and Subramanian, 1989). Short-term fluctuations in demand are transmitted from economic activity in the importing groups to exports of the exporting group. Short-term fluctuations in supply are transmitted from the domestic output of the exporting group (measured by deviations from trend) to their own exports. Price changes are measured by a weighted average of the real effective exchange rates of the countries in the appropriate group. The effects of price changes on exports are assessed using both demand factors in the importing groups and supply factors in the exporting groups (Islam and Subramanian, 1989).

Goldstein and Khan (1985) revealed that the advantage of presenting the supply side as well as the demand side of the imperfect substitute model was to make it clear that the relationship between quantities and prices was simultaneous. Nevertheless, the majority of the time-series studies on import and export equations have addressed the supply side only by assumption. The prevailing practice is the assumption that the supply-price elasticities for imports and exports are infinite.

The motivation for such an assumption is that it allows satisfactory estimation of the import and export demand by single equation methods, since price of imports and price of exports are viewed as exogenous. However, if supply elasticities are less than infinite, one should either estimate the full structural simultaneous model or estimate the reduced form expression for quantities and prices as functions of only the exogenous variables in the system. African countries are price takers in the world market and as a result, the export supply functions should exist independently of the demand functions. In addition, it is not clear whether the explanatory variables in the export price equations represent supply or demand influences (Muhammad, *et al.*, 1997). This study anchors on the above argument and presented a single export supply function

of horticultural exports in Kenya independent of demand function since Kenya is a price taker in the world market.

According to Goldstein and Khan (1985), country p's export supply to country q - (XVS_{pq}) depends on four variables: the domestic price level in country p- (PD_p) relative to the price of exports in market q - (PX_{pq}); output in country p measured by its deviation from trend (QT_p); other factors (Z_p), such as weather conditions, that affect the country's exports; and a time trend (T) that takes into account factors that affect the export production of country p over time, as shown in equation (3.1).

$$XVS_{pq} = \beta_o (PD_p / PX_{pq})^{\beta 1} QT_p^{\beta 2} Z_p^{\beta 3} T^{\beta 4} e^{ut} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.1)$$

Where: $QT_p = GDP_p/GDPT_p$

GDP_p is an index of country p's domestic output. $GDPT_p$ is an index of country p's potential domestic output. All variables except prices are measured in U.S. dollars. In equation (3.1), exporters are expected to increase their supply if the price of exports in local currency rises relative to domestic prices (a proxy for domestic costs). Therefore, it is expected that the signs of coefficients β_1 and β_2 are expected to be positive while, β_3 and β_4 are expected to be indeterminate. This is mainly due to the fact that export supply is heavily affected by official price-incentive policies, tax and trade policies, and other

measures, and by the long gestation periods required for certain products before increased output can occur, where possible, these effects are captured by dummy variables (Goldstein and Khan, 1985). Adjustment of actual exports to the supply of exports is assumed to take place in a period of one year. However, certain products, such as coffee, require very long gestation periods before increased output can occur, and for exporting groups that have a large proportion of these products in their exports, the coefficients will be biased downward (Islam and Subramanian (1989).

3.4 Model specification

The horticultural export supply model for this study was formulated based on works of Goldstein and Khan (1978, 1985) and Islam and Subramanian (1989). Kenya is a small developing country and is assumed to face an infinitely elastic demand for her exports, so that changes in foreign demand can influence exports only through changes in world prices (Goldstein and Khan, 1985). The horticultural export supply function estimated in this study is a modification of equation (3.1) since some factors were dropped and others adopted due to availability of data, where price and non-price variables take the following general form:

$X^s_t = f(RPP_t, AC_t, FDI_t, RD_t, OPEN_t, YPC_t, DEGAP, U_t)$ ..... (3.2)

Where:

X^s_t = Value of horticultural export supply in year t.

RPP_t = The ratio of the producer price for horticultural export to the domestic price index in year t.

AC_t = Agricultural credit in year t

FDI_t = Foreign Direct Investment in year t

RD_t = Classified road network in year t

$OPEN_t$ = Trade openness in year t.

YPCt = Income per capita

DEGAP = Dummy variable for EurepGap protocol that takes the value of 1 for years when protocol was in force and 0 otherwise.

T = Time period.

This study expressed equation (3.2) in Log Linear form. According to Asteriou and price (2007), taking the natural logarithm of a series effectively makes linear the exponential trend (if any) in the time series data, given that the log

function is the inverse of an exponential function. Finally, such transformation allows the regression coefficients to be interpreted as elasticities. The estimating equation for this study becomes:

$$LogX^s_t = \beta_o + \beta_1 LogRPP_t + \beta_2 LogAC_t + \beta_3 LogFDI_t + \beta_4 LogRD_t + \beta_5 LogOPEN_t + \beta_6 LogYPC_t + \beta_7 DEGAP + U_t \quad (3.3)$$

3.5 Definition and measurement of variables for this study

The **Relative Producer Price (RPP_t)** is the ratio of the producer price (in local currency) to domestic price which is a proxy of the consumer price index (CPI). It is vital to note that producer price is the export price at international market. Domestic price index reflects changes in the cost of producing the horticultural export crop. If this cost increased in relation to what a farmer got for selling the horticultural exports, profitability of producing the export crop is expected to fall. Also, given that the resources used in the production of export crops could equally be used for other purposes, the relative profitability of producing export crops fell with an increase in domestic prices (Daniel and Sunday, 2002; Tyler, 2007). This study hypothesized a negative relationship between horticultural export supply and the relative producer price variable.

Agricultural credit (AC_t) refers to loans given to agricultural sector on favourable terms which are extended to farmers by the Kenya government to improve and purchase inputs such as fertilizer and hire labour. It is measured in million Kenya shillings. This has been an important component of government policy to promote the export of horticultural products. There is an opportunity cost for these privileged loans, as other sectors of the economy were deprived of these privileges. Farmers are able to acquire all the required factors of production in horticultural production. The coefficient of agricultural credit is expected to be positive because the larger the magnitude of credits disbursed, the greater the possibility of increased export volume (Daniel and Sunday, 2002).

Foreign direct investment (FDI_t) refers to an investment made to acquire lasting interest in enterprises operating outside of the economy of the investor. Aggregate FDI flows are the sum of equity capital and reinvested earnings hence, aggregate FDI flows and stocks include all financial transfers aimed at financing of new investments, plus retained earnings of affiliates, internal loans, and financing of cross-border mergers and acquisitions. The sum of all direct capital owned by nonresidents in a given country in a certain time period constitutes the existing stock of FDI at that time (Borensztein *et al.*, 1998). FDI inflows are expected to play an important role in explaining growth of

recipient countries (De Mello, 1997). By increasing capital stock, FDI can contribute to a more efficient use of existing resources and absorb unemployed resources and thus increase a country's output and productivity (Seetanah and Khadaroo, 2007).

Some studies (e.g De Gregorio, 2003 and Onyancha, 2006), have found a negative relationship between FDI and exports, while others have found a positive effect (e.g Fugazza, 2004; Gu *et al.*, 2008). This study hypothesized a positive effect of foreign indirect investment on horticultural export supply as agents invest in horticultural farms in Kenya. FDI is measured in million US dollars.

The classified road network (RD_t) is usually classified into three levels: national or primary roads connecting capital cities, which serve as the main linkages to other countries, the sea, and other strategic points; departmental, provincial, regional or secondary roads connecting regions within the country; and municipal, local and tertiary roads connecting towns within one province. Tertiary roads are further divided in rural and urban roads. Practically all countries have a similar classification system. RD was used to measure the effect the classified road network had on the performance of horticultural

exports. The government pays more attention to these roads and also the dry weather roads that are passable for a larger part of the year.

Most African countries are characterized by poor transport infrastructure which is a major impediment to trade, competitiveness and sustainable development and isolates countries, thereby inhibiting their participation in global production networks (Limão and Venables, 2001). RD is measured in million Kenya shillings. An increase in the network of classified roads was expected to have a positive effect on horticultural exports supply as it facilitates transportation to the port of exit.

Trade openness ($OPEN_t$) refers to the impact of trade openness through the trade liberization policies on the horticultural export supply. It is defined by the degree to which countries permit or have trade with other countries. It is expressed as exports plus imports as a percentage of gross domestic products at time t. Trade openness represents what other studies termed as institutional quality (Sharma, 2000; Tyler, 2007; UNCTAD, 2005). Good institutions are those that deliver the universal economic principles of property rights, contract enforcement, information, and learning and are appropriate for local conditions. It was meant to capture the effect of the deregulation of domestic and export marketing activities in the horticultural export subsector in 1990s. It was intended to liberalize trade in these horticultural export crops so as to

increase output and quality of export, and equally to allow a better remuneration for those involved in the subsectors. It is measured by the summation of exports and imports as a percentage of gross domestic products at time t. OPEN was expected by this study to have a positive influence on horticultural export supply.

Real per capita income (YPC_t) is considered as an indicator of a country's standard of living. It is the growth of real gross domestic product per capita in time t (in United States Dollars (USD). There are different/mixed opinions among economists about the relationship between income per capita and exports supply (Muhammad, *et al.*, 1997). That study found that only 9 out of 96 countries had positive impact of income per capita on export supply. This study expects this variable to have a positive relationship with horticultural export supply. Kenyans are expected to increase production of goods and services domestically as their per capita income improves hence more of the products are exported.

Impact of the introduction of **EurepGap** certification by Fresh Produce Exporters Association of Kenya (FPEAK) in 2005 is captured by a dummy (EurepGap). It takes a value of 0 during the period before certification and a value of 1 after the introduction of certification. EurepGap was expected to be

significantly different between the two periods as certification was expected to open more international markets across the world as more customers gain confidence in Kenyan horticultural exports (HCDA, 2006).

3.6 Data type and sources of data

The study used secondary sources of data for its analysis covering the period 1973 – 2010. The main source of data was the Kenya National Bureau of Statistics, where information/data on producer prices, agricultural credit, classified road network expenditure, imports and exports, income per capita and foreign direct investment was obtained from Economic Surveys and Statistical Abstracts. Other sources included Horticultural Crops Development Authority (HCDA) and Fresh Produce Exporters Association of Kenya (FPEAK) which deal with horticultural produce data. Supplementary data was obtained from various of the World Bank publications.

3.7 Estimation technique

The study utilized Ordinary Least Squares (OLS) technique. Before estimation of the horticultural export supply response function, the study investigated the underlying process that generated time series variables, that is, whether the variables were stationary or non-stationary. Non-stationary variables might

lead to spurious regression. In this case, the results might suggest statistically significant relationships between the variables in the model, when in fact this was just evidence of contemporaneous correlation (Hassler, 2006). Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests can be used to examine variables for the presence of a unit root. The ADF test assumes that the data generating process is autoregressive of the first order. This is done so that the autocorrelation in the error term does not bias the test. The ADF includes first-difference lags in such a way that the error terms are distributed as white noise (Dickey and Fuller, 1979). The test was formulated as follows:

$$\Delta y_t = \alpha + \rho y_{t-1} + \sum \gamma_j \Delta y_{t-i} + \varepsilon_t \quad \text{..... (3.4)}$$

Where; Δy_t = the first difference of the dependent variable; j = number of lags in Δy_{t-i} ; ρ is the least square estimate and lies between -1 and 1 (i.e. $-1 \leq \rho \leq 1$) when a series is stationary, ε_t represents a random white noise error term.

The Phillips-Perron (PP) test addresses the problem of the unknown structure of the data generating process under the null hypothesis by adjusting the t-statistic for the potential omitted variable bias ex post. If the results of the unit root tests show that the variables were not stationary in their levels, cointegration analysis is then conducted (Phillips and Perron, 1988). A great advantage of Phillips-Perron test is that it is non-parametric, i.e. it does not

require selection of the level of serial correlation as in ADF. It rather takes the same estimation scheme as in DF test, but corrects the statistic to conduct test for autocorrelations and heteroscedasticity. The PP test was formulated as follows:

$$\Delta y_t = \alpha + \sum \beta_j \Delta y_{t-i} + \varepsilon_t \quad \text{..... (3.5)}$$

Where, Δy_t is the first difference of the dependent variable; i is the number of lags in Δy_{t-i}; α and β are coefficients while ε_t is the error term.

To test for a unit root, equation (3.4) was estimated by OLS and the t-statistic of ρ corrected for serial correlation. If the results of the unit root tests show that the variables were not stationary in their levels, the study would proceed with cointegration analysis (Phillips and Perron, 1988).

3.8 Cointegration Analysis

If results are not stationary, this study uses cointegration analysis techniques which solve the statistical problems associated with non-stationary data series which often lead to spurious regression results. In any error correction model (ECM), cointegration analysis offers a method of obtaining distinct estimates of both the short-run and long-run elasticities.

Various co-integration approaches are available. However, all of them are associated with limitations and assumptions. The most widely known single equation approach to cointegration is the Engle-Granger two-step procedure. It ignores short-run dynamics when estimating the cointegration vector. When short-run dynamics are complex, this biases the estimate of the long-run relationship in finite samples. A test based on the coefficient of the lagged dependent variable in an autoregressive distributed lag framework has been proposed to counter this (Banerjee *et al.*, 1998). However, the parameter estimates are only asymptotically efficient on the assumption of weak exogeneity of the regressors (McKay et al., 1999) on assumption that does not hold for horticultural prices. The procedure only assumes that one cointegrating vector exists leading to inefficiency in estimation in the event that more than one cointegrating vector actually exists (Banerjee et al., 1998).

The Johansen estimation procedure deals with this problem but like the Engle-Granger procedure, it presupposes that the order of integration of all the variables is the same and known with certainty. However, the power of unit root test is low hence it can never be known with certainty whether the postulated order of integration is correct (Muchapondwa, 2008).

The current study makes use of ARDL model (which is a more recent cointegration technique) and further highlights that estimation of the

horticultural export supply response to both price and non-price variables may produce biased estimates if the possibility of reverse causality is not taken into account as often is the case in single equation time series estimation. Autoregressive Distributed Lag (ARDL) approach to co-integration, developed by Persaran, Shin and Smith (2001), tests for the existence of a non-spurious long-run relationship between price and non-price variables.

Unlike other co-integration techniques, the ARDL model does not impose restrictive assumptions that all the variables in the study must be integrated of the same order. This implies that the ARDL approach can be applied regardless of whether the underlying variables are stationary, non-stationary or mutually integrated (Odhiambo, 2009). Another difficulty that the ARDL approach avoids is the decision regarding the number of endogenous and exogenous variables to be included in the supply model, as well as the time lags applicable to each variable. The ARDL approach makes it possible to include different variables having different optimal numbers of lags within the supply model (Muchapondwa, 2008).

Due to the above limitations/problems of Engle-Granger and Johansen estimation procedures, researchers propose the direct estimation of the long-run parameters using unrestricted error correction models (UECM) specified with the inclusion of dynamics (Olokoyo, Osabuohien & Salami, 2009). The

dynamic nature of production and market equilibrium makes it necessary to take into account the dynamics arising both from dependent and independent variables. By including all the identified variables for a selected unrestricted dynamic supply model with the appropriate time lags for each variable, the supply model transforms into an Autoregressive Distributed Lag Model.

The bounds testing approach to the level relationship, together with the ARDL modeling approach to co-integration analysis developed by Persaran *et al.* (2001) involves Ordinary Least Square estimation of an ECM. This can be presented in general as:

$$\Delta InX_t = \alpha_0 + \alpha_1 Inx_{t-i} + \alpha_2 InY_{it-i} + \sum_{i=1}^{p-1} \beta i \Delta InY_{t-i} + \sum_{i=1}^{p-1} \beta i \Delta InY_{t-i} + \varepsilon_t \quad \ldots\ldots (3.6)$$

Where:

Δ is the first difference operator; α_0 is the constant; X_t is the dependent variable; Y_{it} are the independent variables; ε_t is the error term; p and q are the maximum lag orders; α_i is the long-run relationship (elasticities) among the variables; β_i is the short-run relationship among the variables.

The existence of a long-run level relationship in an ECM framework between dependent variable and the independent variable can be tested when it is not

known whether the underlying independent variable is stationary, non-stationary or mutually co-integrated with the ARDL approach. The ARDL approach to co-integration analysis is divided into two stages: The first stage involves the estimation of the ECM to compute the F-statistic [Wald-test] that is used for testing for joint significance of the coefficients of the lagged level independent variables (α_1, α_2, α_i) in the model (Persaran *et al.*, 2001).

The significance of the F-statistic is determined using critical values developed by Persaran *et al.* (2001). These are bounds containing a band of critical values with upper and lower limits for different significance levels. If the F-statistic lies above the upper bound for a specific significance level, a non-spurious long-run relationship exists among the variables in the ARDL model. If the F-statistic lies below the lower bound critical value, there is no long-run relationship among the variables in the ARDL model (Getnet, Verbeke & Viaene, 2005).

If a long-run relationship among variables is confirmed with the Wald test, the second stage of the ARDL approach can be conducted. The second stage involves estimation of the long-run and short-run elasticities of the ARDL model. This approach is used to test for the presence of long-run relationships between horticultural export supply response and price and non-price factors (variables). After the long-run relationship was confirmed among the variables,

Ordinary Least Square (OLS) regression was utilized to estimate the long-run and short-run elasticity coefficients of horticultural export supply (Odhiambo, 2009). Thus, once cointegration was established, the conditional ARDL (p, q_1, q_2, q_3, q_4, q_5, q_6, q_7) long-run model for X_t in equation 3.3 was estimated as:

$$InX_t = \sum_{i=1}^{p} \alpha_{1i}\, InX_{t-i} + \sum_{i=0}^{q1} \alpha_{1i}\, InRPP_{t-i} + \sum_{i=0}^{q2} \alpha_{2i}\, InAC_{t-i} + \sum_{i=0}^{q3} \alpha_{3i}\, InFDI_{t-i} +$$

$$\sum_{i=0}^{q4} \alpha_{4i}\, InRD_{t-i} + \sum_{i=0}^{q5} \alpha_{5i}\, InOPEN_{t-i} + \sum_{i=0}^{q6} \alpha_{6i}\, InYPC_{t-i} + \sum_{i=0}^{q7} \alpha_{7i} DEGAP_{t-i} + \varepsilon_t \quad \ldots\ldots 3.7$$

Where p, q_1, q_2, q_3, q_4, q_5, q_6, q_7 are the lag lengths for each of the variables. The short-run dynamic parameters were obtained by estimating an error correction model associated with the long-run estimates. This was specified as follows for horticultural export supply equation:

$$\Delta InX_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta InX_{t-i} + \sum_{i=1}^{n} \beta_{1i} \Delta InRPP_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta InAC_{t-i} +$$

$$\sum_{i=1}^{n} \beta_{3i} \Delta InFDI_{t-i} + \sum_{i=1}^{n} \beta_{4i} \Delta InRD_{t-i} + \sum_{i=1}^{n} \beta_{5i} \Delta InOPEN_{t-i} + \sum_{i=1}^{n} \beta_{6i} \Delta InYPC_{t-i} +$$

$$\sum_{i=1}^{n} \beta_{7i} \Delta DEGAP_{t-i} + \pi\, ecm_{t-i} + \varepsilon_t \quad \ldots\ldots 3.8$$

Where β_1, β_2, β_3, β_4, β_5, β_6, β_7 are the short-run dynamic coefficients of the model's convergence to equilibrium, and π is the speed of adjustment to long-run equilibrium following a shock to the system. A negative and statistically significant estimation of π not only represents the speed of adjustment but also provides an alternative means of supporting cointegration between the variables (Muchapondwa, 2008).

Where an independent variable had an effect on the dependent variable distributed over different periods, a distinction was made between short run and long run elasticity estimates. The short run elasticity estimates were computed based on the coefficients of non-lagged explanatory variables, while the long run elasticities were computed based on the sum of coefficients of the respective independent variables (Christiaan *et al.*, 2004). Therefore, for an independent variable, X_i, long run elasticity estimate was derived according to the ratio:

$$\theta_i = \frac{\beta i}{A(L)} \quad \text{...} \quad (3.9)$$

Where; θ_i is the computed elasticity, A(L) = 1- $\sum_{i=1}^{p} \beta_i$, that is, one minus the sum of the coefficients of lagged values of the dependent variable. βi is the

sum of coefficients of explanatory variables X_i. However, where an independent variable did not have lagged effects on the dependent variable, the estimate obtained was interpreted as the effect or the long run elasticity. Further for the variables whose coefficients were found to be insignificant, estimates of elasticities or effects were considered to be zero.

3.9 Diagnostic Tests

Diagnostic testing is an integral part of model specification in any econometrics. Several vital diagnostic tests were conducted to ensure that the coefficients of the estimates were consistent and could be relied upon in making references. Sarmiento *et al.* (1998) pointed out that previous studies lack tests for model performance to diagnose whether test of theory or elasticity estimates are subjected to different types of specification errors. In selecting the lag length, Enders (1995), noted that if the lag length is too small, the model could be misspecified and that if it was too large, degrees of freedom would be wasted. The orders of the lags in the ARDL model are selected using either Akaike information criteria (AIC) or the Schwartz-Bayesian information criteria (SBC or SIC). The SBC is more parsimonious with the lag length selection and is a consistent model selection criterion (Pesaran and Shin, 1999). For annual data, Pesaran and Shin (1999) recommended choosing a maximum of two lags. This study adopted this and

chose two lags as the lag length that minimized SBC which also ensured that degrees of freedom were not lost given the number of observations in the study.

Misspecification tests were employed in order to test for the validity of the horticultural export supply model in Kenya. These diagnostic statistics included tests for autocorrelation, where autoregressive conditional heteroscedasticity (ARCH) was used, serial correlation where Breuch-Godfrey Lagrange multiplier (LM) was used, and the Jarque-Bera normality test which was used to determine whether the sample data have the swekness and kurtosis matching a normal distribution. The Durbin-Watson statistic was also checked for autocorrelation. The Ramsey RESET test was conducted for the correct specification of the error-term.

Stability of long-run coefficients was also examined using the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests as proposed by Borensztein *et al.,* (1998) and Suleiman (2005). When the plot of the CUSUM and CUMSUMSQ stays within the 5 per cent critical bound, the null hypothesis that all coefficients are stable cannot be rejected. However, when

either of the parallel lines is crossed, then, the null hypothesis is rejected at 5 per cent significance level.

3.10 Hypothesis Testing

The t-statistic was applied to test the hypothesis that a coefficient was equal to zero (0), while the F-statistic was used to ascertain that all the coefficients in the estimated horticultural export response equations were zero. The t-statistic was interpreted based on the absolute values and the probability (p-value), given that the coefficient was equal to zero. If the value (absolute) of the computed t-statistic was greater than 1.96 at 5 per cent level of significance, then the null proposition was rejected. The p-value was in case utilized to determine the level of significance of the coefficient. If the p-value was established to be less than 0.05, then the null hypothesis was discarded at 5 per cent level of significance. The null hypothesis was cast off if the p-value was established to be less than 0.01 at 1 per cent level of significance. The F-statistic was interpreted based on its related p-value.

CHAPTER FOUR

EMPIRICAL RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the empirical results and discussion. The chapter covers objective one and objective two. The study specified a horticultural export supply function based on an ARDL model approach. Data used is provided in appendix I tables A1 and A2. The chapter begins by presenting descriptive statistics in section 4.2. Section 4.3 presents correlation analysis results, section 4.4 covers time series properties, section 4.5 concentrates on short-run and long-run dynamics while sections 4.6 and 4.7 deals with relative producer price and non-price factors on horticultural export supply, respectively. Section 4.7 concludes with the chapter summary.

4.2 Descriptive Statistics

The first objective of this study was to investigate the relationship between horticultural export supply and price factors in Kenya. Objective two was to investigate the relationship between horticultural export supply and non-price variables in Kenya. The study attempted to establish whether there is a short-run and long-run relationship between both price and non-price variables on

horticultural export supply. Relative producer price was the price variable while foreign direct investment, agricultural credit, income per capita, trade openness, and classified road network were the non-price variables.

The study used 38 observations for each variable included. The descriptive statistics are presented in appendix II, Table A3. The results show that value of horticultural exports had a mean of KShs.15921.63 million with a median of KShs.8846.50 million and a standard deviation of KShs.14631.46 million. Agricultural credit had a mean of KShs.13535.95 million with a median of KShs.7523 million and a standard deviation of KShs.12921.46 million. The mean for foreign direct investment was US$.61.68 million. It had a median of US$.46.00 million and standard deviation of US$.56.58 million.

Trade openness had a mean of 59.82, a median of 58.50 and a standard deviation of 7.26. Classified road network had a mean of KShs.10815.79 million, a median of KShs.6348.00 million and a standard deviation of KShs.10659.59 million. The mean for relative producer price was 0.73, a median of 0.80 and a standard deviation of 0.56. Income per capita had a mean of US$.359.77, a median of US$.355.28 and a standard deviation of US$.18.48. The mean was a good estimator for all the variables since there was no variable with a standard deviation greater than the mean.

4.3 Correlation Analysis Results

The study performed the test for correlation among the independent variables and results are presented appendix II, Table A4. The rule of thumb is that if the pair-wise or zero-order correlation coefficient between any two regressors is high in excess of 0.85, multi-collinearity is a serious problem (Gujarati, 2004). Relative producer price was correlated with classified road network, agricultural credit and Eurepgap certification with coefficient of 0.81, 0.82 and 0.76 respectively. It was less correlated with foreign direct investment, trade openness, and income per capita, where all coefficients were below 0.60. So multicollinearity was not a serious problem in the model.

Foreign direct investment exhibited low correlation with classified road network, agricultural credit, trade openness, income per capita and Eurepgap certification, the highest being a coefficient of 0.66. Classified road network had low correlation with agricultural credit, trade openness, income per capita and Eurepgap certification. Agricultural credit had low correlation with trade openness, income per capita and dummy for Eurepgap certification. Trade openness also exhibited a low correlation with income per capita and Eurepgap certification. Lastly income per capita had a low correlation with Eurepgap certification having a coefficient of 0.5.

4.4 Time series properties

4.4.1 Stationarity analysis

The study used time series data covering the period 1973-2010 to analyze horticultural export supply response. The study investigated the underlying process that generates the time series variables, which was done through testing for stationarity. Non-stationary time series regression estimates do not converge in probability with increased sample size. R-squared values have non-degenerate distributions and divergence in t-value distributions often exist such that asymptotically correct critical values do not exist (Pesaran, *et al.*, 2001). In this section, the stationarity properties of the horticultural export supply model variables are determined.

The stationarity properties are needed to test for a long-run relationship among the specified variables in the Engle-Granger and Johansen approaches to cointegration. The Wald test incorporates the long-run relationship among variables (whether variables are non-stationary, stationary or mutually cointegrated). However, it is still essential to complement the estimation process with a unit root test in order to be sure that the variables to be included in the analysis are not integrated of higher order (Olokoyo et al., 2009). That is, it is necessary to examine the order of integration of variables because

ARDL bound testing approach becomes invalid if any variable is integrated of order 2.

The results of the unit root conducted for the specified variables of the horticultural export supply response model are presented in appendix III, Table A5. The results indicated that foreign direct investment became stationary at levels while classified road network, income per capita, value of horticultural exports, relative producer price, trade openness, and agricultural credit variables were all stationary after first differencing. Thus, the null hypothesis of non-stationarity was rejected as it was clear that the critical ADF and PP values were larger in absolute terms than the corresponding calculated values. It is also clear that the variables were not integrated of the same order hence, application of ARDL model.

The dependent variable, the natural logarithm of value of horticultural export was integrated of order I(1) meaning that ARDL could be used to estimate the model (Pesaran and Shin, 1995; 1999). It is also clear that the variables to be included in the analysis are not integrated of higher order, that is I(2). With the stationarity properties of the data and especially when faced with mixed results, applying ARDL model is the efficient way of determining the long-run relationship among the variables under investigation (Safdari and Motiee,

2011). The horticultural export supply response analysis was therefore done using the ARDL approach as variables were integrated of different orders and none was integrated of order I(2).

4.4.2 Cointegration Analysis

In order to analyze the horticultural export supply response to relative producer price and non-price factors, the study estimated equation 3.6 in chapter three so as to examine the long-run relationship amongst the variables. This involved testing for the joint null hypothesis of no long-run relationship. The presence of a long-run relationship among the variables was tested using Wald 'bounds' test. The results obtained from the 'bounds' test or the calculated F-statistics for the cointegration test are presented in appendix III, Table A6. The critical values reported in the table were compared against the critical values reported by Narayan (2004), since it was based on small sample size of between 30 and 80 observations.

The computed F-statistic for the horticultural export supply model based on the Wald test was 6.5048. This value clearly exceeds the critical upper bound value, I(1), of 4.1959 at 5 per cent level of significance. The estimated F-statistic also exceeds the lower bound value, I(0), of 2.7396 at 5 per cent significance level. Thus, the null hypothesis of no cointegration is rejected for

the horticultural export supply response model and a non-spurious long-run relationship is supported among the variables of horticultural export supply, agricultural credit, relative producer price, foreign direct investment, classified road network, income per capita, trade openness and Eurepgap certification. This result implies that these variables move together and so cannot move 'too far away' from each other independently (Hoque and Yusop, 2010).

From this result, it was concluded that any disequilibrium among the variables in the horticultural export supply model is a short-run phenomenon. Cointegration was therefore considered to truly exist in horticultural export supply equation.

4.4.3 Diagnostic Tests Results

Other diagnostic tests were performed to ensure that the horticultural export supply model captured the salient features of the data and was consistent with the economic theory. Diagnostic tests for serial correlation, autoregressive conditional heteroscedasticity, heteroscedasticity and functional form were conducted and results are presented in appendix IV, Table A7.

The histogram-normality test (J-B test) is a test of the distribution of the error term and it uses the first moments of the distribution namely mean, standard deviation, Skewness and Kurtosis. The model passed the Jarque-Bera normality tests with a p-value of 0.511 which is greater than the critical value of 0.05, suggesting that the errors are normally distributed. Hence, the normality assumption of the regression residuals for the estimated equation was not rejected at 5 per cent level of significance. The regression residuals therefore, followed a normal distribution which means that the estimates obtained were efficient and consistent.

The LM test is a general test for high order autocorrelation and is relatively more powerful than the Durbin Watson (DW) test, where higher order lagged dependent variables were included as regressors and the error process was AR(M). It is possible that the regression disturbances could have been generated by an autoregressive scheme of a higher order (Gujarati, 2004). Given these situations, the DW statistic could have been rendered powerless to detect serial correlation in the model. The table shows no evidence of autocorrelation in the disturbance of the error term with p-value of 0.638. This means that the hypothesis of zero autocorrelation in the residuals was not rejected at 5 per cent level of significance. This was because the probability

was greater than critical value of 0.05. The LM test did not therefore reveal serial correlation problems for the model.

If the magnitude of regression residual is related to the magnitude of recent residuals, the autoregressive conditional heteroskedasticity (ARCH) is said to be present and this may lead to loss of efficiency in estimation (Christiaan et *al.*, 2004). The LM test for no ARCH, was performed and the test involved inclusion of up to the second lagged value of residuals. The horticultural export supply response equation gave a probability value of the F-Statistic of 0.968 which was greater than critical value of 0.05 hence the null hypothesis could not be rejected at 5 per cent level of significance. Results suggest that the errors were homoscedastic and independent of the regressors. This high probability meant that the assumption of homoscedastic residuals for the estimated horticultural export supply equation could not be rejected in favor of the ARCH residuals. The study then concluded that the residual series did not exhibit problems of heteroscedasticity.

Various specification errors such as omitted variables, incorrect functional form, correlation between independent variables and the error term, give rise to nonzero term vector (Johnson and Dinardo, 1997). This was solved by

performing the Ramsey Reset test to determine whether there were specification errors. The RESET test indicated that the model was correctly specified with p-value of 0.148 which was greater than critical value of 0.05 hence the null hypothesis that coefficient of powers of fitted values are all zero, could not be rejected at 5 per cent level of significance. On this basis, it was reasonable to claim that the horticultural export model had a good statistical fit and there was no significant evidence of mis-specification in the model.

Recursive estimation was performed in order to detect specification errors through estimated parameter inconstancy. The cumulative sum (CUSUM) and CUSUM of squares tests validate the stability within the model parameters over the adjusted sample period of the horticultural export supply response model. Appendix VI, Figures A1 and A2 show the CUSUM test and CUSUM of squares test for stability at a 5 per cent significance level. According to Olokoyo, *et al.*, (2009), the null hypothesis, which states that the regression equation is correctly specified, cannot be rejected if the plot of these CUSUM and CUSUM of squares statistics remains within the critical bound of the 5 per cent significance level. Therefore the statistics support the stability of the long-run coefficients in the model and suggest that parameters were constant.

4.5 The Short-run and Long-run dynamics

The study used the t-statistic to test the hypothesis that a coefficient was equal to zero and the F-Statistic to test that all the coefficients in the estimated horticultural export supply response equation were zero. Interpretations of the t-tests were based on the absolute values and the probability (p-value) of observing the t-statistic given that the coefficient was equal to zero. The null hypothesis was rejected if the absolute value of the computed t-statistic was greater than 1.96, at 5 per cent level of significance. The p-value determined the level at which the estimated coefficient was significantly different from zero. At 5 per cent level of significance, the null hypothesis was rejected if the p-value was less than 0.05, while at 1 per cent level of significance the null hypothesis was rejected if the p-value was less than 0.01. Interpretation of the F-Statistic on the other hand was based only on its p-value. All the long-run coefficients are statistically significant.

In the ARDL approach, the short-run and long-run elasticities are interpreted simultaneously. The short-run estimation obtained from estimation of the Error-Correction Model (ECM) as presented in equation 3.8 in chapter three is presented in table 4.1. Table 4.2 shows the elasticities obtained from the long-run elasticities of equation 3.7 in chapter three.

Table 4.1 Error Correction Model Results for the horticultural export supply response model. Dependent variable is ΔLog value of horticultural exports.

Variables	Coefficient	t-ratio	p-value
ΔLog value of horticultural exports(-1)	0.996	1.660	0.119
ΔLog value of horticultural exports(-2)	0.451	1.305	0.213
ΔLog relative producer price	-0.849**	-5.540	0.000
ΔLog relative producer price(-1)	0.015	.0594	0.953
ΔLog relative producer price(-2)	-0.200	-1.478	0.162
ΔLog agricultural credit	-1.887**	-3.253	0.006
ΔLog agricultural credit(-1)	-1.890**	-3.852	0.002
ΔLog agricultural credit(-2)	-1.743**	-3.145	0.007
ΔLog foreign direct investment	0.177**	4.197	0.001
ΔLog foreign direct investment(-1)	-0.125*	-2.104	0.054
ΔLog foreign direct investment(-2)	-0.063	-1.490	0.159
ΔLog classified road network	-0.529	-1.209	0.247
ΔLog trade openness	-0.050	-0.106	0.917
ΔLog trade openness(-1)	-3.785**	-5.283	0.000
ΔLog trade openness(-2)	-1.800**	-3.571	0.003
ΔLog income per capita	5.778	1.685	0.114
ΔEurepgap	0.697	1.138	0.274
ΔEurepgap(-1)	-1.416*	-2.020	0.063
ΔEurepgap(-2)	-1.665**	-3.076	0.008
Ecm(-1)	-0.826**	-2.569	0.002
Adjusted R-squared	0.684		
Akaike Information Criterion	23.59		
Schwarz Bayesian Criterion	1.82		
DW-statistic	3.05		
F-statistic F(20,14)	4.9591	0.002	

Δ is the first difference operator; (*, **) means significant at 10% and 1% levels respectively. ARDL (3, 3, 3, 3, 1, 3, 1, 3) selected based on Schwarz Bayesian Criterion

Source: own computation

Table 4.2 Estimated Long-run coefficients of horticultural export supply (1973-2010) model.

Dependent variable is log value of horticultural export	Coefficient	t- Statistic	P-value
Constant	22.644**	3.672	0.003
Log of Relative producer price	-0.741**	-6.706	0.000
Log of Agricultural credit	2.037**	9.764	0.000
Log of Classified road network	0.438*	2.070	0.057
Log of Foreign Direct Investment	0.188**	4.924	0.000
Log of trade openness	4.678**	5.561	0.000
Log of income per capita	-8.313**	-8.375	0.000
Dummy for EurepGap	1.871**	5.919	0.000
Adjusted R-Squared	0.995		
Akaike Information Criterion	19.66		
Schwarz Bayesian Criterion	3.325		
DW-statistic	2.1361		
F-statistic F(20,14)	325.30	0.000	

(*, **) means significant at 10% and 1% levels, respectively. ARDL (3, 3, 3, 3, 1, 3, 1, 3) selected based on Schwarz Bayesian Criterion

Source: Author's computation

The importance of the error correction term in the horticultural export supply response was to act as an indicator for the presence of a long-run relationship among the variables included in the horticultural export supply model. The

magnitude of the error correction term indicates the speed of adjustment back to the equilibrium position once the system is in disequilibrium. The error correction coefficient of -0.83 indicates that 83 per cent of the previous year's deviation from long-run equilibrium is corrected in the current year. The coefficient of the error correction term had the expected negative sign and was statistically significant which implies that there is adjustment back to the long-run (equilibrium) position once there is disturbance in the short-run due to shocks. This means that the adjustment takes place at a very high speed. A significant coefficient of the error correction term (ECM) indicates long-run Granger causality running from value of horticultural export (dependent) to the independent variables (Granger, 1988).

This ensures zero loss of information and it confirms the validity of an equilibrium relationship among the cointegrating variables in the equation. In other words, the coefficient of the error correction term measures the speed at which the discrepancy between actual and equilibrium value of horticultural exports supply is corrected in each period. Thus there are economic forces in the economy which operate to restore the long-run static equilibrium path of horticultural exports following short-run disturbances. Thus, the estimated ECT-1 can be used to forecast the future of horticultural export supply.

4.6 Relative producer price and horticultural export supply

In Table 4.1, the short-run coefficient for the current relative producer price is negative (-0.85) and significant. This means that if relative producer price is increased by 10 per cent in the current period, horticultural export supply decreases by 8.5 per cent. The explanation for this result is that price is endogenous where it is determined after supply has been observed resulting in low prices during bumper harvests and high prices when supply is low hence the negative elasticity. In other words, as the producer price of horticulture export rises relative to domestic prices, production of horticultural export becomes less profitable and hence horticultural exporters supply less than the proportionate change in producer price. In addition, horticulture exports are posited not to rise as required when there is an increase in the country's capacity to produce resulting from a favorable change in producer price.

This finding supports Lele (1988) who found out that Kenya's export performance can be attributed, in part, to the fact that prices of its two main exports crops – coffee and tea were determined directly by international prices. Jaeger (1989) had found negative price elasticities for Kenya and Malawi. The author tried to explain the results on the basis of the fact that producer prices in these countries are determined ex post at international auctions, and they fluctuate widely year to year to the extent that they have very little effect on

farmers' price expectations. McKay *et al.,* (1999) in the Tanzanian study and Onyenweaku and Madu (1991) in Nigeria on cocoa producer price argued that farmers are not responsive, and justified that government policies are biased against agriculture. They stated that one possible reason for negative and low estimates is that the model and econometric techniques used were inappropriate.

Results in Table 4.2 show that the coefficient of relative producer price was negative (-0.74) and statistically significant at 1 per cent level in the long-run. The implication of this is that a 10 per cent increase in relative producer price would result in a 7.4 per cent decrease in horticultural export supply in the long-run. The less than unity elasticity would be attributed to the fact that the exporters of horticultural products in Kenya do not respond fully to changes in relative producer price. The horticultural crop exporters are price takers rather than price setters which is the case for many developing countries which are primary commodity exporters. The result negates Lukonga's (1994) study which found a positive impact of relative producer prices on cocoa and rubber in Nigeria.

Jaeger (1989) had found negative and insignificant price elasticity for Kenya and Malawi. The author tried to explain the results on basis of the fact that producer prices in these countries are determined ex post at international auctions, and they fluctuate widely year after year to the extent that they have very little effect on farmers' price expectations. This is also the case for horticultural export supply where export prices are ex post determined in the international markets.

The results of the relative producer price elasticity imply that in the long-run, horticultural export supply would not increase primarily as a result of increasing relative producer price of horticultural produce. Kenya being a price-taker in the market of horticultural export has only one way of increasing her export revenue and that is by increasing horticultural export supply. The results show that relative producer prices and export prices do not adjust quite fully in driving the export supply of horticulture. This low elasticity might be attributed to inadequate statistics and information on prices available in global markets which has made Kenya move from being a net exporter of some horticultural produce to the African region to an importer of the same from the region. This has also been encouraged by the weak Kenyan shilling and relatively high cost of domestic production. This might have also been brought

about by an increase in the number of non-tariff barriers to Kenya's horticultural exports (HCDA, 2010).

4.7 Non-price factors and horticultural export supply

In Table 4.1, the study shows that coefficients of agricultural credit lagged once and twice were statistically significant at 1 per cent level, -1.9 and -1.7 respectively. Change in agricultural credit by 1 per cent would cause the horticultural export supply to decrease by more than 1.9 per cent after one year. An increase in agricultural credit by 1 per cent would cause the horticultural export supply to decrease by more than 1.7 per cent after two years all other factors held constant. Results in Table 4.2 depict that agricultural credit coefficient was statistically significant at 1 per cent and had a positive effect on horticultural export supply in the long-run. This implies that a 1 per cent increase in agricultural credit would increase horticultural export supply by 2 per cent in the long-run. This result supports an earlier study by Nwoko (1980), which found that the funds provided by the Nigerian government were directed towards increasing the productive capacity of the agricultural sector. It is also probable that with liberalization of the banking sector and other non-banking financial institutions in Kenya, exporters of horticultural crops have taken full advantage of loans on favourable terms from

government institutions and other non-banking institutions like savings and credit co-operatives societies (Republic of Kenya, 2011).

The coefficient for classified road network variable was statistically significant at 10 per cent level and the variable had a positive (0.44) effect on horticultural export supply. If expenditure in classified network is increased by 1 per cent, horticultural export supply decreases by 0.4 per cent in the long-run, other factors held constant. Thus, horticultural export supply was inelastic with respect to classified network. This might mean that expenditure on classified road network is not well utilized in areas where horticulture is grown. It could also mean that there may be corruption and embezzlement of funds directed towards road network.

These results are consistent with Daniel and Sunday (2002) who found a positive effect between road infrastructure and agricultural exports in Cameroon. The results are also consistent with Fuggaza (2004) who found that internal transport infrastructure captured by the percentage of the paved roads was an important supply capacity element and was found to have a significant and positive impact in raising export performance. This inelastic response might also mean that poor road network isolates horticultural markets from

competition, reduce economies of scale and directly raise import and export costs in Kenya.

The results also suggest that transport problems could pose a serious constraint to commercialization of horticultural produce in Kenya limiting the ability to supply and diversify horticulture and floriculture as found out by Islam and Subramanian (1989) and Tyler (2007). The results suggest that classified network is a good indicator of increased economic activity within an economy and hence influences the horticultural export supply response.

On foreign direct investment and horticultural export supply, the results in Table 4.1 show that foreign direct investment had a positive effect on horticultural export supply and was statistically significant at 1 per cent level in short-run. The results imply that a 1 per cent increase in foreign direct investment would result in a 0.8 per cent increase in horticultural export supply during the current year, other things held constant.

In Table 4.2, the coefficient of foreign direct investment (FDI) has the expected positive sign and is statistically significant at 1 per cent level in the long-run. Elasticity of horticultural export supply response to FDI is 0.19

implying that a 10 per cent increase in foreign direct investment increases horticultural export supply by 1.9 per cent. This response implies that horticultural export supply responds less proportionately to changes in foreign direct investment. The results could be due to the fact that foreign direct investment does not contribute fully to the technological upgrading and structural evolution of the horticultural export supply which include facilities for irrigation, market networking and financial management.

The results also support (De Mello, 1997) who argues that FDI inflows are likely to play an important role in explaining growth of exports in recipient countries. The results are also similar to those from other studies which indicated positive effect on the export performance of host countries (Fugazza, 2004; Gu *et al.*, 2008). These results are in contrast with De Gregorio (2003) and Onyancha (2006) who found negative relationship between FDI and export.

This study's results also imply that the role of FDI in horticultural export promotion could depend crucially on the motive for such investment: If the motive behind FDI is to capture the domestic horticultural market, it may not contribute fully to horticultural export growth. On the other hand, if the motive

is to tap horticultural export markets by taking advantage of a Kenya's comparative advantage, then FDI may contribute fully to horticultural export growth (World Bank, 1993a). Thus, whether FDI contributes to horticultural export growth or not depends on the nature of the policy regime (Sharrma, 2000).

The results in Table 4.1 show that coefficients for the trade openness variable lagged one year and two years were statistically significant at 1 per cent level. The coefficients were -3.8 and -1.8, respectively. The implication of this is that a 1 per cent increase in trade openness would result in a 3.8 per cent and 1.8 per cent decrease in horticultural exports after a period of one and two years respectively. This could be attributed to the gestation period of horticultural crops which is normally less than a year for vegetables, one to two years for flowers and more than four years for some fruits (HCDA, 2011).

In Table 4.2, the coefficient for trade openness variable was 4.68 being statistically significant at 1 per cent level. The variable had a positive effect on horticultural export supply. The results imply that a 1 per cent increase in trade openness would increase the horticultural export supply by 4.7 per cent in the long-run. The results suggest that the trade openness policies, for instance, the

principal structural adjustment policy reforms of 1980s and liberalization of 1990s made it easier for exporters to trade and the benefits of devaluation had been transmitted to exporters. This result might have been brought about by improved and proper coordinated self-regulating mechanism among horticultural export producers which are both less tedious and less costly. This supports findings by Ngugi and Kabubo (1998) and Wagacha (2002), who found a positive impact between liberalization and growth of output. Trade openness also increases competitiveness and provides access to enlarged markets (Balassa, 1978; Feder, 1982).

The results also support the Neoclassical school of thought which postulates that trade openness has many advantages such as efficiency gains that come with specialization and competition from international trade (Piazolo, 1995; Frankel and Romer, 1999). Other benefits brought about by current results include embodied technological transfer through imported inputs; diffusion of ideas through global interaction; and scale economies arising from expanded horticultural export markets.

In Table 4.2, the coefficient for income per capita was statistically significant at 1 per cent level. The variable had a negative impact (-8.31) on horticultural

export supply which implies that a 1 per cent increase in income per capita would lead to 8.3 per cent decrease in horticultural export supply. Contrary to the expectations that income per capita could promote horticultural export supply this study found that increase in income per capita leads to decrease in horticultural export supply in Kenya. This result suggests that there may be competition between domestic and export markets. When income per capita increases, it seems that demand for horticultural produce domestically is increased thus reducing the amount available for export.

There are different opinions among economists about the relationship between income per capita and exports supply. In an attempt to resolve the difference, Muhammad, et al., (1997) examined causality between income per capita and exports supply for 96 countries but found only 9 which showed positive impact of income per capita on exports supply.

Results in Table 4.1 show that coefficient of EurepGap certification was insignificant in the short–run. This dummy took a value of 0 for period before certification and 1 after certification. The coefficients of lagged EurepGap certification were -1.4 and -1.7, respectively. This was probably due to the negative attitude farmers had on the introduction of these certificates (Waitathu, 2010).

Eurepgap certification as shown in Table 4.2 portrayed a relationship between horticultural export supply and its coefficient implying that there was significant difference between the period before certificates and period after the certificates. The certificates required proper production techniques to be followed and payment of charges to get a letter of certification. This added to the cost of production and it was only the large plantations who would meet such requirements (HCDA, 2006). The certificates gave traders and customers in the international markets confidence which led to an increase in the demand for Kenya's horticultural exports. This implies that, there might have been adequate enforcement of packaging and labeling standards that is part of Eurepgap certification efforts.

Eurepgap certification might also have encouraged farmers to start using high-quality planting materials for organic and conventional production systems which are essential in facilitation of horticulture industry development and commercialization. However, this might have been delayed a bit by the ability of smallholder farmers to get access to high-quality planting materials due to high costs and royalties of patented materials such as seeds. The significant difference between the period before the Eurepgap and period after might also be attributed to improved quality inputs due to eradication of counterfeiting, adulteration and high cost which are a catalyst to faster development/adjustment of horticultural subsector. It is vital to note that the

time period for this certification has been very short, with only six years since the implementation of the certificates. It is possible that Eurepgap certification would become more important as time goes by and would even become one of the most important variables as more and more changes are implemented in horticultural exports trade.

4.8 Summary

The study estimated the horticultural export supply response following both the theoretical and methodological approaches presented in chapter three. The ARDL approach to cointegration was used to estimate both the short-run and long-run relationships between horticultural export supply and price and non-price factors in Kenya. From the diagnostics tests presented and discussed in this chapter, the study concluded that the fitted models were well estimated and that the observed data fitted the model adequately. The coefficient of error correction term had the expected sign and was statistically significant which indicated the high speed of adjustment back to the equilibrium in case of any short-run shock/disturbances.

The results showed that most of the coefficients had the expected signs and were statistically significant at 1 per cent level. The estimated results for both

short-run and long-run elasticities indicated that horticultural export supply response to both price and non-price factors supports similar findings in the literature. The inelastic results of horticultural export supply response with respect to relative producer price implies that the importance of non-price variables and that horticultural export supply in Kenya cannot be determined by price alone. Long-run elasticities in this study tend to be higher than short-run elasticities as most factors of horticultural export supply are fixed in the short-run.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Introduction

This chapter presents the summary, conclusions and policy implications of the study's findings. The chapter is divided into five sections. Section 5.2 covers the summary of the study, section 5.3 deals with the main conclusions while section 5.4 sets out the contribution to knowledge of this study. Section 5.5 covers the policy implications arising from the study findings, and section 5.6 closes with areas for further research.

5.2 Summary

Agriculture is the mainstay of the Kenyan economy in achieving food security, income and employment generation, foreign exchange earnings, provision of raw materials for agro-processing, and poverty alleviation (Republic of Kenya, 2010). Horticulture is an important subsector of Kenyan agriculture which implies that sustained horticultural production is essential in realization of Kenya Vision 2030. Despite significant growth that the industry has attained, there was no distinctive horticultural export supply policy in operation in Kenya by the end of 2011. This study was motivated by the fact that a status of

no horticultural export policy is no longer sustainable because there are serious challenges both locally and internationally facing the horticultural sub-sector.

The study aimed at investigating the effects of price and non-price factors on horticultural export supply in Kenya and drew policy implications for enhancing and sustaining horticultural exports from Kenya. Earlier studies on horticulture in Kenya only concentrated on factors that affect the domestic market and none of these studies have touched on horticulture exports. This study therefore attempted to bridge this gap.

To address the study objectives, time series data for the period between 1973 and 2010 was used. The study used the autoregressive distributed lag (ARDL) estimation procedure which tests for the existence of a non-spurious long-run relationship between price and non-price variables. The ARDL model does not impose restrictive assumptions that all variables in a model must be integrated of the same order. The approach also avoids the decision regarding the number of endogenous and exogenous variables to be included in the supply model, as well as the time lags applicable to each variable. An error correction model and a long-run model for horticultural export supply were estimated.

In the Error Correction Model, the relative producer price coefficient was statistically significant and the factor had a negative effect on horticultural export supply. The error correction specification was found to provide a good representation of the data-generating process for horticultural export supply response in Kenya. The chosen ARDL modeling approach captured the essentials of the behavioral relationships underlying the specialized nature of horticultural export supply.

In the empirical analysis, this study investigated the effect of relative producer price, agricultural credit, foreign direct investment, classified road network, trade openness, income per capita, and EurepGap certification on horticultural export supply. Data were obtained from reliable sources which included the Kenya National Bureau of Statistics, Fresh Produce Exporters Association of Kenya (FPEAK), and the World Bank.

Agricultural credit and agricultural credit lagged one and two years respectively all had negative effects on horticultural export and their coefficients were statistically significant. Foreign direct investment had a positive effect on horticultural exports but foreign direct investment lagged once and twice had negative effects on horticultural export supply and their

coefficients were statistically significant. Classified road network coefficient was statistically significant. Trade openness lagged one and two years had negative effects on horticultural export supply and their coefficients were statistically significant. The coefficient for trade openness variable was statistically significant. The coefficient for the Error Correction Term lagged once was statistically significant indicating high speed of adjustment and the negative expected sign thus validating the existence of equilibrium relationship among the variables in the cointegrating vector.

In the long-run, the empirical findings show that horticultural export supply responds positively to agricultural credit, classified road network, foreign direct investment, and trade openness. The horticultural export supply had elastic response on all variables except foreign direct investment where response was inelastic. The coefficients of relative producer price and income per capita were negative and statistically significant. There was significant difference between the period before the Eurepgap certification and period after the certification.

5.3 Conclusion

This study has demonstrated that concepts such as cointegration and error correction specification can be incorporated in the study of horticultural export supply responses, which are clearly non-stationary time series. Coefficients of price and non-price variables of the long-run equation were statistically significant and satisfied most of the standard statistical criteria, therefore, revealing a richness of horticultural export supply response properties.

Results from this study revealed the importance of foreign direct investment, agricultural credit, trade openness, income per capita, classified road network and Eurepgap certification in explaining the sustainability of horticultural export supply in Kenya. This means that price incentives alone are not sufficient to generate the desired horticultural export supply. Therefore, the study concludes that both price and non-price factors affect horticultural export supply response.

5.4 Policy Implications

The empirical results provide invaluable information for policy formulation and implementation. The results from the estimation indicated the overall negative impact of relative producer price on horticultural export supply. The

horticultural export supply response was inelastic with respect to relative producer price. This result could suggest that price reform measures not accompanied by the necessary non-price supply side reforms may be ineffective. This study recommends that more data and information on prices available in global markets should be obtained through provision of information and market connections so as to make horticultural export suppliers well informed of any price fluctuation. Kenyan embassies abroad in conjunction with horticultural export private sector stakeholders should carry promotions through trade fairs and exhibitions so boost horticultural export supply response with respect to relative producer price.

The results show that agricultural credit has a positive impact on horticultural export supply in the long-run. The study recommends that government in partnership with private sector should develop appropriate credit packages for small- and medium-scale producers which could enhance the horticultural sub-sector's funds for production and research. Government would also explore the possibility of establishing a horticultural development fund to be managed by an agency so as to avail more credit to farmers.

The Government should also extend credit for infrastructure bonds to cover the development of horticultural export physical infrastructure such as cold stores, fresh produce markets and collection centers. Government should also establish mechanisms for disseminating information on available sources of funding for the industry. It should also partner with the private sector in developing a comprehensive horticultural crop insurance training curriculum and encourage private insurance companies to develop appropriate horticultural crop insurance products, as is the case with dairy farming. This would encourage and give security/confidence to horticultural export farmers to get credit for their operation, taking full advantage of credit available in the country.

The results show that classified road network has a positive impact on horticultural export supply in the long-run and statistically significant at 5 per cent. The study recommends that the Government should consider developing and maintaining horticultural rural access roads and other roads leading to market outlets to all-weather status to facilitate timely delivery of horticultural exports to the market. It should also promote community and private initiatives in the construction and maintenance of horticultural rural access roads.

The results show that the coefficient for foreign direct investment was statistically significant and had a positive impact on horticultural export supply. One of the major roles of FDI is the provision of training opportunities (Fugazza, 2004). These results imply that much of the in-farm and on the-job training in Kenyan horticulture is done by foreign direct investment companies from more advanced countries that transfer expertise to local farmers and managers or by local farms hiring foreign experts. Therefore, the study suggests that Kenya should not have to wait until she develops an educational system and educate a whole generation of farmers to boost horticultural export supply/growth and diversification. The study suggests that work permits should be provided cautiously to genuine foreign investors who are interested in the horticultural export sub-sector so as to improve and take full advantage of horticultural export supply responsiveness to FDI.

The results showed a positive impact of trade openness on horticultural export supply. This implies that the productive capacity of most sectors in Kenya should be strengthened to achieve the expected gains from trade liberalization and openness to trade. The study proposes enhancement of international competitiveness which should rank high among the strategic objectives of policies at the macro, sectoral and micro levels. The study also recommends careful implementation of full deregulation policies which would help in

addressing the problem of Kenya's inability to diversify her horticultural export supply while avoiding any negative effect on domestic producers.

Trade openness leads to competition among countries in horticultural international markets, therefore farmers, processors and exporters should be encouraged to make Kenyan horticultural exports more competitive through value adding and implementing quality management standards that include food safety, environmental and occupational health. This will ensure consistency in production of quality produce, packaging, appropriate modes of transportation, and meeting phytosanitary requirements.

The coefficient for income per capita was statistically significant and the factor had a negative impact on horticultural export supply in the long-run. The results suggest that Kenyans increase their demand for horticultural produce domestically as their income per capita improves, thus reducing the amount available for exports holding other factors constant. This study recommends that government and horticultural farmers should work to increase efficiency in horticultural production and diversify the horticultural produce to cater for both domestic and international markets.

The significant coefficient of the EurepGap certification variable points to the need for the Government to create awareness and enforce standards for horticultural produce destined for international markets so as to enhance export supply. This can be achieved through enhancing the capacity and harmonizing roles of enforcement agencies and sensitizing actors in the value chain to increase compliance. Development of comprehensive packaging and labeling standards for horticultural exports should be encouraged. Where feasible, private sector players should be facilitated to undertake self-regulation and conform to international market requirements.

5.5 Contribution to knowledge

For many years now, the Kenyan Government has implemented policies aimed at developing her agricultural exports in general. This study has shown how price and non-price factors have influenced horticultural supply export in Kenya. Such assessment is fundamental towards better understanding of how the Government can positively contribute to horticultural export supply. The results of this study yield a number of insights into the understanding of horticultural export supply in Kenya. It has contributed to the understanding of the specification and estimation of the horticultural export supply in Kenya. The results of the study have also demonstrated the importance of examining the time series properties of the data, and also the studying of both short-run

and long-run adjustments when analyzing horticultural export supply response. Many previous studies on agricultural supply response modeling have tended to ignore the dynamics underlying the adjustment processes in commodity markets.

This study will help the policy making process by identifying the variables which are important in explaining horticultural export supply in Kenya. It is hoped that dissemination of the findings of this study would contribute to a wider exchange of ideas on horticultural export supply policy both within Kenya and across the African countries. These results could also contribute to the understanding of horticultural export supply complex development issues and dilemmas confronting the policymakers as elasticities of both price and non-price factors are now clear. It is also a necessary ingredient in promoting sound comparative policies in other agricultural sectors and economic growth in Kenya and generally in developing economies.

5.6 Areas for Further Research

While this study provides some useful guidance to policy makers, a number of issues could be clarified by further research. Lessons learnt in one sector may not necessarily be applicable to other sectors in the agricultural industry in Kenya. On the supply side policies, a critical number of sector case studies are

needed to allow any kind of generalization. There is thus a strong case for undertaking further sectoral case studies for all export crops in Kenya and other Sub Saharan African countries.

The main contribution of this study is in the application of econometric modeling to analyze the potential effects of price and non-price factors on horticultural export supply response in Kenya. Even though the model is capable of explaining how price and non-price variables may influence the horticultural export performance in Kenya, the model in this study is of aggregate form. It would be interesting if the impact of price and non-price factors on horticultural export supply is disaggregated according to individual crops such as cut flowers, fruits and vegetables. This was beyond the scope of this study due to data limitations.

REFERENCES

Akiyama, T. and Trivedi, P. (1987). Vintage Production Approach to Perennial Crop Supply: An application to tea in major producing countries. *Journal of Econometrics,* Vol. 36, pp 133-161.

Amin, A. (1996). The Effects of Exchange Rate Policy on Cameroon's Agricultural Competitiveness. *AERC Research Paper* No. 42, Nairobi, Kenya.

Asteriou, D. and Price, S. (2007). *Applied Econometrics* – A modern approach, Basingstoke: Palgrave Macmillian.

Balassa, B. (1978). Exports and Economic Growth-Further Evidence. *Journal of Development Economics*, Vol.5 (2), pp 181 - 189

Balistreri, E. and Hillberry, R. (2002). *Trade Frictions and Welfare in the Gravity Model.* B-Span, World Bank.

Bannerjee, A., Dolado, J., and Mestre, R. (1998). Error Correction Mechanism Tests for Cointregration in Single Equation Framework. *Journal of Time Series Analysis,* 19, pp 267–283.

Beason, R and Weinstein, D. (1996). Growth, Economies of scale, and Targeting in Japan (1955-1990). *Review of Economics and Statistics* 78(2), pp 286-295.

Borensztein, E., De Gregorio and Lee, J (1998). How does foreign investment

affect economic growth. *Journal of International Economics*, 45(1), pp 115-135.

Bowen, H., Leamer, E. and Sveikausoklas, L. (1987). A Multi-country Multi-Factor Test of the Factor Abundance Theory. *American Economic Review* 77, pp 791-809.

Chipman, J. (1965). A Survey of the Theory of International Trade: Part 1, The Classical Theory. *Econometrica*, 33(3), pp 477-519.

Christiaan, H., Boer, P., Hansranses, P., Kloek, T. and Dijk, H. (2004). Econometric Methods with Applications in Business and Economics, Oxford: Oxford University Press.

Choudhri, E. and Brecher, R. (1982). The Leontief Paradox, Continued. *Journal of political Economy,* 90(4), pp 820-823.

Creswell, J. (2003). *Research Design: Qualitative, Quantitative and Mixed Method Approaches* (Second Edition). Sage Publications, Thousand Oaks, CA. Sage.

Daniel, G. and Sunday, K. (2002). "Determinants of agricultural exports: The case of Cameroon. *AERC research paper* 120.

De Gregorio, J. (2003). The role of foreign direct investment and natural resources in economic development. *Working paper* No. 196. Central Bank of Chile, Santiago.

De Mello, L.R. (1997). Foreign Direct Investment in developing countries and

growth: A selective survey. *Journal of Development Studies* 34(1), pp 1-34.

Denis, S., Hester, V., Michel, F. and Estelle, B. (2006). Case studies of Agri-processing and contract agriculture in Africa. *Rimisp-Latin American Center for Rural Development,* University of Pretoria, South Africa.

Edwards, L. and Alves, P. (2002). South Africa's Export Performance: Determinants of Export supply. *Africa Region Working Paper Series* No. 95, World Bank.

Edwards, L. and Odendaal, M. (2008). Infrastructure, Transport Costs and Trade: A New Approach, *TIPS Research Papers Series* 2008.

Enders, W. (1995). Applied Econometric Time Series. New York: Jorn Wiley and Sons Inc.

Feder, G. (1982). On Exports and Economic Growth. *Journal of Development Economics*, Vol. 12, No. 1/2.

Fosu, Y. 1992. The Real Exchange Rate and Ghana's Agricultural Exports. A*ERC Research Paper* No. 9 Nairobi, Kenya.

Francois, J. and Manchin, M. (2007). "Institutional Quality, Infrastructure, and the Propensity to Export". Tinbergen Institute and CEPR, Italy.

Frankel, J. and Romer, D. (1999). Does Trade Cause Growth? *American Economic Review*, Vol. 89 (3), pp 379 – 399.

Fugazza, M. (2004). Export performance and its determinants: Supply and Demand Constraints, Policy issues in International Trade and Commodities. *Study Series* No.26. United Nations, Geneva.

Getnet, K., Verbeke, W. and Viaene, J. (2005). Modeling spatial price transmission in the grain markets of Ethiopia with an application of ARDL approach to white teff. *Agricultural Economics*, 33 (s3), pp 491-502.

Ghura, D. and Grennes, T. (1994). "Aggregate trade response to economy–wide distortions in Sub–Saharan Africa" *Journal of African Economies*. Vol. 3(3), pp 359 – 86.

Goldstein, M. and Khan, M. (1985). Income and price effects in foreign trade. In: Jones, R.W. and P.B. Kenen (Eds), Handbook of International Economics, 2, pp 1041-1099.

Granger, C. (1988). Some Recent Developments in a concept of Causality *Journal of Econometrics*, Vol.39 (1/2), pp 199 – 211.

Gu, W., Awokuse, T. and Yuan, Y. (2008). "The Contribution of Foreign Direct Investment to China's Export Performance: Evidence from Disaggregated Sectors". American Agricultural Economics Association Annual Meeting, Orlando, FL.

Gujarati, D. (2004). Basic Econometrics, 4th edition. New York: McGraw Hill Companies.

Haberler, G. (1936). The Theory of International Trade. Hodge, London.

Hassler, V. (2006). A note on Phillips-Perron-type Statistics for Cointegration Testing. *Economics Bulletine* 3(16), pp 1-7.

HCDA, (2006). Annual Bulletin. Horticultural Crops Development Authority. Ministry of Agriculture, Nairobi: Kenya.

HCDA, (2010). Annual Bulletin. Horticultural Crops Development Authority. Ministry of Agriculture, Nairobi :Kenya.

HCDA, (2011). Annual Bulletin. Horticultural Crops Development Authority. Ministry of Agriculture, Nairobi :Kenya.

HCDA, (2012). Annual Bulletin. Horticultural Crops Development Authority. Ministry of Agriculture, Nairobi: Kenya.

Hausmann, R. Hwang, J. and Rodrick, D. (2006). "What you export matters." Kennedy School of Government, Harvard University.

Hoque, M. and Yusop, Z. (2010). Impacts of trade liberization on aggregate import in Bangladesh: An ARDL Bounds test approach, *Journal of Asian Economics, Elsevier,* Vol. 21(1), pp 37-52.

Houthakker, S. and Magee, S. (1969). Income and price elasticities in world trade. *The Review of Economics and Statistics*, Vol. 51(2), pp 111-125.

Islam, N. and Subramanian, A. (1989). Agricultural exports of developing countries: Estimates of income and price elasticities of demand and supply. *Journal of Agricultural Economics*. Vol. 40(2).

Jeager, W. (1989). The impact of policy on African Agriculture: An empirical investigation. *The World Bank: AFTTF Mimeo*.

Johnston, J and J. Dinardo. (1997). Econometric Methods, Fourth Edition. New York: The McGraw-Hill Companies, Inc.

KAM (2006). Manufacturing in Kenya, a survey of Kenya's manufacturing sector. Kenya Association of Manufacturers, Nairobi: Kenya.

Krugman, P. and Obstfield, M. (2009). International economics: theory and Policy. Boston, London.

Leamer, E. (1980). The Leontief Paradox Reconsidered. *Journal of political Economy* 88, pp 495-503.

Lele, U. (1989). Sources of growth in Eastern African Agriculture. The World Bank: MADIA Study.

Leontief, W. (1953). Domestic Production and Foreign Trade: The American Capital Position Re-examined. *Proceedings of American Philosophical Society* 97, pp 332-349.

Limão, N. and Venables, A. (2001). Infrastructure, Geographical Distance, Transport Costs and Trade. *World Bank Economic Review* 15(3), pp 451-479.

Lukonga, I. (1994). "Nigeria's non–oil exports: Determinants of supply and Demand, 1970 – 1990". *IMF working paper* No. 94/95.

Maitha, J. (1970). Productivity Response to Price: A case study of Kenyan coffee. *Eastern Africa Economic Review,* Vol. 2(2), pp 31-37.

Maugu, L, Mwirigi, R, Maara, J, and Galo, N. (2013). The determinants of supply of Kenya's major agricultural crop exports from 1963 to 2012. *International journal of business, humanities and technology*, Vol. 3(5).

McKay A, Morriseey O, and Vaillant C. (1999). Aggregate supply response in Tanzania agriculture. *The journal of international trade and Economic Development* 8(1), pp 107–123.

Meier, M. (1989). Leading issues in Economic Development, 5th edition, New York, Oxford University Press.

Méon, P. and Sekkat, K. (2006). Institutional Quality and Trade: Which Institutions? Which Trade? *DULBEA Working Paper* No. 06-06-RS. University of Brussels, Belgium.

Muchapondwa, E. (2008). Estimation of the aggregate agricultural supply response in Zimbabwe: The ARDL approach to cointegration. School of Economics, University of Cape Town, *Working paper* No. 90.

Mudida, Robert (2003). Modern Economics. Nairobi, Focus publications Ltd, Kenya.

Muhammad, S. and Sampath, R. (1997). Exports and Economic Growth. Department of Agricultural and Resource Economics Colorado State University Annual Meeting, Fort Collins.

Mundlak, Y and D. Larson (1992). " On the transmission of World Agricultural prices." *The World Bank Economic Review*. Vol. 6 (3), pp 399 – 422.

Musiabu, B. (2002). Determinants of Export Performance in Sub-Saharan Africa, 1980-2001. Unpublished PhD Thesis, AERC, Nairobi: Kenya.

Narayan, P. (2004). Reformulating the Critical Values for the Bounds Statistics Approach to Cointegration: An Application to the Tourism Demand Model for Fiji. *Discussion Papers, Department of Economics*, Monash University, Australia.

Ng'eno, N. (1991). Kenya's export performance. Trade and Development in SSA. Manchester University Press UK.

Ngugi, R and Kabubo, J. (1998). Financial sector reforms and interest rate liberalization: The Kenyan experience. *AERC Research Paper* No. 72.

Noah, E. and Waithaka, M. (2005). Horticulture Industry in Kenya. Export Processing Zones Authority, Nairobi,Kenya.

Nwoko, S. (1980). An institutional appraisal of Nigeria's agricultural credit guarantee scheme. *Agricultural Administration*, 8, pp 337-342.

Okore, J. (1987). Determinants of Kenya's manufactured exports; An Empirical Analysis. M>A> Thesis, University of Nairobi.

Onyancha, K. (2006). Determinants of foreign direct investment in Kenya. *Journal on Development Studies*, 2, pp 67-8.

Onyenweaku, C. and Madu, E. (1991). Perennial crop supply Response: The case of Nigeria Cocoa. Paper Presented at 1st International Conference on Tree Crops MANR, Imo State.

Odhiambo, N. (2009). "Energy Consumption and Economic Growth in Tanzania: An ARDL Bounds Testing Approach", *Energy Policy,* Vol. 37(2).

Olokoyo, F. Osabuohien, E. and Salami, A. (2009). An Econometric Analysis of Foreign Reserves and Some Macroeconomic Variables in Nigeria (1970-2007). *African Development Review*, Vol.20 (3), pp 454-475.

Pack, H (2003). Review of S.L. Parente and E.C. Prescott, Barriers to Riches. *Journal of Development Economics*, 70.

Pesaran, M., and Shin, Y. (1995). An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis. *DAE Working Paper Series*, No.9514, Department of Applied Economics, University of Cambridge.

Pesaran, M., and Shin, Y. (1999). An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis, Chapter 11, in Storm, S., (ed), Econometrics and Economic Theory in the 20th Century: the Ragnar Frisch Centennial Symposium, Cambridge: Cambridge University Press.

Pesaran, M. Shin, Y. and Smith J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics* 16(3), pp 289–326.

Phillips, P. and Perron, P. (1988). Testing for a Unit Root in Time Series Regressions. *Biometrika*75, pp 35-346.

Piazolo, M. (1995). Determinants of South Korean Economic Growth, 1995 – 1990. *International Economic journal*, 9 (4), pp. 106-133.

Radelet, S. and Sachs, J. (1998). "Shipping costs, manufactured exports and economic growth". Annual Meeting of the American Economics Association, Earth institute, Colombia.

Republic of Kenya, (1992). Economic survey. Government printer Nairobi: Kenya.

Republic of Kenya, (2001). Poverty reduction strategy Paper for the period 2001–2004. Ministry of Finance and Planning, Nairobi.

Republic of Kenya, (2010). Economic survey Ministry of Finance and Planning, Nairobi: Kenya.

Republic of Kenya (2011). Ministry of Agriculture, monthly bulletin, Nairobi: Kenya.

Republic of Kenya, (2012). Economic survey Ministry of Finance and Planning, Nairobi: Kenya.

Republic of Kenya, (2013). Economic survey Ministry of Finance and Planning, Nairobi: Kenya.

Republic of Kenya, (2014). Economic survey Ministry of Finance and Planning, Nairobi: Kenya.

Sachs, J. and Warner, A. (1995). Economic Reform and the Process of Global Integration. *Brookings papers on economic activity*, Volume 1.

Samuelson, P. (1971). An exact Hume-Ricardo-Marshall model of international trade. *Journal of International Economics*, Volume, pp 1-18.

Samuelson, P. (2001). A Ricardo-Sraffa Paradigm Comparing Gains from Trade in Inputs and Finished Goods. *Journal of Economic literature,* 39(4), pp 1204-1214.

Sarmiento, J. Hughes,T, Stouffer, R and Manabe, S (1998). Simulated response of the ocean carbon cycle to anthropogenic climate warming Nature. Vol.393, pp245–249.

Seetanah, B. and Khadaroo, A. (2007). "Foreign Direct Investment and Growth: New Evidences from Sub-Saharan African countries", Paper prepared for the 2007 CSAE conference.

Sekkat, K. and Vaoudakis, A. (1999). Incentive Policies and Manufactured exports in North Africa. *ERF Working Paper,* 99/22.

Sharma, K. (2000). Export Growth in India: Has FDI Played a Role? *Discussion Paper* No. 816, Yale University, Economic Growth Center.

Shiozawa, Y. (2009). Samuelson's Implicit Critism against Sraffa and the Sraffians and Two other Questions. *The Kyoto Economic Review*, 78 (1), pp 19-37.

Steedman, I. (1979). Fundamental Issues in Trade Theory. London: MacMillian

Suleiman, W. (2005). The impact of Investment and Financial Intermediation on Economic Growth: New Evidence from Jordan. Abstract mimeo.

Tyler, B. (2007). Assessing Export supply constraints: Methodology, Data, Measurement. *AERC Research project paper*, Nairobi: Kenya.

UNCTAD (2005). "Determinants of Export Performance: Developing Countries in International Trade", Trade and Development Vol. 5 (4) pp 54 - 88.

Wagacha, M. (2002). Analysis of liberalization of the trade and exchange regime in Kenya since 1980. *IPAR Discussion Paper* No. 023, Nairobi Institute of Policy Analysis and Research.

Waitathu, N. (2010). Kenyan Horticulture in wilt. Fresh Produce Exporters Association of Kenya (FPEAK) Nairobi, Kenya.

Were, M.,Njuguna, S., Geda, A., and Karingi, S. (2002). "Analysis of Kenya's Export Performance: An Empirical Evaluation." Macroeconomics Division, *KIPPRA Discussion Paper* No. 22.

World Bank (1986). World Bank indicators, Washington DC. WB (2010). *World Bank indicators*, Washington DC.

World Bank (1993). The East Asian Miracle, London: Oxford University Press.

World Bank (2004). World Development Report: A Better Investment Climate for Everyone; Washington, D.C World Bank.

World Bank (2006). Review of World Bank Involvement in Trade Reform. World Bank Washington DC.

World Bank (2010). *World Bank indicators*, Washington DC.

Appendix1: Data used in Empirical Analysis

Table A1 Raw data: Dependent variable and independent variables 1973-2010

Year	Value of Horticultural exports in Kenya Million Shillings	Foreign Direct Investment in million US Dollars	Relative Producer Price	Trade openness
1973	115	17	0.08	56
1974	149	23	0.10	75
1975	205	17	0.09	65
1976	315	46	0.08	64
1977	458	57	0.10	67
1978	403	34	0.12	68
1979	431	84	0.13	58
1980	505	79	0.18	66
1981	644	14	0.14	64
1982	769	13	0.15	59
1983	1099	24	0.17	54
1984	1084	11	0.20	59
1985	1059	29	0.23	55
1986	1323	33	0.28	56
1987	1543	39	0.08	47
1988	1896	40	0.09	50
1989	1816	62	0.09	53
1990	2561	57	0.08	57
1991	2877	19	0.09	56
1992	3163	6	0.10	53
1993	5392	2	0.10	73
1994	5540	4	0.13	71
1995	6544	33	0.38	72
1996	8971	11	0.64	57
1997	8688	53	0.63	54
1998	9384	11	0.68	49
1999	11059	14	0.78	48
2000	13421	111	0.76	54
2001	9486	5	0.88	56
2002	15359	28	0.83	55
2003	28840	82	1.00	54
2004	32591	46	0.71	60
2005	38838	21	0.94	65
2006	43121	51	1.60	62
2007	67254	729	1.65	63
2008	57966	96	1.70	70
2009	49352	141	1.95	63
2010	40170	153	2.00	65

Source: Republic of Kenya: Statistical Abstracts, Economic surveys (various issues) and World Bank.

Table A2 Raw Data on independent variables (continued)

Year	Agricultural Credit in KShs. Million	Classified road network in KShs. Million	Real Income per capita in US Dollars	Dummy DEGAP
1973	356	532	341.6906	0
1974	409	515	343.2311	0
1975	737	472	334.0623	0
1976	813	574	329.0944	0
1977	1088	685	347.2467	0
1978	1450	826	357.7941	0
1979	1800	991	371.0154	0
1980	2047	1071	377.4337	0
1981	2212	1016	377.2768	0
1982	2258	1563	368.7871	0
1983	2770	1459	359.6975	0
1984	2729	1434	352.3084	0
1985	2968	1461	353.6865	0
1986	2942	1299	364.9223	0
1987	4094	1302	372.3028	0
1988	5120	1819	380.9968	0
1989	5835	2310	384.5879	0
1990	6015	2386	386.6161	0
1991	6802	2246	378.6154	0
1992	8244	2171	362.7995	0
1993	9576	2741	351.8716	0
1994	11890	4223	349.1898	0
1995	14478	7547	352.7140	0
1996	14730	7472	355.6874	0
1997	17919	7552	346.4461	0
1998	21933	7760	347.3655	0
1999	23426	6785	345.4312	0
2000	24399	9320	338.1616	0
2001	23795	10665	341.7794	0
2002	25304	8619	334.7976	0
2003	28117	10346	335.7626	0
2004	30807	15817	343.8375	0
2005	33685	10463	354.8077	1
2006	33038	35261	367.541	1
2007	28128	42261	384.1542	1
2008	31110	46443	385.2076	1
2009	38182	60841	394.067	1
2010	43160	84752	398.4004	1

Source: Republic of Kenya: Statistical Abstracts, Economic surveys (various issues).

Appendix II: DESCRIPTIVE STATISTICS AND CORRELATION

TableA3 Descriptive Statistics

	VHE	AC	FDI	OPEN	RD	RPP	YPC
Mean	15921.63	13535.95	61.68	59.82	10815.79	0.73	359.77
Median	8846.50	7523.00	46.00	58.50	6348.00	0.80	355.28
Maximum	67254.00	43160.00	729.00	75.00	84752.00	2.00	398.40
Minimum	115.00	356.00	2.00	47.00	472.00	0.08	329.10
Std. Dev.	14631.46	12921.46	56.58	7.26	10659.59	0.56	18.48
Skewness	1.18	0.67	3.43	0.28	2.60	0.58	0.34
Kurtosis	2.85	2.08	17.11	2.24	10.05	2.51	2.15
Probability	0.012	0.122	0.00	0.49	0.00	2.53	0.34
Observations	38	38	38	38	38	38	38

KEY:
VHE = Value of horticultural exports (Million Kenya Shillings.)
AC = Agricultural credit (Million Kenya Shillings.)
FDI = Foreign Direct Investment (Million US Dollars)
OPEN = Trade openness
RD = Classified road network (Million Kenya Shillings.)
RPP = Relative producer price
YPC = Income per capita (US Dollars)

Table A4 Correlation Matrix for the Horticultural exports supply response equation.

	Value of horticulture	Relative producer price	Foreign direct investment	Road classified network	Agricultural credit	Trade openness	Income per capita	Dummy for Eurep Gap
Value of horticulture	**1.000**							
Relative producer price	0.67	**1.000**						
Foreign direct investment	0.653	0.551	**1.000**					
Road classified network	0.720	0.810	0.578	**1.000**				
Agricultural credit	0.798	0.820	0.496	0.785	**1.000**			
Trade openness	0.113	0.049	0.103	0.175	0.007	**1.000**		
Income per capita	0.254	0.353	0.434	0.468	0.138	0.018	**1.000**	
Dummy for Eurep Gap	0.806	0.764	0.661	0.648	0.714	0.29	0.497	**1.000**

Source: Author's computation

Appendix III: Results of stationarity tests and Cointegration

Table A5 Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests results with trend for individual series

Variable	Levels		First Difference		Order of Integration
	ADF	PP	ADF	PP	
Log horticultural export supply output in year t	-2.471	-2.244	-3.27	-4.77	1
Log relative producer price in year t	-2.131	-2.54	-3.34	-4.36	1
Log agricultural credit in year t	-2.249	-2.246	-5.863	-5.865	1
Log classified road network in year t	-1.294	-1.883	-5.650	-5.665	1
Log foreign direct investment in year t	-2.561	-5.881	-	-	0
Log trade openness	-3.017	-3.042	-8.076	-10.56	1
Log income per capita in year t	-2.409	-1.587	-4.276	-4.278	1

Critical values of ADF and PP tests are based on MacKinnon (1996) one-sided values. The critical values at the1% and 5% are: ADF (-4.239 and -3.5403 respectively) and PP (-4.2268 and -3.3660 respectively). Lag length selection is automatic based on Eviews Schwarz Information Criteria.

Source: Author's Computation

Table A6 Wald bounds test for cointegration of the ARDL horticultural export Supply Function.

Test Statistic	Value	Lag	Significance level	Bound critical Values	
				Narayan (2004) Critical Values	
				I(0) Lower bound	**I(1)** Upper bound
F-statistic	6.5048	2	5%	2.7396	4.1959

Source: Author's Computation

Appendix IV: Results of diagnostic tests

Table A7 Results of Diagnostic Tests for the horticultural export supply response

Test Statistics	LM Version	F Version
A:Serial Correlation (LM Test)	CHSQ(1) = 0.221(0.638)	F[1,13] = 0.083(0.778)
B: Functional Form (RESET Test)	CHSQ(1) = 5.74(0.148)	F[1,13] = 3.101(0.102)
C: Normality (J-B Test)	CHSQ(2) = 1.341(0.511)	Not applicable
D: Heteroscedasticity (ARCH Test)	CHSQ(1) = 0.0016(0.968)	F[1,33] = 0.002(0.970)

Note: p-values in parenthesis
A: Lagrange multiplier test of residual serial correlation
B: Ramsey's RESET test using the square of the fitted values
C: Based on a test of Skewness and kurtosis of residual
D: Based on the regression of squared residuals on squared fitted values

Source: Author's Computation

Appendix V: Data for individual horticultural crops

Table A8 Volume of individual horticultural produce

Year	Volume of Cut Flowers exports In tonnes	Volume of Fruits exports in tonnes	Volume of Vegetables exports in tonnes
1995	29.40	13.90	28.50
1996	35.20	16.60	32.70
1997	35.90	17.50	30.10
1998	32.50	10.30	30.00
1999	30.20	11.40	36.80
2000	38.10	15.40	45.00
2001	34.70	18.30	42.20
2002	53.00	21.40	46.70
2003	61.00	23.60	48.70
2004	70.70	23.10	52.00
2005	81.20	18.50	63.40
2006	86.50	15.40	61.30
2007	91.20	15.70	85.30
2008	93.70	17.10	82.40
2009	87.00	21.20	72.50
2010	120.2	32.5	75.6
2011	110.0	27.1	79.2
2012	108.3	31.1	66.4

Source: Republic of Kenya: Statistical Abstracts, Economic surveys (various issues).

Table A9 Value of individual horticultural produce

Year	Value of Cut Flowers exports in Billion Kshs.	Value of Fruits exports in Billion Kshs.	Value of Vegetables exports in Billion Kshs.
1995	2.0	1.1	3.2
1996	2.9	1.2	3.6
1997	3.5	1.2	4.0
1998	4.7	0.9	4.1
1999	8.0	1.0	5.2
2000	7.3	1.1	5.5
2001	14.8	1.6	8.0
2002	10.6	1.5	10.5
2003	16.5	1.8	10.6
2004	18.7	1.8	12.1
2005	22.9	2.0	13.9
2006	23.6	1.7	17.8
2007	43.1	1.8	22.4
2008	39.8	2.1	16.1
2009	30.8	2.3	16.3
2010	35.6	2.7	13.7
2011	58.8	3.5	26.3
2012	65.0	4.7	20.2

Source: Republic of Kenya: Statistical Abstracts, Economic surveys (various issues).

Appendix VI: Diagnostic tests graphs

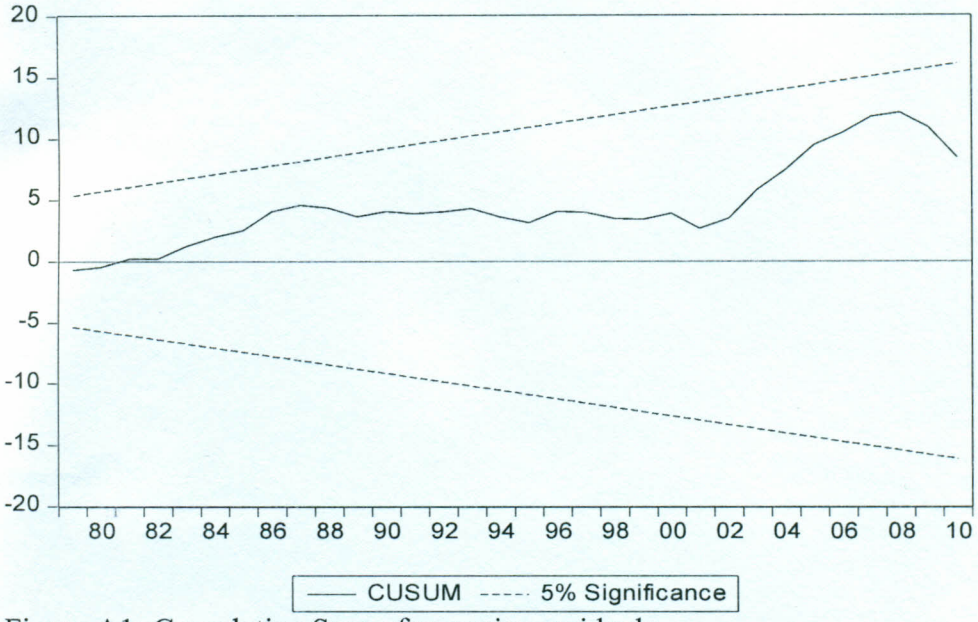

Figure A1: Cumulative Sum of recursive residuals

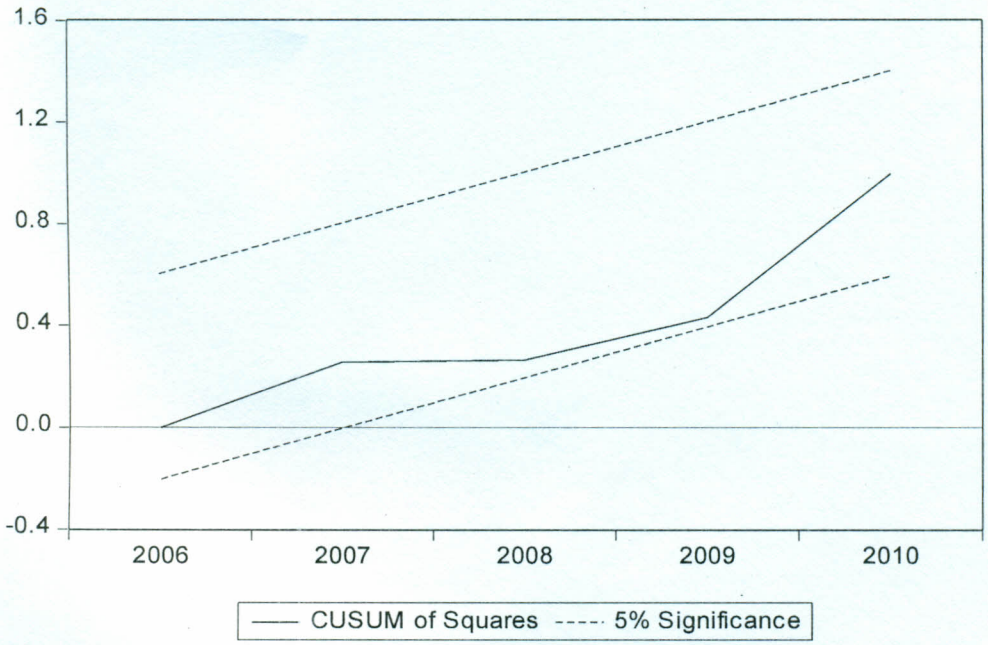

Figure A2: Cumulative Sum of squares of recursive residuals