

**ADDIS ABABA UNIVERSITY
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**DETERMINANTS OF
CUT-FLOWER EXPORT SUPPLY OF ETHIOPIA:
*A PANEL DATA EVIDENCE***

**BY
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**“Determinants of Cut-Flower Export Supply of
Ethiopia: A Panel Data Evidence.”**

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LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|--------------------|--|
| <i>ADB</i> | <i>African Development Bank</i> |
| <i>COMESA</i> | <i>Common Market for Eastern and Southern Africa</i> |
| <i>CPI</i> | <i>Consumer Price Index</i> |
| <i>EAL</i> | <i>Ethiopian Air Lines</i> |
| <i>ECM</i> | <i>Error Correction Mechanism/Model</i> |
| <i>EEA</i> | <i>Ethiopian Economic Association</i> |
| <i>EEPA</i> | <i>Ethiopian Export Promotion Agency</i> |
| <i>EHPEA</i> | <i>Ethiopian Horticulture Producer Exporters Association</i> |
| <i>EJE</i> | <i>The Embassy of Japan in Ethiopia</i> |
| <i>ERCA</i> | <i>Ethiopian Revenue and Customs Authority</i> |
| <i>GDP</i> | <i>Gross Domestic Product</i> |
| <i>GLS</i> | <i>Generalized Least Squares</i> |
| <i>IMF</i> | <i>International Monetary Fund</i> |
| <i>MoARD</i> | <i>Ministry of Agriculture and Rural Development</i> |
| <i>MoTI</i> | <i>Ministry of Trade and Industry</i> |
| <i>NBE</i> | <i>National Bank of Ethiopia</i> |
| <i>OLS</i> | <i>Ordinary Least Squares</i> |
| <i>RER</i> | <i>Real Exchange Rate</i> |
| <i>SAPs</i> | <i>Structural Adjustment Programs</i> |
| <i>UN COMTRADE</i> | <i>United Nations Commodity Trade Statistics (Database)</i> |
| <i>UNCTAD</i> | <i>United Nations Conference on Trade and Development</i> |
| <i>US\$</i> | <i>United States Dollar</i> |
| <i>WB</i> | <i>The World Bank</i> |
| <i>WDI</i> | <i>World Development Indicators</i> |

ABSTRACT

This study generally aims at investigating the basic factors behind the recent performance of Ethiopian cut-flower exports. Efforts are made to check whether factors of production and market and sector-specific incentives affect export supply, and to compute short-run and long-run elasticities. A one way error-component panel data model, based on data of 33 exporting farms from 2005 through 2008, is estimated. Random-, fixed- and between-effects estimators are fit to respectively capture over-all, short-run and long-run determinants and elasticities.

The descriptive analysis shows that the recent growth of Ethiopia's cut-flower exports is notable and can be explained by farms' use of more land under greenhouse cover. The econometric estimations generally reveal that both price and non-price factors explain cut-flower export supply. Land under greenhouse cover is found a strong determinant in all of our estimations. Infrastructure and transportation costs in the short-run and real exchange rates and hired labor in the long-run are additional important factors. All in all, cut-flower export supply is determined significantly by relative prices, land, labor, sector-specific infrastructure and unit costs of transporting flowers to major international markets. Being a foreign investor and association membership do not significantly affect export supply. Coefficients are found elastic for land, infrastructure and transportation costs, and inelastic for others. The results call forth strong efforts to fight inflation; reasonable worker payment, safety and training; continual follow-up of farms for effective and sustainable land use; and adequate infrastructural development.

Key Words: Cut-flowers, Export Supply, Panel Data, Short-run, Long-run, Elasticities.

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 Background of the Study

The various measures of economic growth and external trade performance of sub-Saharan Africa are almost always disappointing. We frequently read statements having such phrases as stagnant/declining per capita income, increasing indebtedness, deteriorating terms and share in world trade, *etc.* Specifically, the merchandize exports trade performance of the region has been too poor which could be evidenced by the relatively lower per capita export and stagnant export/GDP ratio. In 2007, the per capita merchandize export was only US\$ 194 which is insignificant even as compared to US\$ 941 for Latin America and Caribbean. The region's merchandize export as percentage of GDP, which was 22 percent in 1998, has scantily risen to 26 percent in 2007.

Economists and the Bretton Woods institutions provide different reasons of two extremes for those poor performances. At one side, the majority of economists and African governments including the African Development Bank blame demand side factors in terms of volatile and/or declining prices and shocks of the North. At the other side, the IMF and the WB forward supply side constraints such as overvalued exchange rates, mismanagement of resources and private sector suppression. The latter group, which has been more powerful than the former, ordered such prescriptions as devaluation, reduction of government expenditure and privatization of

resources. However, these have not yet been observed bringing significant improvements. Given that over 80 percent of the region's export earnings come from not more than three primary commodities (Melesse, 2004) and that the markets are much concentrated partly due to colonialism (Alemayehu, 2002), the need for diversification is mandatory. The diversification efforts must be made to relatively high-valued and non-traditional commodities.

Observing the Ethiopian external sector provides an even worse export performance. The country's foreign exchange earnings have been highly dependent on a few such traditional items as coffee, hides and skin, and oilseeds and pulses, with coffee dominating the sector. Although the prescribed policies of the Bretton Woods have been implemented since early 1990s, the sector's relative performance has still been far from satisfaction. For instance, the export/GDP ratio has not only been too small and stagnant (at only 6 percent) between 2000 and 2008 but also incomparable to the import/GDP ratio which grew from 16 percent to 34 percent for those same years. In addition, the import financing capacity of the export sector fell to 19 percent in 2008, a 100 percent decrement of its value in 2000. It could not even well surpass financing the country's fuel imports.

The possible reasons for those poor accomplishments could generally be excessive dependence on very few traditional commodities whose prices are volatile and problems in policy implementation. It might also be said that little has been done to practically diversify to export of non-traditional goods. Added to these would be other supply side constraints such as inadequate infrastructure, bureaucratic requirements for producers and/or exporters, and lack of internationally competitive producers.

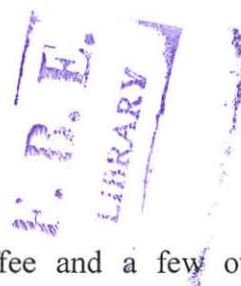
In spite of the above disappointing aggregate export figures, performances of a few individual export commodities seem to be attractive. Recent years have started reaping the fruits of previous years' little diversification efforts to cut-flower exports. Ethiopian has recently become competitive with such eastern and southern Africa potential cut-flower exporters as Kenya, Zimbabwe and Tanzania. Of course, the history of the Ethiopian cut-flower industry dates back to 1980, when state farms started to export flowers to Europe. Although the Derg regime had established Horticulture Development Corporation during the time, problems related to greenhouses, diseases and mismanagement inhibited the growth of the industry (EEPA, 2003). After the reform, a few private companies have started business before 2000; but, it is only since 2005 that the industry has prospered. Existence of suitable topography, conducive climate, arable land and cheap labor, and initiative of the government have all contributed to its recent progress¹.

The industry's export performance during the past few years is encouraging. For instance, the foreign earning from cut-flowers in 1997 was only US\$ 0.15 million. This rose to US\$ 10 million in 2005 and to US\$ 104 million in 2008 which implies that exports of the industry change roughly by 240 percent annually between 2005 and 2008. For similar time range, the major exportable, coffee, grew only by 14 percent. In addition, flower production and export involves various labor-intensive processes. As a result, it has created a number of permanent and temporary employment opportunities directly and indirectly for many people especially for unskilled poor women. EHPEA estimates that over fifty thousand direct and about seventy thousand indirect jobs are generated by the horticulture sector until 2007.

¹ *Ethiopia has an area of 1.2 million km² (out of which 65% is arable land but, only 15% is yet cultivated); 3.7 million hectare of irrigable land (only 3% of which is yet used); 14 major rivers and 11 major lakes; annual rainfall between 100 and 2200 mm; topography between 100 b.s.l. and 4600 a.s.l. (flowers grow well above 1100m a.s.l.); and a population of over 80 million (Nigussie, 2006; EJE, 2008).*

The different roles of the industry and particularly its attention-grabbing export performance necessitate undertaking of intensive research. The current study focuses only on the latter and attempts to find the sources of such an accomplishment. The central theme of the study is therefore to seek to explore the factors that determine the supply of Ethiopian cut-flower exports.

1.2 Statement of the Problem



Ethiopia has long been dependent on the export of coffee and a few other agricultural commodities for the lion's share of its foreign exchange earnings. Owing to both internal and external factors, the sector however performed too poor. The combined policy consequences of these constraints were, among others, devaluation (by 242 percent in October 1992) and intensification of the diversification endeavors of previous years. These efforts have not however been fruitful for long. An exception is the recently flourishing cut-flower export industry.

Although cut-flower industry is not new for Ethiopia, its recent export growth calls forth large attention. Many stakeholders have even been stating that coffee has got a strong ally. Cut-flowers were not significantly known as exportables before 2003 which can be seen from annual export performance reports of NBE. However since 2005, foreign exchange earnings from them and their share from total exports have been growing notably. For instance, in 2008 cut-flowers became the fourth major exportable commodities following coffee, oil seeds and fruits and vegetables. The number of producers and exporters of cut-flowers is also showing rapid increment which has reached over 100 by 2008.

The basic question that arises now is: “What factors affect the export supply from the country’s cut-flower industry?” One might classify them into grower/exporter-specific factors, macroeconomic policy developments within the home economy and market developments in the importers’ economy. Which of these are significant and the magnitude of the specific effects are however subject to empirical investigation.

The paper intends to model cut-flower export supply of Ethiopian grower exporters. A number of reasons have inspired the study. Firstly, the industry’s sizeable recent export accomplishment deserves much research work which is of paramount input for its future progress. Secondly, previous studies focus much on aggregate export supply which undermines the roles of commodity-specific implications. Even if some works exist on commodity modeling, a few go further from coffee and most of them use value of exports rather than volume as a dependent variable. Finally, very little has been done on cut-flower export supply modeling mainly due to its recentness and data problems. The single ever attempt obtained is Amin (2007) which uses time-series model. Nevertheless, the lifespan of the industry in the country does not allow one to employ time-series analysis alone.

This study therefore attempts to bridge those gaps by complementing farms’ (cross-section) data with time-series data in an effort to explore the factors that influence farm-level export supply of cut-flowers from Ethiopia.

1.3 Objectives of the Study

The general objective of the study is to ascertain the factors that determine the supply of Ethiopian cut-flower exports.

The specific objectives of the study are:

- ♣ To find out the responsiveness of cut-flower export supply to factors of production;
- ♣ To measure the effect of market and sector-specific incentives on the supply of cut-flower export;
- ♣ To compute short-run and long-run cut-flower export supply elasticities; and
- ♣ To draw implications for cut-flower export growth based on the empirical findings.

1.4 Significance of the Study

For a country that pursues an export-led growth strategy, researches on the area are of paramount significance. To this end, the study will be beneficial to a number of parties. Firstly, the study is primarily based on micro-level export data (rather than on aggregate data) so that the results may inform grower exporters of flowers the average responsiveness of their volume of export to changes in factors of production. They may also be able to learn to what extent internal and external economic situations and developments affect their export success or failure.

Secondly, the government badly needs the progress of the industry for a number of reasons. On the one hand, it is recently becoming a good source of foreign currency for which the country is almost always in severe shortage. On the other hand, the industry's ability of job creation goes in line with the government's economic and political stands. Officials have to be sure that these benefits of the industry exceed its side effects of the medium-term (loss of revenue from duty free importation of inputs and thus outflow of foreign exchange) and of the long-term (environmental and resource issues). The study's outputs may consequently help policy makers to act in suiting the politico-economic situation of the country for the industry (and vice versa – the industry for the country). Identifying the determinants of the past performance enables to work on the significant ones for further development of the industry.

Lastly, the methodologies that are employed by the study may add a spoon of knowledge to the existing literature of non-traditional commodity export supply modeling. The study might assist future researchers who want to explore more about Ethiopia's flourishing cut-flower exports in particular and the floriculture sector in general.

1.5 Limitations of the Study

The basic limitation for any study and especially studies in developing countries is usually related to data. Owing to the infancy of the area under investigation, it has been found difficult to take a large sample of cut-flower exporting farms which might have an impact on the degree of freedom at the modeling stage. And for the same reason, all relevant data have not been obtained for sample farms for the required periods and this has forced the researcher to use the available data

only. In addition, collection of data from various sources might pose inconsistency. Every effort is however made to reduce the problem.

1.6 Organization of the Paper

The paper is organized to have six chapters. Following this introductory chapter comes the second chapter which provides a descriptive analysis of the potential, performance and related concerns of the cut-flower industry and exporting farms in Ethiopia. The third chapter shall review the available literature on export supply modeling. This chapter shades light on the fourth one which provides the econometric model, the estimation issues and the data. Econometric results are then presented and discussed in chapter five. The sixth chapter concludes major findings and provides implications.

CHAPTER TWO

OVERVIEW OF THE ETHIOPIAN CUT-FLOWER INDUSTRY

2.1 Overview of the Global Cut-Flower Export Trade

Cut-flowers are parts of plants which include the flowers or buds and some attached plant materials, but excluding roots and soil. They are usually used for decorative purposes like arrangements at formal events; designs for weddings and funerals; gifts on occasions such as Valentine's Day; in times of illness; at holidays such as Christmas and Easter; and informal displays to beautify homes and public places. Cut-flowers could be either fresh or preserved. While the former are highly perishable since they maintain only limited life-supporting processes by taking water up through their stems, the latter are dehydrated, preserved with chemicals and then dried so that less perishable.

The principal types of fresh cut-flowers are roses, carnations, and chrysanthemums (USITC, 2003). Roses dominate the global flower production and trade. At least 100 species and thousands of varieties of roses are known to exist. The most commercially important types are sweetheart (intermediate), hybrid tea, and spray roses. Sweetheart roses have one small bloom per stem, generally one-half inch to 2 inches in diameter, and are typically used in bridal bouquets. Hybrid tea roses also have one bloom per stem but with a much larger flower head, ranging from 3 to 6 inches in diameter. Spray roses are a relatively newer variety with multiple

blooms, one-half inch to 2 inches in diameter. Although the most typical roses are red, they may be almost any color except true blue or black. As fresh cut-flowers, roses may last 3 to 7 days in the home without the use of floral preservatives, depending on the variety of the rose and environmental factors such as temperature and care. Their life can be doubled by using floral preservatives.

By 2007, the global cut-flower export trade reached US\$ 7.1 billion. It is more than doubled from its 1997 value in ten years time. The number of countries actively participating in the process has well passed 107. *Table 2.1* summarizes the export market shares of a few major European, Latin American and African cut-flower exporting countries for three years.

Table 2.1 Recent Global Cut-flower Export Trade

| Exporter | Export Value (US\$ million) | | |
|--------------------------|-----------------------------|--------------|--------------|
| | 1997 | 2006 | 2007 |
| WORLD | 3,440 | 6,834 | 7,082 |
| Netherlands | 2,001 | 3,333 | 3,945 |
| <i>Share (of World)</i> | 58.17% | 48.77% | 55.70% |
| Colombia | 546 | 967 | 1,115 |
| <i>Share (of World)</i> | 15.87% | 14.15% | 15.74% |
| Africa | 100 | 1,107 | 600 |
| <i>Share (of World)</i> | 2.90% | 16.19% | 8.47% |
| COMESA | 100 | 1,104 | 597 |
| <i>Share (of Africa)</i> | 100.00% | 99.75% | 99.41% |
| Kenya | 79 | 275 | 313 |
| <i>Share (of World)</i> | 2.30% | 4.02% | 4.43% |
| <i>Share (of Africa)</i> | 79.30% | 24.84% | 52.22% |
| Ethiopia | 0.15 | 25 | 69 |
| <i>Share (of World)</i> | 0.00% | 0.37% | 0.97% |
| <i>Share (of Africa)</i> | 0.15% | 2.27% | 11.47% |

Source: Computed based on Data from UN COMTRADE and ERCA

The Netherlands is the world's largest producer and exporter of cut-flowers followed by Colombia and Ecuador. In 2007, The Netherlands accounted for 56 percent of the global export

trade by covering most of the European market. The excess demand not satisfied by domestic production in the USA is met primarily by the two Latin American countries constituting 21.5 percent of the global export, the largest share (16 percent) being for Colombia. The developed world is the principal exporter as well as buyer of cut-flowers. Only four industrialized countries –The Netherlands, Italy, Belgium and Israel– constitute about 60 percent of the exports. United Kingdom, German, USA, The Netherlands, France, Russia, Japan and Italy are among the leading consumers with only the first three importing 47 percent of the world's total.

Africa's earnings from and share in the global cut-flower export trade are small as compared to its potential and grow in a fluctuating manner. Only 8.5 percent or US\$ 0.6 billion of global export receipts in 2007 flew to Africa. Although this share increased by three fold compared to its value in 1997, it was only half of the 2006 value. Almost all of the continent's cut-flower export is made by Eastern and Southern Africa countries. COMESA member countries have suitable climate for flowers and enjoy the advantage of proximity to the major European and Asian markets. Kenya, Zimbabwe, South Africa, Zambia, Tanzania and Ethiopia are the region's principal exporters. Cote d'Ivoire is also another West African supplier of the continent. Kenya and Zimbabwe ranked 4th and 5th respectively in the 2007 global cut-flower export performance. More than half of Africa's cut-flower exports is supplied by Kenya.

Ethiopia, which joined the industry quite late, seems to have a bright future. The country is able to become the 12th world supplier with a share of 1 percent in 2007, which was almost not known in the area ten years back. Following Kenya and Zimbabwe, Ethiopia was the third major African cut-flower exporter during the same period.

2.2 Ethiopia's Cut-Flower Industry

Like many developing-country flower growers and exporters, Ethiopia does not have a long history related to cut-flowers as the industry had usually been focused by developed countries. Since the primary buyers are citizens of industrialized countries, flowers were produced by these countries for domestic production. However, with the advancement in transportation and refrigeration, Westerners began to consider production in and export from developing countries. This was aided by the expansion of foreign direct investment inspired by trade liberalization. Existence of suitable climate and cost-reducing cheap labor in many LDCs has also significantly contributed to the industry's growth as a whole. Ethiopian cut-flower industry's recent spreading out could be highlighted in this general background.

Nonetheless, the history of the country's commercial cut-flower industry dates back to 1980 (EJE, 2008). There were a few state farms exporting flowers to Europe during the time. The Derg regime had established Horticulture Development Corporation. However, such problems as absence of private sector greenhouses, diseases and mismanagement were among the severe obstacles for the growth of the industry (EEPA, 2003). Seizure of power by EPRDF in 1992 opened doors for privatization. Consequently, private floriculture farms started to come to the scene. Two private producers, one in 1997 and the other in 1999, began their operation by exporting to The Netherlands. The post 2004 period saw a noteworthy growth in the industry in terms of number of farms, land and/or greenhouses coverage, number of people employed and, very importantly, amount of foreign exchange obtained.

The information from EHPEA shows that the main flower species produced and exported by Ethiopian farms are varieties of roses (hybrid tea and sweetheart), hypericum, carnation, gypsophila, allium and carhamus. Like in many other producing countries, the majority of growers (an estimated 80 percent) in Ethiopia cultivate roses. The rest 20 percent of the area is covered by other species of flowers. The country is recently noted for the production of large-budded and long-stemmed roses with vibrant colors. The main production season of flowers is between October and May. They are produced in modern production facilities around Addis Ababa and the Rift Valley towns and are exported via Bole International Airport.

2.2.1 Potential of the Economy and the Roles of the Industry

Potential of and Policy Environment for Cut-Flower Industry in Ethiopia

One of the most important conditions for growing good quality flowers is altitude which provides the appropriate climate. Other indicators of potential include soil quality and land availability, abundant water sources, labor, proximity to market, physical and institutional infrastructure, and policy environment. Ethiopia has one of the best production natural climate particularly for roses. Flowers grow well above 1100 meter a.s.l (above sea level) and Ethiopia has topography of up to 4600 meters a.s.l. Further, production of good quality flowers (i.e., those having large buds, long stems and vibrant color) requires warm days and cool nights which many areas in the country possess. With regards to land, there is some 0.78 million km² of arable land whose only 15 percent is cultivated (Nigussie, 2006). In addition, 3.7 million hectare of irrigable land is available. The soil types in many highland areas are also found suitable for flower production.

Concerning water resources, Ethiopia has 14 major rivers, 11 major lakes, and average annual rainfall between 100 and 2200 mm. With a population exceeding 80 million, the country has one of the cheapest labor in the world. For instance, Ethiopian laborers in the floriculture sector are paid twice lesser wages than Kenyan laborers (Ammerlaan, 2005). The country also enjoys a geographical advantage of reaching major international markets. Compared to other southern and eastern Africa potential growers of flowers, Ethiopia is closer to the main fresh cut-flower markets of Western Europe, Middle East, Asia and Russia.

The highlands of Ethiopia are suitable for flower production. There are many areas located above 1500 meters altitude. However, the selection of production sites by producers has yet been dependent much on proximity to airport. Many farms are consequently established within an average distance of 50 kilometers from Bole International Airport. The outskirts of Addis Ababa and many small nearby such towns of Oromia as Holeta, Debre Zeit, Addis Alem, Sebeta and Ziway are crowded by floriculture and horticulture farms. It seems after understanding this unfair regional distribution that the government is encouraging investors to grow in other regions which have the potential. A recent report by MoARD (2009) indicates that lands are already prepared and some investors have begun constructing greenhouses in Bahir Dar and Mekelle. In addition, construction of cold stores in the airports of these two towns is under progress.

Having a suitable natural climate is only necessary but not sufficient condition for the progress of the cut-flower industry. A good policy climate created by the government is also important for growers and/or exporters to actively participate in the industry. Such a climate can be made possible directly and indirectly.

Directly, the government may provide institutional and infrastructural facilities as well as incentives coined for the progress of the sector. Shortening of investment license securing processes and days, setting up of a government body closely watching the sector, facilitating credit and foreign exchange requirements for growers and input importers, *etc.* are among the wide range of institutional arrangements in our context. Such important physical infrastructural facilities as roads, water supply, electricity, refrigerated transport and storage facilities including at airport and cargo, *etc.* are also expected primarily from the government. Investors in floriculture, like in other sectors, expect incentives of various kinds from policy makers before and after they start operation.

The Ethiopian Government has undertaken different real measures to promote the sector. The number of days needed and bureaucratic requirements in taking investment license in Ethiopia are reduced although there is much to do in the future. This is translated into more floriculture local and foreign farm investors. The asphalt road coverage in the country has shown improvement which helps refrigerated vehicles to safely transport fresh cut-flowers from farms to the airport. The Ethiopian Airlines has increased the number of cargo planes and flights suitable for perishables.

From the institutional facilities point of view, a former agency called Ethiopian Export Promotion Agency (currently a department under the Ministry of Trade and Industry), Ethiopian Investment Agency, Ministry of Agriculture and Rural Development as well as regional counterparts particularly of Oromia Region have been amongst the responsible government bodies facilitating the promotion of the industry. Very recently, in 2008, a separate agency named Ethiopian Horticultural Development Agency is established by the Council of Ministers Regulation

Number 152/2008. The agency, under the umbrella of the Ministry of Agriculture and Rural Development, aims to help farms involved in floriculture as well as other horticulture activities maximize their production and productivity.

A number investment incentives have also been provided to floriculture growers and exporters. These include: duty free importation of capital goods, spare parts and raw materials (for production destined for export); exemptions from payment of export customs duties; no price control on export items; tax holidays up to five years; access to finance (the Development Bank of Ethiopia lending up to 70 percent of investment capital); and land reserve in highland areas.

In addition to the above direct interventions, the Government should also act indirectly. This includes, among others, helping farms through various export promotion activities and actively involving in the setting up of their own association (like the one shown in EHPEA) and supporting it sustainably.

The Roles of Cut-Flower Industry to the Economy

After having a glance at the natural and man-made potential of the Ethiopian cut-flower industry, the importance of the sector to the economy is worth discussing. In the following few paragraphs, we attempt to highlight those benefits from the perspective of generation of foreign exchange, reduction of risks of commodity price variability through diversification, and creation of both direct and indirect employment opportunities.

Since capital goods cannot be produced in home economies, LDCs need to import them from industrialized countries. This requires huge foreign exchange which is in a scarce quantity in those economies. The primary importance of the Ethiopian cut-flower industry could thus be considered as the generation of foreign currency. Even if the amount yet generated seems insignificant, its growth rate indicates that the industry can become a major source of foreign exchange for the country. Data-backed discussion of this issue shall be presented in the next subsection where we analyze the recent relative performance of the industry's exports.

For the past many years, one could not single out the Ethiopian export trade from coffee and a few others. However, the majority of these commodities have frequently been struck by price reductions and/or variabilities. The cut-flower industry, having different species and varieties, contributes much in diversifying the country's export commodities. As flowers are consumed by the developed world and thus have higher elasticities of income and price, they are superior to traditional exportables of the country. This has the importance of reducing the risk of price and exogenous demand variabilities in international markets.

World Bank (2004) identifies three dimensions or stages in the value chain of non-traditional exports: production, logistics and marketing. Each of these stages employs a significant number of people. Floriculture sector involves labor-intensive processes especially at its production stage. Such activities as seeding, cultivating, packing and loading make the sector unique in absorbing large labor force. According to EHPEA, estimated permanent employment opportunities about for 38,000 people and temporary employment for over 46,000 people were created in 2007. Less-educated women are the most benefited groups by the flower farms. The figures are expected to increase in subsequent years since the number of farms is on the increase.

The employment benefits from the industry also get large when one considers those created indirectly by the supportive industries. These industries provide the sector with support services, capital goods, physical inputs and information. Cut-flower industry works closely with companies involved in greenhouse production and distribution, flower variety breeding, transportation and refrigeration installation, irrigation systems construction, agrichemical and heavy equipment supply, corrugated box production, trading or marketing, *etc.* Even if some of these services are not yet provided in the home economy, the employment opportunities from them are considerable. No reliable data is found; however, one document estimated the indirect employment until 2006 to be 66,504².

2.2.2 Recent Aggregate Performance of Cut-Flower Exports

Primary commodity dependence for export has been observed making Ethiopia vulnerable to changes in prices. Recently, few non-traditional exportables have been identified and expanded. These include minerals; meat, meat products and live animals; and horticultural commodities such as fruits, vegetables and flowers. Although some of these non-traditional export items were supplied even in earlier years, their shares in the aggregate export were insignificant. Let us have a look at the export performance of the country for the past decade, part of which is summarized in *Tables 2.2 and 2.3*. The very reason behind observing the performance in the last decade only is that the country has expanded exporting flowers since the beginning of that decade so that we compare their performance with that of other commodities.

² www.ethiopianembassy.org

Table 2.2 Recent Values and Growth Rates of Ethiopia's Major Export Items

| Item | Export Values (Million US\$) | | | | | Growth Rate in Export Values (Percent) | | | | |
|-----------------------|------------------------------|------------|------------|--------------|--------------|--|--------------|--------------|--------------|--------------|
| | 1997 | 2005 | 2006 | 2007 | 2008 | 2005 | 2006 | 2007 | 2008 | 2005-2008 |
| Coffee | 373 | 356 | 427 | 404 | 553 | 45.75 | 19.96 | -5.28 | 36.68 | 13.83 |
| Oil Seeds | 38 | 176 | 128 | 156 | 255 | 95.05 | -27.52 | 22.05 | 63.50 | 11.16 |
| Fruits and Vegetables | 23 | 40 | 61 | 105 | 141 | -6.94 | 51.27 | 72.54 | 34.26 | 62.61 |
| Cut-flowers | 0.15 | 10 | 25 | 67 | 104 | 2116.18 | 154.52 | 166.99 | 55.73 | 239.56 |
| Hides and Skin | 58 | 72 | 81 | 90 | 91 | 4.75 | 13.13 | 11.63 | 0.95 | 6.87 |
| Minerals | 0 | 45 | 51 | 58 | 79 | -43.84 | 14.53 | 13.57 | 36.25 | 19.30 |
| Meat & Live Animals | 6 | 42 | 53 | 52 | 74 | 277.78 | 26.40 | -0.33 | 41.27 | 19.49 |
| Others | 75 | 164 | 173 | 226 | 233 | 112.19 | 5.48 | 30.65 | 3.26 | 10.58 |
| TOTAL | 573 | 904 | 998 | 1,159 | 1,530 | 47.16 | 10.43 | 16.10 | 32.04 | 17.32 |

Source: Computed based on Data from Ethiopian Revenue and Customs Authority

In 1997, the country secured a total of some US\$ 573 million from all of its exportables. Of this, US\$ 373 mil (i.e., 65 percent) was the share of coffee followed by hides and skin with 58 mil (10 percent) and oil seeds with 38 mil (7 percent). Cut-flowers, with only US\$ 0.15 million, had an insignificant share of 0.03 percent from the total export. In 11 years time, the aggregate export increased by about three-fold and reached US\$ 1530 mil in 2008. The export value of coffee also rose to US\$ 553 mil. However, its share got reduced to 36 percent since other export items, and those having insignificant shares earlier, emerged as dominant export commodities. Among these, the most important ones are fruits and vegetables (US\$ 141 mil); cut-flowers (US\$ 104 mil); minerals primarily gold (US\$ 79 mil); and meat, meat products and live animals (US\$ 74 mil). The previously dominant exportables –oil seeds and hides and skin– also showed noteworthy growth.

The growth rate in cut-flowers export has seen its largest value compared to other exportables in the decade under consideration. Especially between 2005 and 2008, it grew by an average rate of 240 percent per annum. This is by large higher judged against 17.32 percent for total exports and 13.83 percent for coffee. As depicted in *Table 2.2*, a maximum growth rate of 2116 percent was registered in 2005 (so that we call this year the boom-year of the country's cut-flower exports). Of the four years, the recent year of 2008 has registered the minimum growth rate of the industry's exports indicating the impact of the world's economic crisis of the time.

Table 2.3 Exports of Cut-flowers and Other Commodities as a Share of Total Exports

| Item/ Year | Coffee | Oil Seeds | Fruits and Vegetables | Cut-flowers | Hides and Skin | Minerals | Meat and Live Animals | Others | TOTAL |
|---------------------|--------|-----------|-----------------------|-------------|----------------|----------|-----------------------|--------|--------|
| 1997 | 65.15 | 6.55 | 4.00 | 0.03 | 10.09 | 0.00 | 1.12 | 13.06 | 100.00 |
| 2005 | 39.37 | 19.48 | 4.47 | 1.08 | 7.91 | 4.93 | 4.61 | 18.15 | 100.00 |
| 2006 | 42.77 | 12.79 | 6.12 | 2.50 | 8.10 | 5.12 | 5.28 | 17.34 | 100.00 |
| 2007 | 34.89 | 13.44 | 9.09 | 5.74 | 7.79 | 5.00 | 4.53 | 19.51 | 100.00 |
| 2008 | 36.12 | 16.64 | 9.24 | 6.77 | 5.96 | 5.16 | 4.85 | 15.26 | 100.00 |
| Average (1997-2008) | 44.96 | 10.95 | 5.87 | 1.37 | 9.61 | 4.90 | 2.28 | 20.05 | 100.00 |

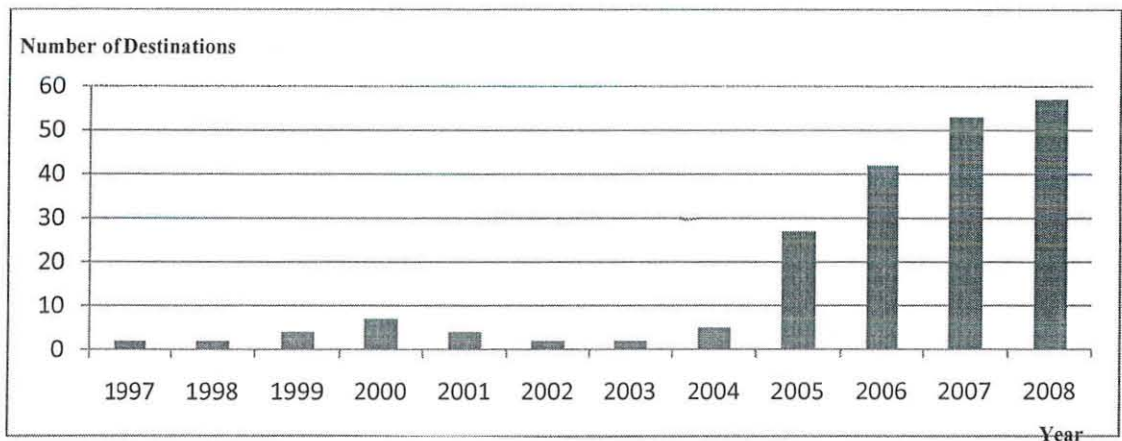
Source: Computed based on Data from Ethiopian Revenue and Customs Authority

Those higher annual growth rates have helped cut-flowers to become the fourth major export commodity groups of the country in 2008 with a share of 7 percent of the total. Even if their annual average share is less than 2 percent between 1997 and 2008, the recent growth rates provide some evidence of bright prospects under an assumption of normal world economic conditions.

It is interesting to see that the increase in export earnings from cut-flowers fits the increase in the number of international markets for the commodities. As visually indicated in *Figure 2.1*, the

number of destination countries for Ethiopia's cut-flower exports fluctuates between 2 and 7 from 1997 to 2004 but remarkably rises since 2005. By end of 2008, that figure reached 57 destinations. In the face of economic crisis, this measure of market area diversification is very important. Such endeavors must also be taken by exporting farms, EHPEA, the government and other stakeholders even under normal economic situations.

Figure 2.1 Trends in the Number of Destination Countries of Ethiopia's Cut-Flower Exports



Source: Based on Data from Ethiopian Revenue and Customs Authority

The direction of Ethiopia's cut-flower exports shows that the European Union is the major market. The share of the dominant destinations is depicted in *Table 2.4*. Private cut-flower exporters of the country began their operation by supplying to the markets of the Netherlands and United Kingdom in 1997 with the former taking 86 percent of the whole. In general, Western Europe, the Middle East, and recently, the Far East and Eastern Europe are the principal market areas of Ethiopian cut-flower exports.

Table 2.4 Share of Major Destinations of Ethiopia's Cut-Flower Exports

| Destination Country | % Share in Total Cut-Flower Export | | | |
|----------------------|------------------------------------|---------------|---------------|---------------|
| | 1997 | 2004 | 2007 | 2008 |
| The Netherlands | 85.73 | 5.24 | 82.60 | 88.19 |
| Germany | - | 93.97 | 5.91 | 3.77 |
| United Kingdom | 14.27 | - | 3.83 | 1.46 |
| Japan | - | - | 1.26 | 1.26 |
| United Arab Emirates | - | - | 1.18 | 1.07 |
| Saudi Arabia | - | 0.67 | 0.86 | 0.79 |
| Israel | - | - | 1.90 | 0.58 |
| Others | - | 0.12 | 2.46 | 2.87 |
| TOTAL | 100.00 | 100.00 | 100.00 | 100.00 |

Source: Computed based on Data from Ethiopian Revenue and Customs Authority

The World's large flower auctions are found in the Netherlands and hence it remains a major destination for Ethiopian cut-flower exports. Consequently, 88 percent of the total corresponding exports of the country routed to the Netherlands in 2008. Germany (which took 94 percent of the exports in 2004), United Kingdom, Switzerland and France are other European Union markets. United Arab Emirates, Saudi Arabia and Israel represent some of the markets in the Middle East. Asian countries like Japan, Singapore and India and such Eastern European nations as Russia, Ukraine and Georgia are emerged out as new destinations. African markets like Djibouti, Egypt, Senegal and even the competitor Kenya have also been assessed.

2.2.3 Farm Level Cut-Flower Export Performance Analysis

The previous analysis of the export performance of the Ethiopian cut-flower industry was only an aggregate analysis. As the study is based primarily on farm level analysis, we shall see in brief the micro accomplishment of the industry from the perspective of exporting farms.

Table 2.5 Recent Major Ethiopian Exporting Farms of Cut-flowers

| Exporting Farm | 2005 | | 2006 | | 2007 | | 2008 | |
|--------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| | Value (mil US\$) | Share from Total | Value (mil US\$) | Share from Total | Value (mil US\$) | Share from Total | Value (mil US\$) | Share from Total |
| Linssen Rose | 0.68 | 6.79% | 3.95 | 15.81% | 5.79 | 8.64% | 9.30 | 8.94% |
| AQ Rose Plc. | 0.01 | 0.13% | 1.64 | 6.57% | 5.35 | 7.98% | 8.63 | 8.30% |
| Ziway Roses Plc. | 0.23 | 2.29% | 2.95 | 11.82% | 6.04 | 9.01% | 8.26 | 7.95% |
| Enyi Ethio Rose | 0.93 | 9.33% | 2.44 | 9.75% | 3.48 | 5.20% | 3.88 | 3.73% |
| Meskel Flowers | 0.19 | 1.92% | 0.20 | 0.81% | 2.26 | 3.37% | 3.41 | 3.28% |
| The above five | 2.05 | 20.46% | 11.19 | 44.76% | 22.91 | 34.19% | 33.48 | 32.20% |
| Others | 7.95 | 79.54% | 13.81 | 55.24% | 44.09 | 65.81% | 70.52 | 67.80% |
| TOTAL CUT-FLOWER EXPORT | 10 | 100% | 25 | 100% | 67 | 100% | 104 | 100% |

Source: Computed Based on Data from MoTI and ERCA

By 2008, Ethiopia obtained some US\$ 104 million from its cut-flower exports. The total number of exporting farms has exceeded 100. However, a few farms dominate the share from the total, since 2005. Based on their share in 2008, *Table 2.5* summarizes the export performance of the top five farms. These are Linssen Rose, AQ Rose Plc, Ziway Rose Plc, Enyi Ethio Rose and Meskel Flowers. These five farms constituted twenty to forty five percent of the total cut-flower export earnings between 2005 and 2008. While the first three are foreign owned, Enyi Ethio Rose and Meskel Flowers are owned by Ethiopian investors. Linssen Rose alone obtained US\$ 9.3 million in 2008, amounting to 9 percent of the country-wide earnings from the sub-sector.

These export accomplishments of farms are achieved by complementing different factors of production. Land is one of the most important ones. *Table 2.6* shows data on land holding by major farms from 2005 to 2008. For the purpose of comparison, their export supply (volume by kilogram) and export value in foreign exchange are also shown.

Table 2.6 Land Holding and Cut-flower Exports, by Major Holding Farms (2008)

| <i>Farm</i> | <i>Export</i> | | <i>Land Holding (hectare)</i> | | <i>Land Imple- mentation Ratio (=b/a)</i> | <i>Greenhouse Land to Volume Ratio</i> |
|----------------------------------|----------------------------|-----------------------------|-------------------------------|-----------------------------------|---|--|
| | <i>Volume (mil kg)</i> | <i>Value (mil US\$)</i> | <i>Total (a)</i> | <i>Greenhouse Covered (b)</i> | | |
| <i>Sher Ethiopia</i> | 0.005 | 0.022 | 500 | 291.3 | 0.58 | 0.000 |
| <i>Ethiopia Meadows</i> | 0.49 | 1.59 | 471.6 | 90 | 0.19 | 0.005 |
| <i>Awassa Green Wood</i> | 0.03 | 0.07 | 100 | 17 | 0.17 | 0.002 |
| <i>Maranque Ethiopia</i> | 0.22 | 3.16 | 70 | 15 | 0.21 | 0.015 |
| <i>Linssen Rose</i> | 2.06 | 9.30 | 65 | 41 | 0.63 | 0.050 |
| <i>Enyi Ethio Rose</i> | 0.94 | 3.88 | 41 | 27 | 0.66 | 0.035 |
| <i>Share of the above</i> | 14.92% | 17.33% | 38.56% | 42.68% | - | - |
| <i>COUNTRY TOTAL</i> | 25.12 | 104 | 3235.56 | 1127.8 | 0.35 | 0.022 |

Note: A farm may hold land in different sites in which case holdings are summed up.

Source: Computed Based on Data from MoARD and ERCA

The total land held by farms involved in floriculture production and export has reached 3236 hectares by 2008. However, only 35 percent of it is implemented.³ This implies that 1128 hectare is covered by greenhouses. The majority of the total land (and thus implemented land) is held by a few large farms. For instance, only six farms account about 39 percent of the total and 43 percent of the implemented land. Sher Ethiopia, Dutch owned, alone has taken 500 hectares of land. The smallest total land holding is by Ethio Plants having 5.3 hectares and implemented land is by SMR Agriculture covering only 2 hectares by greenhouses (both figures not reported in our table). Having a glance at the land implementation ratio column, one may conclude that the smaller the land size the higher is its implementation rate. Linssen Rose and Enyi Ethio Rose, which have moderate land sizes, have respectively covered 63 and 66 percent of their land by greenhouses. These are much higher than the country average of 35 percent.

³ According to MoARD (2009), land in the floriculture sector is said to be implemented if it is covered by greenhouses.

Further, it is possible to see the relationship between land implementation and export performance. This can be observed from the last column which reports the ratio of greenhouse covered land (implemented land) and flower export supply in millions of kilograms. The ratio helps to tell how farms use their land for producing exportable flowers. In more technical and advanced context, it might inform one the scale that a given farm attains. For all farms in the country, this ratio stands at 0.022. For the largest land holder, Sher Ethiopia, the ratio is surprisingly zero. However, the two farms, Linssen Rose and Enyi Ethio Rose, have higher greenhouse to export volume ratio. Note that these two farms are amongst the top export performers and at the same time have moderate land sizes.

2.2.4 Challenges and Future Threats and Concerns

Due to its recentness, the Ethiopian cut-flower industry is surrounded by a number of obstacles. These could be domestic and/or foreign. On the other hand, its promotion raises many issues for attention. No industry is perfect. Efforts of making its path smooth, i.e. removing the challenges, have their own repercussions which could be judged from environmental and economic dimensions. This section closes the chapter by attempting to brief the main problems the country's cut-flower sub-sector faces and the burning concerns associated with its promotion.

At the domestic front, cut-flower industry has to face problems related, among others, to physical and human capital, banking, research and development, infrastructure, industrial linkage and economic and political stability. The industry is not only labor-intensive. It also involves a number of capital requiring processes such as at greenhouse construction, refrigeration installation, transportation, *etc.* These need relatively large stocks of both physical and human

capital which are otherwise scarce in Ethiopia. In addition, the majority of the inputs including seedlings, fertilizers and other agrichemicals are not available at home. No adequately equipped academic institution is found except Jimma University which trains horticulturalists. There is also lack of well skilled and trained human resource or government institution which provides sufficient technical support for the farms at various stages. All these capital items must thus be imported at expensive hard currencies. This may be a challenge for producers and exporters. To cope up with the fierce competition from experienced exporters of other countries, they have to be aware of the external world. This is reflected in the fact that a good number of the farms are either owned or managed by foreigners and returnees of the Ethiopian Diaspora.

Research and development are at the core of the progress of any industry. Floriculture sector requires intensive research from variety and soil type selection to disease prevention. However, the capacity of the country's agricultural research institutions in terms of necessary equipment and qualified personnel for the sector is questionable. This might continue costing farms and the country a lot of foreign exchange. Another challenge for the industry emanates from the insufficient infrastructure provided by the government. Electricity and water are among the crucial ones, but they are not usually supplied as required. It has also been observed that there is a problem of cargo which is much related to the Ethiopian Airlines (EAL). Den-Belder and Elings (2007) for instance observed that some produce may not be exported sometimes. A related future obstacle might be fixation of high cost of transportation per kilogram of flower exported. The EAL is still providing cargo services below cost price which may not continue sustainably.

Lack of appropriate industrial linkage and inadequate banking services represent yet other barriers to the cut-flower export industry. The industry, owing to its chain from production to

marketing, needs strong linkages with other industries. At production level, timely provision of fertilizers and other agrichemicals is important. Unless due attention is given to the local supply of such inputs, its current importation might have undesirable consequences. The air transportation of commodities, which is beyond the control of the exporters, is one requiring huge attention. The seriousness of the matter is exacerbated by the perishable nature of the products. Also, due to the increasing number of farms and exporters, the import of raw materials and flower export has grown. This requires increased banking services. On the contrary, the capacities as well as competitiveness of commercial banks in the country are at their infancy.

Lack of stability in the domestic economy in terms of exchange rate, inflation and politics is also of an obstruction for the industry's healthy performance. An overvalued birr discourages exporters. For instance, the reduction in value of the Euro compared to the birr in the past year has made many flower exporters to Europe to lose a significant amount of the domestic currency. Inflation in the home economy has led to a rise in the price of factors of production such as labor. Many flower farms were forced to raise wage rates due to the double-digit inflation rate persisting in the country. Political stability, in addition to attracting new entrants into the industry, encourages farmers to expand their production and export levels. It is important to give due emphasis for the matter as the country has been observed to be prone to conflicts related to political elections (as seen in the May 2005 elections), religious and ethnic issues, and terrorist attacks.

At the foreign front, cut-flower industry is affected by developments in the developed world as it is the principal consumer. Unlike food, flowers are not necessities. When an economic crisis, like the 2008's, occurs in Western countries, people give priority to food items. This has a severe

impact in reducing the export earnings of developing countries such as Ethiopia. Exporters to only these crisis-struck countries are the most damaged. Diversification is one of the ways out. Had not Ethiopian flower exporters diversified their markets to the less attacked areas of Asia, the Middle East and Eastern Europe, there would have been a huge loss to the industry. The other foreign challenge might be global over-supply of cut-flowers. Nowadays, many developing countries are producing and considering export of flowers especially of roses. This simultaneous action might result in a market glut problem known as 'adding-up effect' or 'fallacy of composition'. The problem in turn leads to reduction in prices and thus exchange earnings. Under such a situation, being strong competitor helps for sustained benefits from the industry.

Although the country's cut-flower industry is operating in the face of a number of impediments, their reduction/removal however requires consideration of environmental and economic concerns. The environmental concern, which is related to chemicals, is the most important. Production of flowers is characterized by a significant use of fertilizers and agrichemicals such as pesticides. For example, according to Danse *et al* (2007) and Den-Belder and Elings (2007), almost all floriculture farms use chemical crop protection products to control pests and diseases in greenhouses. Other controlling techniques include biological and cultural practices which are environmental friendly but their use is very limited. Chemicals might have undesirable impacts on surrounding water, production of other food crops and workers' health. Even if a Code of Practice for the use proper of chemicals by farms is prepared, only a few of them have yet started implementing it.

From the economic point of view, the industry might be one of those exhibiting large capital flights as it is primarily owned and run by foreigners. Very importantly, the promotion of the industry might create landlessness. Small land holding farmers might lose their land. The fact that flowers grow well in the highlands implies that good lands are used for flowers leaving marginal lands for food crop production. These concerns require the government's remarkable foresight.

CHAPTER THREE

REVIEW OF THE LITERATURE

3.1 Introduction

Having made a glance at the potential, importance and performance of the Ethiopian cut-flower industry in the previous chapter, the next task of the paper shall be to identify the major determinants of the export supply of the industry. To accomplish this task, it is necessary to find out theoretical and/or empirical bases in the available literature.

Attempts to theoretically and empirically explore the factors determining supply of export commodities have a relatively longer history. The initial theoretical underpinnings could be found in the well known ‘cob-web theorem’ compiled by Ezekiel (1938). The theorem states that supply (output) is determined by price of the previous period. The cob-web theorem, based on the simple notion that supply depends on price, paved the way to the development of empirical models called ‘supply response models’. The primary objective of these models is to know the average responsiveness of producers (suppliers) to changes in prices by estimating elasticities. While Nerlove (due to Nerlove, 1956, 1958a, 1958b; and Nerlove and Addison, 1958) is considered to be the first in the area of individual commodity supply response modeling, Griliches (1960) pioneered aggregate (economy-wide) output response.

These price-based models have since then been adopted, modified and even extensively revised by numerous later authors in examining supply response. The modifications have been made mainly due to the advancements in econometrics and the diverse nature of commodities and economies under investigation. For instance, it might not be correct to use a single model to study the supply behavior of farmers and manufacturers of the same economy, or of farmers of developing countries and developed countries, or even of farmers producing annual crops and other crops which need more time to give outputs. Through time, non-price factors have begun getting equal (and sometimes even more) emphasis as (than) prices. It is in this course that commodity-specific export supply models emerge. Our literature survey tries to systematically show the above path in an attempt to find the theoretical and empirical bases for modeling Ethiopia's cut-flower export supply.

3.2 Determinants of Primary Commodity Supply

The major export commodities of SSA have been agricultural. Depending on their nature and time they take until harvesting, agricultural commodities could be grouped into annuals, perennials and minerals. The distinction between annual crops and perennial crops must be clear. While annuals have a sowing-to-sowing cycle of one year or less (Bond, 1983: 709), perennials require more than a year before providing output. Cotton, wheat, maize, many varieties of vegetables, *etc.* are examples of annual crops. Perennial crops include coffee, cocoa, rubber, sisal, palm, tea, *etc.* All these commodity groups could be produced for domestic consumption and/or for foreign market. Any effort of identifying the main determinants of primary commodities export supply should emanate from those commodities produced necessarily not for export.

3.2.1 Supply of Agricultural Commodities in General

Nerlove (1956) is considered by many researchers of the area as the first econometric⁴ attempt to model dynamic supply function of individual annual agricultural commodities. He regresses acreage planted on expected price (represented by price lagged one year) and on lagged acreage to reduce serial correlation in his time-series model. The author provides preliminary results of the supply elasticities to deflated prices for cotton, wheat and corn. Although the reported results were tentative, the specification that supply is entirely dependent on price called forth criticisms. Brandow (1958) is the first to comment that non-price factors are equally important as prices after he tests them on the supply of barley.

The various models of supply response that emerge beginning from early 1960s could be generalized as Nerlovian. Many researchers have been attempting to test the applicability of these models and modifying them particularly to developing countries.

One of the earliest efforts to model supply response in Africa is that of Dean (1965). According to him, the notion that economic theory is useless in underdeveloped countries appears to be unsound. By running different regressions of peasant grown tobacco crop in Malawi on such independent variables as relative prices of tobacco and labor as well as weather, he concludes that farmers in Africa respond to prices.

⁴ *Alemayehu (2002) of course classified commodity models in general as econometric, spatial equilibrium and programming, and input-output models. However, econometric models are the most widely used ones. So, our emphasis here shall be on these models only.*

Bateman (1965) develops the first econometric model for the supply of perennial crops. He specifies supply functions for the Ghanaian cocoa. The model suggests that the change in cocoa harvested from year to year can be explained by producer prices (of both cocoa and coffee), rainfall and humidity, and lagged changes in output. But, the last variable is found to be insignificant. The prices he uses follow the Nerlovian (expected) form. Even though Bateman's (1965) model may be given credit for its initiative in perennial crop supply modeling, it fails to incorporate non-price factors. Later, Ady (1968) explicitly adds a non-price explanatory variable - existing acreage (i.e., the stock of the crop). Wickens and Greenfield (1973) and Saylor (1974) have also endeavored to model coffee supply. Both studies however end up concluding the supply of coffee as determined solely by prices.

Another group of primary commodities is minerals. Desai (1966, 1972) and Banks (1972) are considered as pioneering studies for one of the minerals – tin. Nonetheless, their models fail to get significant price factors primarily due to statistical problems such as use of short time span. A dynamic model that incorporates both price and non-price determinants is then developed by Richard (1978) for copper. Both demand and supply functions of refined copper are specified against price and non-price factors. The price variable is the relative price of copper relative to that of aluminum. The non-price factors include, among others, an index of manufactured output, consumer stocks of refined copper and strike losses. Mainardi (1999) provides a pooled panel data evidence of the supply determinants of gold and other minerals from South African mining companies. The analysis is different from previous studies in that it incorporates company-specific, macro and geographical environment as well as demand side determinants. He finds that mineral supply is determined significantly by prices, institutional framework, geological characteristics, scale of mine operations and specific features of controlling holdings.

Recently, IDRC (2007) specifies Zimbabwean tobacco supply against current and lagged prices, lagged output, rainfall, simple and quadratic time trend, and others; and Brescia and Lema (2007) use only price as an explanatory variable for the supply of wheat, maize and soybeans in Latin American countries.

The modeling of aggregate agricultural supply response is pioneered by Griliches (1960) who estimates the supply elasticities of U.S. aggregate farm output. He uses an index of farm output as a dependent variable. The independent variables incorporated are real price, weather and trend (assumed to capture the effect on supply of technological change). In an attempt to reduce autocorrelation, like Nerlove (1956), he includes lagged farm output as a right-hand side variable. The author also applies a similar model to check the responsiveness for two sub-groups: all crops, and livestock and livestock products. The results are similar to the aggregate ones. The study goes one step up (compared with Nerlove, 1956) by its treatment of a few non-price factors as determining supply of primary commodities even if no clear-cut distinctions between short-run and long-run responsiveness are made.

A frequently cited paper concerning aggregate supply response in SSA is Bond (1983). She develops that per-capita agricultural output is dependent on aggregate real producer price, time trend (to take into account the effect of long-run structural changes) and a weather dummy. The aggregate results are reported for nine SSA countries. However, the aggregate price elasticity of supply and the coefficients of other variables are found insignificant in seven of the countries considered. This could be attributed to the quality of data used which the author herself claimed.

Contributions after the early 1980s have identified a wide range of additional and crucial factors. These could be grouped under macroeconomic environment factors including financial developments, inflation, institutional arrangements, infrastructure and other structural constraints and policy changes (reforms) following the structural adjustment programs. For instance, Binswanger *et al* (1987) show, in particular, that roads, public systems of irrigation, literacy and life expectancy have direct effects on supply. Sharma (1992) obtains a positive and significant influence on farm output of technological, institutional and structural factors in Kenya. Rozelle and Huang (1999) indicate that technological transformations (such as hybrid seeds), investment in agricultural infrastructure (especially on irrigation) and environmental stress (especially related to degradation) have been important in China's past and future supply of primary commodities.

A study to explicitly test the impact of adjustment programs (reforms) on agricultural supply is Danielson (2002). He tries to capture reforms by a multiplicative dummy and uses relative prices and other non-price factors such time trend to estimate his model by non-linear maximum likelihood. The regression provides insignificant reform dummy. The finding shows that reforms had not helped farmers to increase their competitiveness on a sustained basis, albeit it is not clear as to what type of multiplicative dummy is used in the agricultural output model.

Many other recent studies are not basically far from the schemes reviewed above. Heltberg and Tarp (2001) stress the importance in farm supply in Mozambique of non-price factors such as technology, transport infrastructure, farm environment and area characteristics. Recently, Subervie (2008) shows that aggregate supply in developing countries is affected by inflation, infrastructure and financial system in addition to price instability.

In general, the empirical literature on agricultural commodity supply has evolved with time from price-focused models to mixed ones. Non-price determinants in the African context have been identified as natural factors like weather conditions, producer-related situations like input use and managerial skills and macroeconomic (policy) related including institutional and structural reforms. Would these factors continue affecting export supply (if the commodities were produced for foreign market)? This question drives us to the next sub-section.

3.2.2 Factors Affecting Primary Commodity Export Supply

There is an abundant theoretical and empirical literature available on the determinants of developing countries' traditional commodities export supply. Theoretically, the literature reveals in general two, largely contrasting, groups of factors (Svedberg, 1991; Berhanu, 2005). The first set of factors relates to the demand side determinants, sometimes called price factors, which is exacerbated by the protectionist actions of industrialized countries. The second group is ascribed to the supply side constraints within exporting countries. However, the recent view is that both factors are equally important.

A latest report by UNCTAD (2008) on export competitiveness and development outlines various types of factors which determine the aggregate and individual commodity export supply and growth in LDCs. The report asserts that both demand side (or market access) and supply side (or domestic institutional and policy environment) factors have an impact on export supply. The former includes: unfavorable preferences, protection and subsidies, and standards and technical regulations in developed countries; poorly operating regional trading arrangements (for instance, lack of intra-Africa trade); minimal trade-related technical assistance aid for trade and poor

operation by the Integrated Framework (designed to help LDCs integrate into the world economy); and WTO rules and export promotion in LDCs. The domestic factors incorporate: market-based reforms; infrastructure; institutional environment; export and investment promotion. The UNCTAD (2008) report shows that the demand side factors should not necessarily be associated to the developed world but also to the intra-LDCs trade.

For Henson and Loader (2001), who focus much on the demand side factors, the major barriers to LDCs' agricultural exports are sanitary and phytosanitary requirements of the developed world. Kadiero and Randa (2004) add, to the market access problems, such other factors as access to inputs (like fertilizer, credit) to bolster production and access to information about markets, prices and qualities. Berhanu *et al* (2002) substitute the demand side and supply side factors by external and domestic factors respectively. According to them, the domestic determinants include, in addition to those already raised, firm specific factors such as skill composition, personnel and engineering management, among others. Biggs (2007a) emphasizes the role played in export supply by comparative factor advantage which is in turn constrained by market access, infrastructure and trade facilitation services, anti-export bias in trade policies, real exchange rates, weak institutions, human capital and learning mechanisms, financial depth and market failure. The same author also claims that macroeconomic and trade policies are only necessary but not sufficient for a successful export performance by LDCs (Biggs, 2007b).

Other people such as Bond (1987) argue that developing countries' exports are also affected by commodity composition and geographical location. For these countries, much success or the lack of it in exporting can depend on the types of commodities exported and how world demand for each commodity group moves over time. The growth of exports can depend in part on the

location of the exporter. For instance, most of the markets for Africa's commodity exports are in the European Union because of Africa's proximity to Europe. Bond (1987) holds the view that Africa's exports to Europe had declined due to the expansion of the European agriculture.

From the empirical point of view, a number of studies have been conducted the majority of which support the intermingling effect of the domestic and external factors on export supply. We shall carry on our survey starting from aggregates (cross-country and commodity groups from individual countries) to commodity-specific export supply of a specific country, by once again focusing on SSA. This is made based on the fact that the majority of African exports are primary exports and on the assumption that models of aggregates provide necessary information for individual commodity exports.

3.2.2.1 Aggregate Primary Export Supply

We begin with Bond (1985) for cross-country or aggregate studies. Following Goldstein and Khan (1978), she models export quantity flows from groups of non-oil exporting developing countries to groups of importing countries. Two equations are developed - export demand and export supply- for each individual country. The initial specification is that export supply depends on: domestic price level, output, a trend term and weather conditions. The results for non-oil exporting developing countries export flows shows, besides the above, the lethal effect of higher oil prices on their exports through increased production costs. This is seen by the inclusion into the model of dummy variables for the 1973/74 and 1979/80 oil crises. Its merged treatment of demand and supply side factors helps the model get some credence.

Chu and Morrison's (1986) principal argument is that export supply of a commodity depends on potential production (supply) and its utilization. Real prices (current, lagged and exchange rates) and other supply shocks are responsible in affecting the utilization of the potential production. And the change in potential production (supply) is specified as a function of average excess profits in recent years which in turn are a function of prices. They use this general approach to specify and estimate the utilization functions of different commodity groups – food, beverages, agricultural raw materials and metals – by the introduction of assumptions about lags. For example, for food and beverages, production decisions are made at the beginning of a crop year, and it is not easy for producers to revise their production plans during the course of the year (i.e., a one year lagged real price would be used).

A further empirical evidence of the theoretical underpinnings raised above is also granted by Bond (1987). She adopts the approaches of her own in Bond (1985), Goldstein and Khan (1978) and Chu and Morrison (1986). First, she divides the developing world into five regions - Africa, Asia, the Middle East, Europe and the Western Hemisphere; and primary exports similarly into five - food, beverages and tobacco, agricultural raw materials, minerals and energy. Next, the author specifies identical demand and supply equations for the first four commodity groups and different functions for energy for each region. Finally, unlike Bond (1985), these equations are themselves estimated but not their reduced-form. Accordingly, Africa's supplies of primary export groups are found to be significantly affected by prices, except the beverages and tobacco group. Only food exports are influenced by the index of productive capacity, reminding of the notes by Chu and Morrison (1986) that it is difficult to assign productive capacity for individual commodities.

A few classic contributions for African aggregate export supply modeling could be surveyed: Alemayehu (1999); Ghura and Grennes (1994); and Kandiero and Randa (2004). Alemayehu (1999) makes a notable endeavor of identifying the determinants of aggregate primary commodity export supply from Africa. Adopting Bond (1987), Africa is split into three regions. Its primary exportables are grouped into five. The export supply function is specified as consisting of the short-run (capacity utilization) and long-run (capacity creation or potential output) and is largely a Chu and Morrison (1986) type. Capacity utilization is assumed to be determined by current and one period lagged real prices. The long-run part is built by expected profit, which is based on the summation of lagged real prices, capital formation and foreign inflow.

The pooled data cointegration and ECM regressions discover that capital formation indicators have a statistically significant positive impact on export supply especially in the long-run. Regarding the impact of foreign inflows on exports, no firm conclusion is arrived by the study. Results are also found to vary across commodity groups and the three regions of Africa. The approach as well as the inclusion of such variables as capital formation (which consists of domestic credit and government investment, among others) and foreign inflow makes Alemayehu's (1999) model praiseworthy. However, it is not commendable to model the aggregate export supply of primary commodities independent of their demand as developments in the importing countries have huge impact on Africa's exports. In this connection, it seems important to raise Ghura and Grennes (1994). According to them, to the extent that Africa is affected by external factors (they show this in their study) that are beyond its control, getting policies right is a necessary but not sufficient condition to improve export performance.

Of the fairly recent studies that explicitly treat the effects of importers' policies on SSA primary exports is Kandiero and Randa (2004). They model SSA's agricultural exports. In addition to the traditional determinants – real exchange rate and terms of trade – they include a number of other domestic and external factors. Incorporated in the former are agricultural productivity, access to information and availability of infrastructure at micro level and the sustainability of the macroenvironment (measured as the ratio of parallel exchange rate to official exchange rate) at macro level. The external/foreign market access factors are represented by foreign tariff and foreign governments' market support variables such as producer nominal assistance coefficient and producer support estimates. Other variables like trend are also used to capture the growing standards and technical barriers. Their results provide significant and strong evidence of those variables suggesting the need of urgent effort from African governments at both micro and macro levels as well as from the international community.

Concerning country-specific aggregate export supply modeling, the post 1980s period saw a huge literature following the implementation of the stringent stabilization and structural adjustment programs by many developing countries. These studies underline the impact on export supply and performance of a wide range of factors including: relative prices (McKay *et al*, 1998; Ahmad, 2000; Prasad, 2000; Sharma, 2000; Utkulu, 2004), real exchange rate (Ahmad, 2000; Sharma, 2000), liberalization (policy reform) (Arslan and van Wijnbergen, 1993; Ahmad, 2000), domestic production capacity including weather conditions and technological innovation (Prasad, 2000; Utkulu, 2004), domestic demand (Sharma, 2000), and importers' income and demand (Prasad, 2000).

3.2.2.2 Commodity-Specific Primary Export Supply

The above sub-section has surveyed studies on aggregate primary export supply at both cross-country and individual country levels. However, aggregation of crops in estimating export response not only obscures the effects of policies on specific commodities, but can be expected a priori to generate a low aggregate elasticity of supply, given the substitution relationships commonly existing among agricultural commodities (Markussen and Lee, 1994). In view of that, a large literature is also available on the export supply of specific traditional commodities from individual countries. Sub-Saharan Africa export commodities include such primaries as cocoa, coffee, tea, cotton, gold, tobacco, groundnuts, copper, *etc.* Cocoa and coffee, for instance, cover more than a third of the total agricultural export receipts of the region (Melesse, 2004). While the majority of studies have identified various factors other than those determining aggregate exports, others have attempted to check differences between individual commodity and aggregate exports regarding their responsiveness to similar determinants.

This review uses Lukonga (1994) as a starting point which attempts to model supply and demand determinants of Nigeria's non-oil exports. The author estimates both equilibrium (long-run) and non-equilibrium (short-run) models for three commodities: cocoa, palm kernel and rubber. A log-linear export supply function for these commodities is specified as: quantity of export supplied is determined by relative prices, domestic capacity, domestic demand and a policy reform variable. The supply function is specified independently of export demand function following the assumptions that Nigeria is a price taker in world markets and that primary commodities are sold in perfectly competitive markets.

The OLS estimation results show that cocoa and rubber export supply significantly respond to relative prices, domestic demand and policy reforms both in the short- and long-run. The relative price coefficients are inelastic except for the short-run elasticity of rubber that marginally exceeds unity. Domestic demand is found to be major impediment to export supply which is shown by the significant coefficient for all of the commodities considered. The coefficient of productive capacity, which indicates the degree of bias associated with agricultural expansion, is statistically significant only for cocoa with unexpectedly negative sign. Lukonga's (1994) model is unique in that it explicitly shows the role of domestic demand for a certain commodity in affecting the quantity of the commodity supplied for export market. However, the approach is criticized on the ground that it uses the same model for all of the commodities treated. The perennial nature of the commodities was ignored (only one year lagged relative price is used).

The modeling problems associated with export supply of perennials raised above are partly reduced by Were *et al* (2002). In an effort to analyze the export performance of Kenya, the authors decompose the country's exports into three categories: coffee, tea and other exports of goods and services. They use real exchange rate and real foreign income as explanatory variables. Investment as proportion of GDP is included as a proxy to capture supply constraints. The results for coffee reveal that the long-run coefficients of real exchange rate and investment as a ratio of GDP are significant and positive. However, current income of trading partners is not significant. Given that coffee is a perennial crop, the authors try to capture lagged effects by incorporating lagged variables in the estimation. Nonetheless, the estimation results are poor as evidenced by insignificant and/or wrongly signed coefficients. This is also true for the short-run model: while (current change) in income of trading partners and lagged variables are insignificant, only the price effect is significant.

A recent attempt to model the Zambian copper export supply is Pollen (2008). He adopts Alemayehu (1999) except that he replaces capital formation and foreign inflow variables by imports and gross domestic investment as proportion of GDP and that a liberalization dummy is included. Copper export supply is specified as a function of real exchange rate and the above variables. Although the author presents no theoretical justifications, two long- and short-run models are estimated – one with current and the other with current as well as one year lagged explanatory variables. The estimation procedures are also similar to Alemayehu (1999) and Were *et al* (2002) who use cointegration and ECM techniques. The results of those models indicate that current real exchange rate and imports and liberalization affect copper export supply only in the long-run. Current imports are found having both long-run and short-run effects.

3.3 Determinants of Non-Traditional Commodity Export Supply

Many people and institutions are currently having the view that the policy environment for exports in many LDCs has shown dramatic improvement. According to UNCTAD (2008), while such indicators of domestic policy environment as index of overvaluation, black market premium and economic controls indicators have been falling since early 1980s, the openness indicator has risen. Morrissey and Mold (2008) strongly argue that contrary to the conventional wisdom, the basic problem is not that Africa trades too little, or that the trade regime is excessively closed – rather that it is trading the wrong kind of products: primary commodities with low value, low prices and very low elasticity of demand on world markets.

Export taxes and severe quantitative restrictions are reduced in SSA countries but they have not driven significant benefits. Overdependence on (narrow range of) traditional commodity exports has been recognized as a major constraint to export-led growth in SSA (Morrissey and Mold, 2008). Diversification of agricultural production is seen as a priority for most of these countries because it is considered one of the possible ways out of that commodity dependence (Gioè, 2007). In this line of argument, Biggs (2007a) suggests that export diversification policies must focus on a mix of interventions designed (a) to improve factor advantage and (b) to improve incentives for entrepreneurship and investment in non-traditional commodities export. The second point is what the current section of the review and the paper as a whole will give much emphasis.

No universally accepted definition of non-traditional commodities exists. The common understanding, however, is that these commodities have relatively high-value (compared to the traditional or primary ones), i.e., they have higher elasticities of price and income. Takane (2004) attributed the difference to the relative recentness of export increase of these commodities in comparison with increases in traditional export crops such as cocoa, coffee and cotton. Nonetheless, Singh (2002) defines nontraditional crops as those that are not part of the customary diet of the local population and grown primarily for their high cash values and export potentials. According to the UN (2007), high value-added (non-traditional) agricultural products are defined as groups included in the following categories: meat and meat products; dairy products; fish, fish products and sea food; vegetables, roots and tubers, and preparations; fruit, nuts and fruit preparations; spices; live plants, cut flowers and foliage; and fixed vegetable oils and fats.

The lack of a conventional definition could be attributed partly to the fact that individual countries and groups differ in their export items. For instance, UNCTAD (2008) identifies three important areas of non-traditional exports for LDCs: horticulture, fishing and tourism. Guatemala's high-valued exports include cardamom (whose seeds are used as spice), vegetables, fruits, and flowers and plants (Braun, 1989). The most important Ugandan non-traditional agricultural exports are flowers, fresh and frozen fish, fresh fruit and vegetables, hides and skins, vanilla, sesame seed, and maize and beans (Dijkstra, 2001). It is recently seen that the major non-traditional exports of many LDCs are horticultural commodities which include various types of fruits, vegetables and floriculture (fresh and cut flower). Sub-Saharan Africa countries have a comparative advantage in a number of horticultural commodities due to their favorable climate, proximity to European markets, and cheap labor (World Bank, 2004:17).

Since the majority of non-traditional commodities of SSA are also agricultural, the main determinants of their supply for export do not basically differ from those of primary or traditional ones. Generally, these factors may fall into prices, nature and policies. Asopa (2006) summarizes all of these under competitiveness which is determined, among others, by favorable policy, efficiency at various stages, fair price proportional to quality, infrastructural availability (temperature and humidity controlled transportation and storage) and closeness to market. Recent policy shifts toward more market-oriented strategies in most African countries and diversification efforts of few of them, growing demand by European consumers and price competitiveness of African suppliers have contributed to the growth of the Africa's horticulture export sector (Takane, 2004).

From the success stories of four major SSA exporting countries, the World Bank (2004) pinpoints a wide range of factors influencing the development of horticultural exports. Among the factors which have positive roles include: investment in transportation, airport, and port infrastructure; efficient customs procedures; market information; extension service and farmer training; plant disease control; pesticide regulation; realistic exchange rate and access to foreign exchange; promoting competition in marketing and transport services; investment in varietal research in horticulture and post-harvest management; establishment of grades and standards; quality grading and certification; and creating a conducive investment and business climate.

In addition, government measures which are not conducive to private sector development consist of: direct participation in horticultural production and marketing; mandatory adoption of production methods or crops; price controls on commodities, inputs, or transportation services; administrative allocation of foreign exchange; over-valued foreign exchange; permanent subsidies on fertilizer and other inputs; and state monopolies in transport services (World Bank, 2004: 28).

Just like primary commodity export models, (empirical) analyses of export supply of non-traditional commodities date back to late 1950s. Nerlove and Addison (1958) open up the modeling endeavor on different vegetable varieties. They estimate long-run supply functions for onion, cabbages, carrots, tomatoes, cauliflower, spinach, *etc.* These models and others that emerge afterwards have however been attacked for being price-focused.

Non-traditional commodity export supply models which incorporate non-price factors then continue appearing in the literature. Because of the fact that Latin American and Caribbean countries have suitable conditions for the production of fruits and vegetables and that they were the pioneers in adopting structural adjustment policies, a number of export supply models have been developed since early 1990s. A few of them are: Farrell (1992) for tomatoes of Mexico, Bejarano *et al* (1993) for banana of Ecuador and Markussen and Lee (1994) for various types of fruits of eight Latin American countries.

Farrell's (1992) model stipulates Mexican tomato export supply to the U.S as a function of producer prices, minimum agricultural wage rate, one year lagged acreage, fertilizer prices and supply, weather, and price conditions in the U.S. The author uses these variables as measures of competitiveness of vegetable exports. Acreage is also dependent on a number of variables like growing and harvesting unit costs, average prices of other vegetables, *etc.* The coefficients are all significant. The results indicate that Mexican export supply response is influenced, in the short-run, predominantly by U.S supply conditions and prices. Production costs and weather conditions are observed to have an immediate, though small, impact on exports. Input costs, i.e., wage rates have no instant effect although in the long-run the influence of supply side factors becomes more important.

Bejarano *et al* (1993) use real effective real exchange rate and other price and non-price factors such as world prices adjusted to export taxes and transfers, annual minimum wage (a proxy for cost of production), and seasonal and weather dummies to model the Ecuadorian export supply of banana. The estimation results are however poor which could be attributed to (i) ignorance of a number of non-price factors and (ii) existence of autocorrelation.

The impact of stabilization and adjustment reforms on various fruit exports from individual Latin American countries is measured by Markussen and Lee (1994). It is assumed to be captured by the reform's effect on prices and exchange rates. Their model specifies fruit export supply solely in terms of these two variables, excluding other non-price determinants. Export response equations are estimated for each commodity-country combination. They are done for two time periods: first for 1961 (or proximate initial year) through the year prior to the initiation of the programs, and then for the entire time series through 1990. Estimated by OLS, the results show that price and exchange rate changes accompanying stabilization and structural adjustment reforms have positive but non-uniform effects on non-traditional agricultural export supply in Latin American countries.

Regarding the modeling of non-traditional export supply of SSA, Lukonga's (1994) model for rubber and palm kernel of Nigeria is worth mentioning. The model is of course investigated above as the author uses a single model for different export commodities. Value of exports (i.e. the dependent variable) and real exchange rate variables used in Bejarano *et al* (1993) are now substituted by quantity of exports and relative prices respectively. His major concern was to analyze the effect on non-traditional commodity export supply of domestic demand and obtained significant coefficients. According to Lukonga (1994), high domestic demand for these commodities reduces their quantity available for export.

There is no adequate literature on flower export supply modeling. The one available is Kihangire *et al* (2002). In an attempt to determine the effect of exchange rate variability on the export of Ugandan flower exports, the authors developed theoretical export supply, export demand, and

equilibrium and disequilibrium models. Flower export supply is initially considered as a function of relative prices (ratio of flower export price index to domestic price index), capacity utilization, real effective exchange rate, terms of trade and variability of exchange rate. In addition to the last three variables, ratio of flower export price index to world export price levels and income of major trading partners were set to determine demand for flower exports. However, based on the Hausman specification tests for simultaneous bias, no sufficient evidence of simultaneity is found between export supply and export demand via the relative export price variable. As a result, they estimate a single structural equation of flower export supply only.

Kihangire *et al* (2002) discover that although Uganda's flowers exports are negatively correlated with exchange rate variability, the measured effects are insignificant. The results also show a positive correlation between flower export supply and levels of exchange rate (with elasticity of response more than unity) and consistent with devaluation theory. Further, the elasticity of supply response of exports of flowers with respect to export prices relative to domestic price levels is found very high. The evidence suggests that the positive terms of trade elasticity of response goes in line with comparative advantage theory. Finally, the results for exports of flowers indicate a positive but insignificant response for capacity utilization of Uganda's industrial sector. Absence of appropriate lags and omission of other non-price factors might have contributed to the poor performance of the model in terms of significance of many explanatory variables.

3.4 Export Supply Determinants in Ethiopia

Supply response analyses in Ethiopia do not significantly go beyond 1990s. A number of contributions have started coming to the scene following the country's implementation of liberalization policies stirred by devaluation of the birr in 1992. In this section, the literature on the supply determinants of the country are surveyed from aggregate, traditional and non-traditional commodities points of view in that order.

Dejene (1994) outlines a number of non-price factors constraining aggregate supply response in Ethiopia. He discusses, with the aid of available literature, constraints related to innovations, institutions, land, labor, market imperfection, consumer goods inadequacy, rural infrastructure, producers' own consumption, nature, and draft oxen. On the other hand, the World Bank (1987) considers exchange rate overvaluation, low level of investment, the coffee surtax, inadequate marketing infrastructure, high raw material import tariffs, unfavorable terms of trade and insufficient adjustment of producer prices as the major obstacles of Ethiopian export performance. The Bank, using the Nerlovian method (Nerlove, 1956), estimated the short- and long-run aggregate supply elasticities at 0.24 and 0.56 respectively. However, Dejene (1994) note the difficulty of accepting these coefficients as they are much greater than the SSA averages and non-price variables are more binding in Ethiopia than in SSA.

According to Abay and Zewdu (1999), the major constraints of the Ethiopian export sector could be seen from demand and supply sides. On the demand side, they outline such problems as low level of demand for agricultural products (due to very slow population growth rate in industrial countries), low income elasticity of demand for primary exports, production of synthetic

products, and restrictive trade policies followed by importing countries. Type and composition of products, concentration of export markets in few countries, natural factors like drought and diseases, and poor domestic policies are among the supply side challenges of the Ethiopian export trade.

Relatively recent empirical efforts to identify the major determinants of Ethiopia's aggregate export performance are Berhanu (2005) and Mouz (2005). In Berhanu (2005), both short- and long-run relationships between the real exports of the country and various explanatory variables are specified and estimated using cointegration and ECM. The long-run model reveals that real exchange rate (positively), real private sector credit (positively) and real private consumption (negatively) determine the country's exports (all significant at 10 percent level). Similarly, the short-run factors significantly affecting exports are real GDP, real private sector credit and real private consumption with 51 percent coefficient of adjustment.

The model by Mouze (2005) specifies value of aggregate agricultural exports of Ethiopia as a function of real effective exchange rate (REER), terms of trade (ToT), infrastructure variable (measured by the percentage of paved road to total road), net value of world trade (i.e., Ethiopia's export value), agricultural input (fertilizer consumption) and a dummy to capture the impact of government change. Nonetheless, the ECM-based estimation results provide only REER, ToT and fertilizer consumption as the significant short-run and long-run determinants of agricultural export supply of the country.

The above two models have their own attributes: Berhanu's (2005) explicit treatment of the impact of domestic demand pressure on exports which was not much included in previous studies and Mouze's (2005) unsuccessful inclusion into modeling of government change.

Regarding the modeling of commodity-specific export supply in Ethiopia, we begin with coffee. These works include: Yoseph (1994), Asmerom (1999), Dercon and Lulseged (1994) and Tadesse (1995). While the first two focus on production (supply), the rest attempt to model export supply. Yoseph (1994), based on a survey in Gomma *Wereda* (district) of Jimma Zone, confirms the importance of land and labor in crucially and positively affecting coffee production (marketable surplus). However, the price effect is not only too minimal but also not significant at all relevant levels.

Asmerom (1999) goes further and runs two regressions of two dependent variables – sales or production and net new planting – using a panel of 276 small-scale coffee farmers for the years 1992, 1993 and 1994. These are explained by producer price, real exchange rate (RER), number of coffee trees, household labor, hired labor, and fertilizer and other chemical inputs. RER is defined in the study as the price ratio of tradables to non-tradables to capture the effect of devaluation. Fixed and random effect models are estimated. He also provides the basis for the estimation of long-run, short-run panel data models. It is obtained that devaluation positively and significantly affects both short-run and long-run coffee production (sales) as well as new planting of coffee trees. Household labor, hired labor and fertilizer have positive and significant effect only on coffee supply, but not on net new coffee planting.

Dercon and Lulseged (1994) model official coffee supplies on various relative prices and three dummies capturing the revolution period of 1974-76, the drought year of 1984 and the reform period after 1991. Relative prices are discriminated according to the ratio of official and smuggling (black market) coffee prices, of official coffee and smuggling *chat* prices and same ratios for the 1960s only. The perennial nature of coffee is acknowledged by taking three years lags of the relative prices at estimation stage. A single equation is used to capture both short- and long-run elasticities. The OLS estimation reveals that relative prices have a negative effect on coffee supply in the short- and long-run. However, no short-run effect of official coffee prices relative to black market *chat* prices is detected for the 1960s, nor any extra long-run effect for that period. The three dummies are significant and negative as expected.

Following Bond's (1987) approach, Tadesse (1995) specifies a general supply equation for Ethiopia's eleven export commodities. Ratio of price of exports to domestic CPI, an index of production capacity and a trend are used as independent variables. Eleven regressions are run, one for each commodity or group of related commodities. We here present the results of the coffee export supply regression, retaining the rest for later paragraphs. The coefficients of the explanatory variables are found to significantly affect coffee export supply. Both current and lagged export price elasticities however have unexpected signs.

Other commodities or their groups that have been analyzed concerning their export supply determinants and responses include oilseeds (Tadesse, 1995; Gebrelibanos, 2005) and *chat* (Tadesse, 1995; Mouze, 2005). For the case of oilseeds and pulses, Tadesse's (1995) model provides current export prices as the single significant variable with positive effect. Gebrelibanos (2005) finds that oilseeds export supply is affected positively by real exchange rate (both in the

long- and short-run), positively by weather (both in the long- and short-run) and negatively by cost of production (in the long-run only). He uses CPI as a proxy for cost of production and an ambiguously defined rainfall variable to measure weather.

Regarding *chat*, the model by Taddesse (1995) reveals export prices, productive capacity and trend variables as significantly influencing export supply. Mouze (2005) specifies the country's *chat* export supply (volume) as a function of a number of variables. However, only REER, real GDP and the infrastructure variable are finally obtained to be long-run determinants and real GDP short-run determinants of *chat* export supply.

The literature on export supply of Ethiopia's horticultural commodities is scarce. Those works which are available also yield no interesting outcomes. For instance, the regression results of Taddesse (1995) for export supply of fruits and vegetables do not provide any significant coefficients at good levels.

The export supply literature of flowers is the scarcest. This is not of course surprising given the recentness of the cut-flower industry in the country. The single modeling attempt available is Amin (2007). He, initially, specifies a log-linear cut-flower export function constituting both supply and demand side explanatory variables. The dependent variable is the quantity of cut-flower export. The right hand side variables are land under cut-flower production, trading partners' per-capita income, real effective exchange rate, revealed comparative advantage, export credit, and public investment to GDP ratio. The revealed comparative advantage variable is calculated based on Balassa's Index which simply takes the ratio of the share of a commodity in a country's total exports to the share of the same commodity in total world exports.

However, the OLS regressions produce the result that only revealed comparative advantage affects the country's cut-flower exports both in the short- and long-run, with (theoretically) expected positive sign. Other variables are found insignificant. The fact that Amin (2007) uses variables whose values are trivial (e.g. quantity of cut-flower export before early 1990s) and that other industry-specific factors are excluded might have led to the unsatisfactory performance of his model. The author uses estimation period beginning from 1986 during when there was no farm significantly exporting cut-flowers. In other words, as the industry flourishes only recently, annual data point time-series modeling results in biased and/or insignificant coefficients.

To summarize the review, the available literature provides a wide range of determinants of primary commodity export supply. In addition, both short-term and long-term responsiveness to the various factors are estimated. It has been noted that owing to the diverse features of commodities, economies and pursued approaches, the determinants vary. One might generalize the basic determining factors as internal and external, with the former consisting of nature- and policy-related factors.

Arguing that the export supply literature in the Ethiopian context is not enough seems sound. Even though a few contributions exist, the majority of them focus on coffee, although not surprising. Further, the available works have problems in terms of data as well as approach through specification. More specifically, almost no econometric effort of identifying the main factors influencing flower export supply has yet been made. So, it will be the responsibility of the current study to exert the possible endeavors to reduce those gaps in the literature.

CHAPTER FOUR

MODEL SPECIFICATION AND DATA

4.1 The Econometric Model of the Study

The literature survey of the previous chapter has provided us the ground for modeling export supply from a developing country's context. It however falls in short of providing one with specific approaches for cut-flower export supply specification. The paper is moving smoothly to produce a model that captures the determinants of Ethiopia's cut-flower export supply. An attempt is made to introduce a simple and parsimonious model. Consequently, the theoretical model of this study shall be developed based on simple economic theories and the scant empirical literature on non-traditional export supply.

There are studies like Were *et al* (2002) which specify export supply of and export demand simultaneously for individual exports of individual small countries. These studies use a single-equation for export by incorporating both supply and demand determinants or finally solve a reduced-form equation. However, unless the country is able to significantly influence world supply of the commodity, it is practically infeasible to pursue such an approach (See Lukonga (1994) and Kihangire *et al* (2002)). One may safely use those methodologies for aggregate exports from groups of exporting countries.

Therefore, it is important to note from the outset that the study sticks to the theoretical determinants of supply and thus pursues a single-equation approach. Non-price demand side determinants of exports are ignored since Ethiopia's flower exports are yet too small to affect the world's cut-flower market.

The theory of production states that labor and land are the important determinants of output supply. However, under a situation where there is no domestic demand, the determinants of output supply also determine export supply. As noted previously, the Ethiopian cut-flower industry is characterized by an almost zero domestic consumption. Except very insignificant consumption by a few rich local people and foreigners at Valentine's Day and some occasions, it is possible to argue that cut-flowers are produced in Ethiopia entirely for export to advanced countries. This is ascribed to the fact that these commodities possess high income elasticities of demand.

Following the above background, the simple model of export supply can be expressed as:

$$Y_s = f(L, S) \dots\dots\dots(4.1)$$

Where: Y_s = Supply of Cut-flower Export
 L = Labor
 S = Land.

The supply of cut-flower export variable is captured by the volume in kilogram exported of cut-flowers by each exporter. The labor variable here represents the number of permanent workers and temporarily employed laborers at farms. Land in the case of flower production is covered by greenhouses for quality produce. Floriculture farms may lease or rent large hectares of land but

all may not be implemented. The one under effective usage is part of the land which is greenhoused. This study thus considers the land covered by greenhouses as the land variable. Amin (2007) uses similar land variable for flower export supply and Asmerom (1999) includes labor and land to model coffee supply.

Nonetheless, a number of other domestic price and non-price factors exert their influences on flower exports of the country in addition to labor and land. Data accessibility problems however oblige us to consider only some of these factors. To begin with, production and transportation costs, through their impact on the profitability of producing and exporting farms, may affect export supply of cut-flowers. As production of cut-flowers requires use of some variable inputs from home, changes in the price of these inputs affect production and thus export supply. In this study, those effects are assumed to be captured by the domestic price index. Following Pollen (2008), nominal exchange rate, i.e. the birr/US\$ ratio value, also affects the motivation and birr receipts of exporters.

Transportation of cut-flowers to major international markets is also of enormous importance in modeling their export supply. This is discussed in Vega (2008). Due to the perishable nature of the commodities under consideration, costs of transportation are supposed to occupy a significant share of total export costs. We shall attempt to secure those effects by per-kilogram costs. Almost all flower exports are carried by the Ethiopian Air Lines. There are two major destinations: Brussels and Dubai. Since the major markets are found in Western Europe, large bulks of cut-flowers go to Brussels which are then distributed to other countries especially to the main Dutch flower auctions. The transportation cost variable is thus composed of the per-kilogram air (cargo) cost from Addis Ababa to Brussels and trucking costs to The Netherlands. Besides, following

Asopa (2006), the infrastructure in the country has its huge role to play in the export supply of cut-flowers. This is proxied by investment outlays on cold store and cargo developments at the cargo terminal of Bole International Airport.

Incorporating the variables discussed in the last two paragraphs to Equation (4.1) provides the following cut-flower export supply model:

$$Y_s = f(L, S, CPI, E, TC, IN) \dots\dots\dots(4.2)$$

Where: *CPI = Domestic Consumer Price Index*
 E = Nominal Exchange Rate (Birr/US\$)
 TC = Transportation Costs of Cut-flowers (US\$/kilogram)
 IN = Expenditure on Cold Store and Cargo Infrastructure (mil Birr)

And others are as defined previously in Equation (4.1).

Now, as exports primarily to developed economies, the external world has an important influence on the country’s cut-flower exports. Taking the small-country assumption (i.e., Ethiopia does not influence the global cut-flower market and hence is a price-taker), these effects are supposed to be engulfed by cut-flower export prices. As a result, Equation (4.2) becomes:

$$Y_s = f(L, S, CPI, E, TC, IN, P_x) \dots\dots\dots(4.3)$$

Where: *P_x = Cut-flower Export Prices*

And others are as defined previously in Equations (4.1) and (4.2).

We next determine which data type (time-series, cross-section or panel data) to use. It has been noted earlier that the cut-flower industry of Ethiopia has prospered very recently. Its performance before 2004 as compared to other exportables is negligible. The analysis should thus begin from 2005 which is the boom year of the industry. Hence, use of time-series analysis alone cannot be feasible since there might be a huge problem regarding the degree of freedom if annual data points are used. Quarterly and/or monthly data for all necessary variables are hardly available. To partly solve this problem, an alternative at this time is to consider a combination of data of both time-series (for years 2005 to 2008) and cross-section (of individual cut-flower exporting farms) – panel data modeling. The fundamental advantage of panel data analysis over others is that it allows the researcher great flexibility in modeling differences in behavior across individuals over time.

Accordingly, the variables of the previous models and a purposive combination of some of them could be expressed as a one way error-component panel data model given below:

$$Y_{it} = \beta_0 + \beta_1 \frac{E_t P_{it}}{CPI_t} + \beta_2 L_{it} + \beta_3 S_{it} + \beta_4 TC_t + \beta_5 IN_t + V_i + \varepsilon_{it} \dots\dots\dots (4.4)$$

for $i = 1, 2, \dots, 33$ and $t = 2005, \dots, 2008$

- Where:
- Y_{it} = Volume of Cut-flower Export of farm i during year t (kilogram)
 - E_t = Average Nominal Exchange Rate during year t
 - P_{it} = Cut-flower Export Price received by farm i during year t (US\$)
 - CPI_t = Domestic Consumer Price Index during year t
 - L_{it} = Hired Labor by farm i during year t

S_{it} = Land under Greenhouse cover owned by farm i during year t (hectare)

TC_t = Transportation Cost of Cut-flower during year t (US\$/kilogram)

IN_t = Expenditure on Cold Store and Cargo Infrastructure during year t

V_i = Exporting Farm Specific Residual

ε_{it} = an Error Term with the usual properties

i = denotes individual exporting farms

t = denotes time

β 's are the parameters to be estimated.

Even if defining real exchange rate is theoretically and practically complex, this study adopts the simple and traditional approach. It defines real exchange as the nominal exchange rate multiplied by the ratio of foreign to domestic price levels. However, this approach is general which may be applied to aggregate modeling and thus has a limited application to commodity export supply modeling. Following Alemayehu (2002) and Pollen (2008), the real exchange rate (RER) is defined using the variables accompanying coefficient β_1 of Equation (4.4). The previously defined export prices of cut-flowers (P_{it}) are used to replace foreign price level. Due to lack of data on general domestic price level, the domestic consumer price index (CPI_t) is used.

Consequently, RER in this study is defined as the nominal exchange rate multiplied by the ratio of cut-flower export price to domestic consumer price index. That is:

$$\frac{E_t P_{it}}{CPI_t} = \left(\frac{EP_i}{CPI} \right) = RER_{it} \dots\dots\dots (4.5)$$

Due to the fact that each exporter sells differentiated cut-flowers to different world markets, the real exchange rate varies from exporter to exporter and obviously over time. In order not to lose much degree of freedom, only current and one-period-lagged RERs are incorporated.

Finally, two dummy variables are incorporated in the last model. First, it is usually argued that being or working in joint with a foreign investor contributes much to export success and thus to export supply due to the outward-looking nature of the cut-flower industry. In order to account for such an effect, a form of ownership dummy variable in favor of foreign owned and joint ventured exporting farms is added. Second, as EHPEA provides market and other related information to its members, another dummy variable is also used to see whether association membership significantly affects export supply.

Inserting Equation (4.5) into (4.4) and considering lag RER and the dummy variables provide the following panel data model:

$$Y_{it} = \beta_0 + \beta_1 RER_{it}^+ + \beta_2 RER_{i,t-1}^+ + \beta_3 L_{it}^+ + \beta_4 S_{it}^+ + \beta_5 TC_t^- + \beta_6 IN_t^+ + \beta_7 D_{1i}^+ + \beta_8 D_{2i}^+ + V_i + \varepsilon_{it} \dots (4.6)$$

for $i = 1, 2, \dots, 33$ and $t = 2005, \dots, 2008$

Where: RER_{it} = Real Exchange Rate for farm i during year t and $RER_{i,t-1}$ is its lag

$D_{1i} = 1$, if farm i is foreign-owned / Joint Venture
 $= 0$, otherwise

$D_{2i} = 1$, if farm i is member of EHPEA
 $= 0$, otherwise

And others are as defined previously in Equation (4.4).

Equation (4.6) is the basic model of the study which shall be estimated ultimately using the estimators introduced in section 4.4. For the apparent reasons (of assuming non-linear relationship and interpreting the estimated coefficients as elasticities) natural logarithm of variables (except dummies) are taken during estimation.

4.2 Hypotheses on Expected Signs of Estimated Coefficients

The expected directions of the relationships between the dependent variable and the various explanatory variables are indicated by + and – symbols at the top of each independent variable in Equation (4.6). The upcoming paragraphs contain further explanations.

Real Exchange Rate (RER_{it}):

Let us first recall the definition of RER used in the study:

$$RER_{it} = \frac{E_t P_{it}}{CPI_t}$$

It is constituted by three variables. Firstly, when the average annual nominal exchange rate or the birr/US\$ ratio (E_t) increases, exporters get more domestic currency per each dollar received from abroad so that they supply more cut-flowers for export. Secondly, it is evident from the theory of supply that an increase in the export price of cut-flowers for each exporter (P_{it}) motivates more flowers to go to the international market. Lastly, changes in the domestic consumer price index (CPI_t) are associated inversely to exports as the effects are transferred to them via input costs especially wages. Put differently, when inflation increases, producers of exportables have to pay more wages to their laborers. This effect is likely to happen in cut-flower industry since it is characterized by a significant use laborers' time. All in all therefore, we expect a positive relationship between export supply and RER (i.e., estimated β_1 and β_2 will be positive).

Hired Labor (L_{it}):

The fact that cut-flower industry involves labor-intensive techniques at its various stages implies that hiring more workers makes more stems of cut-flowers available for export market. That is, the estimated sign of coefficient β_3 is expected to be positive.

Land under Greenhouse Cover (S_{it}):

Although it is costly to cover lands by greenhouses, when done, more flower plants can be cultivated and hence the farm can supply more stems of cut-flowers. Consequently, we expect the sign of the estimated β_4 to be positive.

Transportation Cost (TC_{it}):

This variable is similar across cross-sections since similar costs are charged per kilogram of cut-flowers for each exporter. That is, it is cross-section-invariant but may vary over time. As marketing costs, higher transportation costs discourage the supply of cut-flowers for export. This implies that β_5 will have a negative sign.

Infrastructure (IN_{it}):

Of the factors that boost production as well as export supply of commodities, infrastructural facilities come at the forefront. Since cut-flowers are more perishable than many other commodities, they are usually transported by air and require cold stores at airports. When the government and concerned bodies expand these facilities, more cut-flowers come to airports for export. In terms of our model, this means that the sign of estimated β_6 will be positive. Just like the transportation variable, the infrastructure variable is also cross-section-invariant.

Form of Ownership Dummy (D_{1i}):

This dummy variable is assumed to be time-invariant or constant over time. Transfers (from foreigner to Ethiopians or vice versa) since the initial period are assumed not to occur. The hypothesis for this variable is that foreign-owned or joint-ventured producer exporting farms significantly supply more cut-flowers (than those owned by Ethiopians) so that β_7 is positive after estimation.

EHPEA Membership Dummy (D_{2i}):

The association membership dummy is also assumed to be time-invariant. The membership data is taken from EHPEA in March 2009. Therefore, the time-invariant assumption disregards the occurrence that some farms may join the association too late or quit their membership before that month. A priori, it is expected that members supply more than non-members due to the market information provided by EHPEA so that estimated β_8 shall be positive.

4.3 Estimation Issues

4.3.1 Short-run, Long-run and Over-all Estimators

Estimation of short- and long-run elasticities of supply is an important task in export supply modeling. So, our basic model (Equation (4.6)) could be estimated for the short-run and the long-run. Following Asmerom (1999), a brief and simple procedure is presented below.

To proceed, let:

- ~ X_{it} denotes the set of all explanatory variables that vary over farms and over time. For our case, these variables are real exchange rate (current and lagged), hired labor and land under greenhouse cover;
- ~ Z_t denotes the set of explanatory variables which vary only over time. Included in this set are transportation cost and infrastructure variables; and
- ~ W_i denotes the set of explanatory variables that are constant over time. The variables of the original model of the study incorporated in this group are our two dummies: form of ownership dummy and EHPEA membership dummy.

Thus, Equation (4.6) may be re-written as:

$$Y_{it} = \alpha_0 + X'_{it}\alpha_1 + Z'_t\alpha_2 + W'_i\alpha_3 + V_i + \varepsilon_{it} \dots\dots\dots(4.7)$$

From Equation (4.7), it is easy to get the following from the means of the variables:

$$\bar{Y}_i = \alpha_0 + \bar{X}'_i\alpha_1 + \bar{Z}'\alpha_2 + \bar{W}'_i\alpha_3 + V_i + \bar{\varepsilon}_i \dots\dots\dots(4.8)$$

Where:

$$\bar{Y}_i = T^{-1} \sum_t Y_{it} ; \quad \bar{X}_i = T^{-1} \sum_t X_{it} ; \quad \bar{Z} = T^{-1} \sum_t Z_t ; \quad \bar{W}_i = T^{-1} \sum_t W_i ; \quad \bar{\varepsilon}_i = T^{-1} \sum_t \varepsilon_{it}$$

Equation (4.8) is known as a “between-effect”. It describes the response of a typical exporting farm over study period T_i and tends to provide the long-run export supply response. The between-effect or long-run response is based on the cross-section component of the data (Asmerom, 1999; Balatagi, 2005). This implies that the estimate of α_2 is hardly available since Z is constant across the i exporting farms. As a result, the intercept of the equation will be $\alpha_0 + \bar{Z} \alpha_2$. Our long-run model will be determined by ordinary least squares (OLS) in a regression of individual exporter averages of Y (export volume) on individual exporter averages of X and W (sets of explanatory variables).

Subtracting Equation (4.8) from Equation (4.7), we obtain:

$$\left(Y_{it} - \bar{Y}_i \right) = \left(X_{it} - \bar{X}_i \right) \alpha_1 + \left(Z_t - \bar{Z} \right) \alpha_2 + \left(W_t - \bar{W}_i \right) \alpha_3 + \left(\varepsilon_{it} - \bar{\varepsilon}_i \right) \dots\dots\dots(4.9)$$

Equation (4.9) is typically called “within-effect”. It is also known as “fixed-effects”. The information depicted in that equation gives a good insight into the short-run cut-flower export supply response to the corresponding determinants. The fixed-effects or the short-run model makes use of the time-series component of the data set. Because W is constant over time, one cannot find an estimate of α_3 so that the error term of Equation (4.9) captures the effect of variables which are time-invariant. In terms of the model of the study and statistical package terminology, form of ownership and association dummy variables will be dropped. The fixed-effects estimator shall be determined as the OLS estimator in a regression of deviations from individual means.

The overall effect or the “random-effects model” is obtained as a (matrix) weighted average of the long-run (between-effects) model, i.e., Equation (4.8) and the short-run (within- or fixed-effects) model, i.e., Equation (4.9). For some weight θ which is a function of the variances of residuals V and ε , this is given below:

$$\left(Y_{it} - \theta \bar{Y}_i \right) = (1 - \theta) \alpha_0 + \left(X_{it} - \theta \bar{X}_i \right)' \alpha_1 + \left(Z_i - \theta \bar{Z} \right)' \alpha_2 + \left(W_i - \theta \bar{W}_i \right)' \alpha_3 + (1 - \theta) V_i + \left(\varepsilon_{it} - \theta \bar{\varepsilon}_i \right) \quad ..(4.10)$$

Note that $V_i + \varepsilon_{it}$ of Equation (4.7) is now treated as an error term consisting of two components: an individual exporter-specific component V_i which is time-invariant and a remainder component ε_{it} which is assumed to be uncorrelated over time. It is assumed that V_i and ε_{it} are mutually independent and independent of Xs , Zs and Ws . This implies that OLS results in unbiased and consistent parameters. However, the composite error component structure of the model does not provide us efficient estimator (Verbeek, 2004: 348). Consequently, the random-effects model is estimated by generalized least squares (GLS) which is greater than OLS in terms of estimator efficiency.

It has already been noted that between-effects estimator discards the over-time information in the data in search of simple means and this makes the fixed-effects estimator to ignore variables that are time-invariant. The random-effects estimator however uses both the within and the between information. Therefore, the between- and within-effects estimators are less efficient than the random-effects estimator.

4.3.2 Static Panel Data Tests⁵

Testing for Heteroskedasticity and Autocorrelation

Panel data heteroskedasticity (non-constant error variance) and autocorrelation (serial error correlation) tests are relatively less complex for the fixed-effects model than the random-effects model. Since the fixed-effects estimator is also consistent in random-effects model, one may use the tests on the former and then apply the results for the latter. The between-effects estimation may similarly be used. The study has undertaken the Breusch-Pagan test for heteroskedasticity and the Bhargava, Franzini and Narendranathan modified Durbin-Watson test (Bhargava *et al* test hereinafter) for serial correlation using fixed- (within-) effects residuals. The test procedures as discussed in Verbeek (2004) are briefly presented below.

The auxiliary regression of the Breusch-Pagan test regresses the squared within residuals $\hat{\varepsilon}_{it}^2$ upon a constant and J variables p_{it} that we think may affect heteroskedasticity. The null hypothesis is presence of homoskedastic errors with an alternative: $\text{var}(\varepsilon_{it}) = \sigma^2 h(p_{it}'\gamma)$ where h is an unknown continuously differentiable function with $h(0)=1$, so that the null hypothesis tested can be restated as $H_0: \gamma = 0$. That is, under the null hypothesis, the test statistic is computed as follows and is compared with Chi-squared distribution: $\xi = N(T-1)R^2 \sim \chi_J^2$.

where R^2 is the goodness-of-fit of the auxiliary regression. Heteroskedasticity, if tested present, might be reduced by using logarithmic estimation and robust standard errors.

⁵ *The structure of the panel data set is obtained in such a way that the time period is small which obliges us to pursue a static (against a dynamic) approach. Further, panel data unit root tests could not be undertaken since most such tests are poor when the time dimension is small (Levin and Lin, 1993) so that panel cointegration and ECM approaches can not be used to capture long-run and short-run effects.*

Panel data autocorrelation test has the following alternative hypothesis in the fixed-effects model:

$\varepsilon_{it} = \rho\varepsilon_{i,t-1} + \nu_{it}$, where ν_{it} is independently and identically distributed across cross-sections and time which allows for presence of the same correlation coefficient ρ for each cross-section.

Consequently, the null hypothesis becomes: $H_0: \rho = 0$ (no autocorrelation) against the one-sided

alternative of either positive ($\rho > 0$) or negative ($\rho < 0$) autocorrelation. If $\hat{\varepsilon}_{it}$ denotes the residuals from the fixed-effects regression, Bhargava *et al* suggest the following modified

Durbin-Watson statistic:
$$dw_p = \frac{\sum_{i=1}^N \sum_{t=2}^T \left(\hat{\varepsilon}_{it} - \hat{\varepsilon}_{i,t-1} \right)^2}{\sum_{i=1}^N \sum_{t=1}^T \hat{\varepsilon}_{it}^2}.$$

The computed value of this statistic shall be compared with lower and upper bounds which are derived by Bhargava *et al* based on the true critical values that depend on the number of cross-sections N, time periods T and explanatory variables K only (Verbeek, 2004: 357).

Specification Tests

It has been noted in the above sub-section that the study uses three estimators: between-effects, fixed- (within-) effects and random-effects to capture the long-run, short-run and over-all impacts of determinants of cut-flower export supply, respectively. There is an element of purposive selection of estimators. Therefore, we undertake neither the Hausman nor the Breusch-Pagan specification tests to choose an estimator that best explains our data set. A pooling effect test against existence of individual effects (i.e., an F test which helps distinguish between pooled OLS and random-/fixed-effects estimators) is however undertaken.

4.4 The Data

The study is primarily based on secondary data sources. They are collected from the Ministry of Trade and Industry, Ministry of Agriculture and Rural Development, Ethiopian Revenue and Customs Authority, National Bank of Ethiopia, Ethiopian Horticulture Producer Exporters Association (EHPEA) and its members, the IMF's World Economic Outlook website, the World Bank's World Development Indicators CD-ROM, and other relevant documents and web addresses.

The variables used in the study together with their corresponding definitions and data sources are found in *Appendix 1*.

Since the study is concerned with a farm-level panel data analysis, drawing sample exporting farms is necessary. According to EHPEA, the number of member farms involved in production and export of horticultural commodities in Ethiopia has reached over 80 as of March 2009. From this figure, over 50 of them export rose flowers which account over 63 percent of the horticulture industry. Flower exporters data from MoTI however shows that the total number of farms has reached over 100 implying the existence of some non-members of EHPEA. From the total exporters, only 35 of them have begun exporting before or since 2005, the year which marks the potential of the country's cut-flower industry. These farms are checked whether they have been exporting until the end of 2008. Two farms fail to do so. As a result, a sample of 33 cut-flower exporting farms for years 2005 through 2008 is drawn. The sampling is done purposively in order to get a relatively larger cross-section and time-series combined (panel) data set.

CHAPTER FIVE

ECONOMETRIC RESULTS AND DISCUSSION

This chapter is devoted to presentation and discussion of the estimation results of our econometric model specified in the previous chapter. Those estimations will help us identify the factors which significantly affect Ethiopia's supply of cut-flower exports from its exporting farms. However, before making any presentation and discussion of the findings, it is important to test for heteroskedasticity and autocorrelation in our estimations. The test results are provided at the appendix to the study.

5.1 Determinants of Cut-Flower Export Supply

The random-effects estimator, which is the weighted average of between- and within-effects estimators, is capable of providing us with the general factors determining Ethiopia's cut-flower export supply from its exporting farms. The GLS regression results are summarized in *Table 5.1*.

It is shown that real exchange rate (RER) and its lag are both significant at 5 percent level with the current RER having an unexpected negative sign. Farms' land covered by greenhouses, government's outlays invested on cold store and cargo infrastructure and unit transportation costs are also found to have significant impacts at a higher 1 percent level. Expectedly, the first two have positive effects and the last is explored to affect cut-flower export supply negatively. Hired labor, form of ownership dummy and association membership dummy are however found to be

insignificant. In spite of this, the joint significance of the variables and their explanatory power are interesting. The Wald Chi-squared value 108.92, which tests the null hypothesis that the eight independent variables are jointly zero, is too big to confirm their relevance. The following discussions are made depending mainly on the signs and magnitudes of relationships between the dependent variable and its various independents.

Table 5.1 Regression Results of the Random-effects Model

| <i>Dependent Variable: lnCut-flower Export Supply</i> | | |
|---|---|------------------|
| <i>Estimation Method: Generalized Least Squares (GLS)</i> | | |
| <i>Period: 2005 – 2008; Cross-sections: 33</i> | | |
| <i>Independent Variable</i> | <i>Coefficient</i> | <i>t - ratio</i> |
| <i>Constant</i> | -2.060 | -0.54 |
| <i>lnRER</i> | -0.893** | -2.05 |
| <i>lnLagRER</i> | 0.597** | 1.99 |
| <i>lnL</i> | 0.292 | 0.92 |
| <i>lnS</i> | 1.327*** | 4.40 |
| <i>lnTC</i> | -7.072*** | -3.29 |
| <i>lnIN</i> | 2.641*** | 3.28 |
| <i>D_{1i}</i> | 0.155 | 0.59 |
| <i>D_{2i}</i> | 0.364 | 0.64 |
| <i>Joint Significance</i> | <i>Wald chi2(8) = 108.92, Pr > chi2 = 0.0000</i> | |
| <i>R²</i> | <i>Within = 0.4487, Between = 0.6118</i> | |
| | <i>Overall = 0.5174</i> | |

, ** and * show significance at 10%, 5% and 1% levels respectively.*

ln before a variable indicates use of natural logarithm.

From the estimation results, it is easy to observe that the proxy of infrastructure has the largest positive effect, other things remaining constant, on farm level cut-flower export supply followed by land covered by greenhouses. As discussed in the second chapter, cut-flower industry possesses both capital- and labor-intensive processes. The most important capital inputs are greenhouses at production stage and cold stores and transportation facilities at distribution stage. Therefore, the finding that cut-flower export supply responds positively and largely to infrastructure and greenhoused land is expected and highly welcome. The elasticities are more than unity for both. No adequate comparisons of the research findings of this study could be made with other studies mainly since they are either hardly available follow different approaches. Amin (2007), for instance, found insignificant infrastructure and land variables for the aggregate Ethiopian cut-flower exports in his time series analysis.

A positive but less-than-unity elasticity of 0.6 is reported for lagged RER which informs us the role of other non-price factors constraining exporting farms not to quickly respond to price signals. Producer exporters of cut-flowers are less responsive to changes in cut-flower own-export prices, nominal exchange rate and inflation which constitute the RER. Put differently, the competitiveness level of the country has not yet provided exporters with the possible confidence to supply. Even if he used real effective exchange rate, Amin (2007) obtained an insignificant coefficient for competitiveness. Kihangire *et al* (2002) however found very large supply elasticity of 6.11 for Ugandan aggregate flower exports.

To a larger extent, the farm-level cut-flower export supply is found to be negatively influenced by freight costs. The negative relationship is theoretically expected; since cut-flowers are perishable, they require special vehicles and cargo services which increase costs. However, the

finding of such a big elasticity (-7.1) is surprising taking into account the fact that air transportation unit costs, which constitute the largest share in freight costs, are largely subsidized. Following unit transportation costs, another negative influence on cut-flower exports comes from current real exchange rate. The previous small and positive export supply elasticity of 0.6 for lagged RER becomes negative with value of 0.9 for current RER. This strengthens the argument raised already.

The random-effects regression result of *Table 5.1* also reveals that hired labor, form of ownership and EHPEA membership affect farm level cut-flower export supply positively, even if the measured effects are insignificant. The outcome that the coefficient of hired labor is insignificant looks less plausible as laborers play pivotal roles in flower production and packaging. Nonetheless, this result is reverted by the between-effects estimator which we shall discuss in the next sub-section.

The finding that the two dummies are not significant may be justified. The form of ownership dummy in favor of foreign owned and joint ventured farms may be less important since it is possible for Ethiopian owned farms to employ foreign managers or Ethiopian farm owners may themselves be Diasporas who are aware of foreign markets and conditions. One may interpret this result in such a way that being a foreign investor does not matter for cut-flower export success or failure. Against the initial hypothesis that being an EHPEA member significantly contributes to export supply, the estimation unveils the opposite. This could have happened since non-members are small in number and thus get much of the export market information of EHPEA from individual members, the association's website and other sources.

In general, the Ethiopian farm level export supply of cut-flowers is determined significantly by real exchange rate, land covered by greenhouses, infrastructural facilities and unit costs of transporting the flowers to major international markets.

5.2 Short-run and Long-run Determinants and Elasticities

One of the standard tasks in export supply response analyses is identification of short-run and long-run determinants, if any, and computation of corresponding elasticities. Accordingly, of the explanatory variables included in our basic model of Equation (4.6), an attempt is made to pinpoint which of them significantly determine cut-flower exports in the short- and long-run. These are captured by estimating logarithmic form within- (fixed-) effects Equation (4.9) and between-effects Equation (4.8) respectively. The regression results are depicted in *Table 5.2*.

In the short-run, only three factors are found to be significant determinants: land under greenhouse cover and infrastructure at 1 percent and freight costs at 10 percent. Prices and hired labor are explored not to significantly affect the short-term response of cut-flower exporters. Since form of ownership and EHPEA membership dummies do not vary over time, they are excluded. All in all however, the model performs well as evidenced by the F statistic value of 11.04 which supports the alternative hypothesis of non-zero overall variables' significance.

The coefficient estimates of land and infrastructure variables are expectedly positive at best levels. Once again, changes in outlays on cold store and cargo development infrastructural facilities have produced the largest positive short-run response. Keeping other things constant, a 1 percent annual change in the deviation of sector-specific infrastructure investment outlay from

its mean value makes the deviation of farm level cut-flower export supply to change by 2.7 percent annually from its mean. The other higher and positive elasticity of greenhoused land is obviously expected. With a large value, transportation costs, like in the over-all estimator, influence short-term cut-flower exports negatively.

Table 5.2 Regression Results of the Short-run and Long-run Models

| <i>Dependent Variable: lnCut-flower Export Supply</i> | | | | |
|--|--|------------------|--|------------------|
| <i>Estimation Method: Ordinary Least Squares (OLS)</i> | | | | |
| <i>Period: 2005 – 2008; Cross-sections: 33</i> | | | | |
| <i>Independent Variable</i> | <i>Short-run Model</i> | | <i>Long-run Model</i> | |
| | <i>Coefficient</i> | <i>t - ratio</i> | <i>Coefficient</i> | <i>t - ratio</i> |
| <i>Constant</i> | -6.618 | -1.10 | 5.262*** | 2.82 |
| <i>lnRER</i> | -0.695 | -1.11 | -2.411** | -2.17 |
| <i>lnLagRER</i> | 0.390 | 1.20 | 2.222** | 1.94 |
| <i>lnL</i> | 0.205 | 0.60 | 0.837* | 1.81 |
| <i>lnS</i> | 2.598*** | 3.80 | 0.802** | 2.07 |
| <i>lnTC</i> | -4.226* | -1.70 | (dropped) | - |
| <i>lnIN</i> | 2.742*** | 2.80 | (dropped) | - |
| <i>D_{1i}</i> | (dropped) | - | 0.226 | 0.89 |
| <i>D_{2i}</i> | (dropped) | - | 0.333 | 0.56 |
| <i>Joint Significance</i> | <i>F(6, 92) = 11.04,</i> <i>Pr>F = 0.0000</i> | | <i>F(6, 26) = 8.45,</i> <i>Pr>F = 0.0000</i> | |
| <i>R²</i> | <i>Within = 0.4854</i> <i>Between = 0.5584</i> <i>Overall = 0.4674</i> | | <i>Within = 0.2568</i> <i>Between = 0.6611</i> <i>Overall = 0.3372</i> | |

, ** and * show significance at 10%, 5% and 1% levels respectively.*

The long-run estimation results reveal that four of the eight explanatory variables included are significant. Real exchange rate (both current and lagged), labor and land determine the supply response of cut-flower exporting farms in the long-term. Existence of insignificant dummies makes the between-effects estimator similar to the random- and fixed-effects estimators. Taken jointly, the coefficients are significant.

Current relative prices, proxied by real exchange rate received by cut-flower exporters, are found to have a big long-term negative impact on supply with elasticity exceeding -2.4. For a similarly defined RER, Pollen (2008) obtained a long-run elasticity of 0.25 for Zambian copper exports which becomes negative when its lag is included. The inverse relationship between RER and cut-flower export supply with such relatively large magnitude might occur because of the persisting inflation outweighing other prices (export prices and nominal exchange rate) which positively affect export supply.⁶ For farms to respond in the long-term, they need appropriate timing for adjustment. This is evidenced by a positive estimate of lagged RER in our long-run model with elasticity amounting to 2.2. An important thing that makes the between-effects regression different from those of random- and fixed-effects is that it provides significant estimate for hired labor. Export supply elasticity with respect to labor, albeit it is less-than-unity (0.84), is found to be greater than that with respect to land (0.80).

In summary, our estimations discover that land, transportation costs and infrastructure are important determinants of cut-flower export supply of Ethiopian farms both in the short- and long-run. Real exchange rates and hired labor are also found to additionally determine the long-

⁶ Recall that domestic consumer price index (whose percentage change shows inflation), export prices of cut-flowers and nominal exchange rate are constituents of RER in this study.

run response. However, Amin (2007) obtained an ambiguously defined revealed comparative advantage as the only short-run and long-run determinant of the country's aggregate cut-flower exports.

5.3 Comparing Results of the Estimators

Under certain conditions, four (usually) different estimators (systems) may be fitted for any panel data set: pooled OLS, random-effects, between-effects and fixed-effects. Comparing their results provides one with a better observation of the matter under analysis. Various tests are also available to determine which of these fits the data set on hand unless no purposive selection is made by the researcher. The estimation results of the above four systems are summarized in *Table 5.3* with the required tests' results beneath the corresponding system.

To begin with, the variables of the four estimators are all jointly significant. All that is known about the random-effects estimator is its asymptotic properties, so rather than reporting an F statistic for overall significance, it reports a chi-squared statistic. The F and chi-squared (for random-effects) statistics test that the coefficients on the regressors $\ln RER$, $\ln Lagged RER$, . . . , *Membership dummy* are all jointly zero. The results of these tests show that all of our four estimators are significant. We have already found out that our estimators suffer from heteroskedasticity problem (as indicated by the Breusch-Pagan test's chi-squared statistic of 23.196) so that robust standard errors are applied. However, the Bhargava *et al* modified Durbin-Watson (autocorrelation test) statistic of 1.862 tells us that serial-correlation is not as such a threat to our estimators.

Table 5.3 Pooled OLS, Random-, Between- and Fixed-effects Models Compared

| <i>Dependent Variable: lnCut-flower Export Supply</i> | | | | |
|---|-------------------------------|---|---|---|
| <i>Estimation Method: GLS (for Random-effects) and OLS (for Others)</i> | | | | |
| <i>Period: 2005 – 2008; Cross-sections: 33</i> | | | | |
| <i>Independent Variable</i> | <i>Pooled OLS Coefficient</i> | <i>Random-effects Coefficient</i> | <i>Between-effects Coefficient</i> | <i>Fixed-effects Coefficient</i> |
| <i>Constant</i> | -2.580 (-0.67) | -2.060 (-0.54) | 5.262*** (2.82) | -6.618 (-1.10) |
| <i>lnRER</i> | -0.920** (-2.24) | -0.893** (-2.05) | -2.411** (-2.17) | -0.695 (-1.11) |
| <i>lnLagRER</i> | 0.617** (1.92) | 0.597** (1.99) | 2.222** (1.94) | 0.390 (1.29) |
| <i>lnL</i> | 0.390 (1.23) | 0.292 (0.92) | 0.837* (1.81) | 0.205 (0.62) |
| <i>lnS</i> | 1.175*** (4.23) | 1.327*** (4.40) | 0.802** (2.07) | 2.598*** (3.83) |
| <i>lnTC</i> | -7.617*** (-3.31) | -7.072*** (-3.29) | (dropped) | -4.226* (-1.70) |
| <i>lnIN</i> | 2.761*** (3.30) | 2.641*** (3.28) | (dropped) | 2.742*** (2.88) |
| <i>D_{1i}</i> | 0.17 (0.77) | 0.155 (0.59) | 0.226 (0.89) | (dropped) |
| <i>D_{2i}</i> | 0.436 (0.90) | 0.364 (0.64) | 0.333 (0.56) | (dropped) |
| <i>Joint Significance</i> | $F(8, 122)=16.45$ | $chi2(8)=108.92$ | $F(6, 26) = 8.45$ | $F(6, 92) = 11.04$ |
| <i>R²</i> | 0.5189 | Within = 0.4487 Between=0.6118 Overall=0.5174 | Within = 0.2568 Between=0.6611 Overall=0.3372 | Within = 0.4854 Between=0.5584 Overall=0.4675 |
| <i>F Test (Pooled vs. Fixed/ Random)</i> | | | | $F(32, 92)=1.94$ $Pr>F=0.0077$ |
| <i>Heteroskedasticity Test</i> | | | | $chi2(6) = 23.196$ |
| <i>Autocorrelation Test</i> | | | | $dw_p = 1.862$ |

*, ** and *** show significance at 10%, 5% and 1% levels respectively.

t - ratios in parentheses.

Our estimators' goodness-of-fits may be contrasted to a certain extent. Between-effects estimator maximizes R^2 -between and the fixed-effects maximizes R^2 -within. That is, the fixed-effects estimator results in the largest within R^2 and thus explains the within (over-time) variation better than any other estimator. For instance, R^2 -between (= 0.6611) of the between-effects estimator is greater than R^2 -between (= 0.5584) of the fixed-effects estimator. The reverse happens for the R^2 -within. All R^2 's of the random-effects estimator are difficult to be compared with others; they however explain reasonably in all dimensions. The R^2 -between of the between-effects and the R^2 -within of the fixed-effects estimator are identical to the ordinary R^2 so that they are comparable to the pooled OLS' R^2 . While the between-effects estimator explains more than the pooled OLS, the fixed-effects estimator does less.

It is not difficult to notice from the table that the number of significantly estimated coefficients and their signs in the pooled OLS and random-effects are just similar. The magnitudes of these elasticities are also almost identical, the pooled OLS ones being slightly higher. They produce the result that real exchange rates, land, transportation costs and infrastructural facilities significantly determine cut-flower export supply.

Against the closeness of the pooled OLS and random-effects elasticities, the F test, which tests the null hypothesis that cross-section (individual farm) effects are zero, confirms that random- and/or fixed-effects estimator is appropriate for our data set. That is, since there are individual effects, the pooled OLS estimator is not relevant for our basic model. Our previous discussions for the random-effects, fixed-effects and between-effects estimators are therefore based on correctly specified estimations.

We can also read from our results that greenhouse covered land is significant in all of our estimations with high and positive elasticity. Its short-run influence is the largest. The between-effects and the random-effects estimators yield three common determinants: higher pressure is exerted on flower export supply by real exchange rates in the former and by greenhoused land in the latter. Similarly, infrastructure and land generate larger and freight costs lower responses in the fixed- than in the random-effects estimator. Comparing the fixed- and between-effects estimators, we observe that greenhoused land has higher elasticity in the short-run than in the long-run.

CHAPTER SIX

CONCLUSIONS AND IMPLICATIONS

6.1 Conclusions

Ethiopia, like many other sub-Saharan African countries, has for long been dependent on primary commodities to partially meet its foreign exchange demand. Owing to both internal and external factors, these traditional exports could not however satisfy the ever increasing demand. Diversification of exports to those having relatively higher values, usually called non-traditional commodities, has been an important policy option and embarked on in different times. Even if such efforts avail no significant and sustainable outcomes yet, the recent cut-flower export performance is attention-grabbing.

This study has made an attempt to identify the factors that determine export supply of cut-flowers from Ethiopia. The descriptive analysis initially points out that the natural environment in Ethiopia is suitable for the production of various types of flowers. It is also indicated that the sector-specific policy environment has become more conducive than before. Consequently, cut-flower exports have grown significantly especially since 2005. Cut-flowers, which were almost unknown before 2003, have become the fourth major foreign currency earners for the country in 2008. Disaggregating the export performance by individual farms indicates dominance by a few of them. It has been finally noted from the descriptive analysis that cut-flower export supply from farms can be explained by the proportion of land covered by greenhouses.

The econometric analysis of the study consists of three estimations of a panel data model using random-, between- and fixed-effects estimators. The results generally reveal that both price and non-price factors explain cut-flower export supply from farms. The country's cut-flower exports are found responsive to factors of production such as labor and land. The Government's incentives provided to the horticulture sector in general and the cut-flower industry in particular as well as market incentives (price and costs) are also other important determinants. All of our estimations however indicate that foreign ownership of a farm and its being an EHPEA member do not significantly contribute to export supply.

Firstly, the over-all determinants as captured by the random-effects estimation are real exchange rate (used to represent relative prices), land covered by greenhouses, infrastructural facilities and unit costs of transporting the flowers to major international markets. The finding that current relative prices negatively and lagged ones weakly positively affect export supply indicates that the competitiveness level of the country has not yet provided exporters with the possible confidence to supply. This also implies that non-price factors are more influential than prices. This is evidenced by very large supply responses with respect to investments on cold store and cargo developments infrastructure and transportation costs.

Secondly, the short-run significantly determining factors, obtained from fixed-effects estimation, are land under greenhouse cover, infrastructure and freight costs. Price factors are not found to explain the short-run behavior of cut-flower suppliers. Consistent with theory, land and outlays on industry-specific infrastructural facilities positively affect supply with fairly large magnitudes. Transportation costs, although to a lesser extent than in the over-all estimation, have a negative impact on the short-run supply of Ethiopian cut-flower exports.

Lastly, the between-effects estimation reveals that relative prices, hired labor and land are the most important factors determining cut-flower export supply in the long-run. Lower elasticity with respect to land is estimated in the long-run than in the short-run. Contrary to theory that labor is a variable input, it is found affecting supply in the long-run than in the short-run with an inelastic coefficient. This should not however be surprising given the labor-intensive nature of the industry under investigation.

6.2 Implications and Future Research

Implications

Success in export sector, under unchanged external environment, requires the government and exporters as well as other stakeholders to work hand-in-hand. Taking this into account, the findings of the study help us draw the following implications which might be useful for the cut-flower export industry in Ethiopia:

- ♣ Macroeconomic stability, usually ascribed to inflationary pressures, is obviously important for any industry to work properly. The study results provide more emphasis for non-price factors. However, the finding that real exchange rate negatively and/or inelastically affects exports might imply the hazardous impact of inflation. Since costs of living increase with inflation, these impacts may also indirectly affect cut-flower export supply through labor, an important input for the industry. It is therefore of paramount importance to work on stabilizing the economy. Put differently, policies that maintain competitiveness (such as by lowering domestic inflation) might benefit Ethiopian supply of cut-flower exports.

- ♣ Setting up of reasonable worker payment system is important in order to get the full advantage from hired laborers. It is mandatory to complement this with provision of safe working environment. Due to massive use of agro-chemicals, cultivation of flowers requires workers' safety materials whose supply failure reduces the long-term demand for the job by workers. Very importantly, the finding that hired labor is crucial for long-run supply also necessitates provision of adequate educational and technical training facilities for workers of the industry.

- ♣ The results of the study have additional implications for land implementation and administration and natural resource use. It is found that land is an important factor determining export supply (from the econometric analysis) but at the same time it is less implemented (from the descriptive analysis). Consequently, continual government follow-up of farms is required to effectively implement their land (i.e., cover with greenhouses) or return that which is not implemented. It is at the same time necessary to control land over-exploitation for sustainable benefit from the resource.

- ♣ Infrastructural developments, especially horticulture sector-specific facilities like cold transportation and storage, are of paramount importance for flower exports growth. The study's positive and large elasticity for infrastructure has an important further implication that much emphasis must be given to the allotment of enough outlays for the construction of cold stores in such airports as Bahir Dar, Mekelle and others whose surroundings are studied suitable for flower and horticulture production. The government should give due emphasis for the provision of other infrastructural facilities such as roads, power and water supply which are yet found at their poor levels of quantity and quality.

Future Research Indications

Even if its pioneering effort of applying panel data econometric analysis for the country's cut-flower export supply may be appreciated, this study has to raise more questions than answers. Owing to its infancy, the industry requires more in-depth studies than this. The fact that the government is investing and forgoing much money, taking into account future benefits from the cut-flower industry in particular and the horticulture sector in general, demands sustainability issues. This, being beyond the scope of the current study, is an important future research agenda. As flower production is characterized by huge use of fertilizers and agro-chemicals, the sustainability issue may be expanded by investigating the impact of these inputs on natural resources and the environment.

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APPENDICES

Appendix 1 Variables' Definition and Their Sources

| <i>Variable</i> | <i>Definition</i> | <i>Data Source</i> |
|----------------------|--|--|
| <i>Y</i> | <i>Cut-flower Export Supply (kg)</i> | <i>MoTI</i> |
| <i>E</i> | <i>Nominal Exchange Rate (Birr/US\$)</i> | <i>NBE</i> |
| <i>P</i> | <i>Weighted Average of Prices of Cut-flowers (US\$/kg)</i> | <i>MoTI</i> |
| <i>CPI</i> | <i>Domestic (Ethiopian) Consumer Price Index (Average Annual Percentage Change)</i> | <i>IMF</i> |
| <i>RER</i> | <i>Real Exchange Rate</i> | <i>Constructed based on E, P and CPI</i> |
| <i>L</i> | <i>Number of Hired Laborers</i> | <i>EHPEA and Exporting Farms</i> |
| <i>S</i> | <i>Land under Greenhouse Cover (Hectare)</i> | <i>MoARD and EHPEA</i> |
| <i>IN</i> | <i>Outlays on Cold Store and Cargo Development Infrastructure at Bole International Airport (Million Birr)</i> | <i>EAL</i> |
| <i>TC</i> | <i>Transportation Cost (Air to Brussels, Belgium and Tracking to Dutch Auctions) (US\$/kg)</i> | <i>Meskel Flowers PLC</i> |
| <i>D₁</i> | <i>Form of Ownership Dummy =1, if a farm is foreign-owned/Joint Venture =0, otherwise</i> | <i>EHPEA</i> |
| <i>D₂</i> | <i>EHPEA Membership Dummy =1, if a farm is member of EHPEA =0, otherwise</i> | <i>EHPEA</i> |

Appendix 2 Descriptive Statistics of Variables

| <i>Variable</i> | <i>Mean</i> | <i>Std. Dev.</i> | <i>Min</i> | <i>Max</i> | <i>Observations</i> |
|----------------------|-------------|------------------|------------|------------|---------------------|
| <i>Y</i> | 285805 | 363949.40 | 160 | 2057282 | 132 |
| <i>RER</i> | 2.39 | 1.08 | 0.73 | 8.81 | 132 |
| <i>L</i> | 265.72 | 158.54 | 26.00 | 750.00 | 132 |
| <i>S</i> | 10.13 | 6.86 | 1.50 | 41.00 | 132 |
| <i>TC</i> | 2.20 | 0.22 | 1.80 | 3.10 | 132 |
| <i>IN</i> | 289.00 | 93.26 | 154.00 | 405.00 | 132 |
| <i>D₁</i> | 0.58 | 0.50 | 0.00 | 1.00 | 132 |
| <i>D₂</i> | 0.94 | 0.24 | 0.00 | 1.00 | 132 |

Appendix 3 Correlation Matrix of Independent Variables

| | <i>lnRER</i> | <i>lnL</i> | <i>lnS</i> | <i>lnTC</i> | <i>lnIN</i> | <i>D₁</i> | <i>D₂</i> |
|----------------------|--------------|------------|------------|-------------|-------------|----------------------|----------------------|
| <i>lnRER</i> | 1.0000 | | | | | | |
| <i>lnL</i> | -0.2686 | 1.0000 | | | | | |
| <i>lnS</i> | -0.0854 | 0.5409 | 1.0000 | | | | |
| <i>lnTC</i> | 0.5106 | -0.4399 | -0.4513 | 1.0000 | | | |
| <i>lnIN</i> | 0.5564 | -0.5217 | -0.4312 | 0.5226 | 1.0000 | | |
| <i>D₁</i> | 0.0901 | 0.0277 | 0.0386 | 0.0113 | 0.0000 | 1.0000 | |
| <i>D₂</i> | -0.0093 | 0.3163 | 0.3558 | 0.0034 | 0.0000 | -0.2180 | 1.0000 |

Appendix 4 Test Results

In the Breusch-Pagan test for heteroskedasticity discussed in the text, the auxiliary (OLS) regression of the squared fixed residuals provides an R^2 value of 0.2343. Since we have $N = 33 =$ number of cross-sections (i.e. exporting farms) and $T = 4 =$ number of years, the test statistic is computed as:

$$\xi = N(T - 1)R^2 = 33 * (4 - 1) * 0.2343 = \underline{\underline{23.1957}} \sim \chi_8^2.$$

The figure is large enough to reject the null hypothesis of homoscedasticity implying presence of heteroskedastic errors in our estimators (variance of errors differs widely across exporting farms).

Since the heteroskedastic errors are obtained from a logarithmic fixed-effects estimator, our next measure of reducing the heteroskedasticity is use of robust standard errors. Therefore, the estimations and discussions are based on heteroskedasticity corrected or robust standard errors.

Regarding autocorrelation, a modified Bhargava et al Durbin-Watson statistic is computed and compared to bounds: $dw_p = 1.862$. This value supports the null hypothesis of no autocorrelation in our estimators.

Appendix 5 Exporting Farms Included in the Sample of the Study

| | | | | | |
|----|------------------------------|----|-----------------------|----|------------------------|
| 1 | <i>A Flowers</i> | 12 | <i>Golden Rose</i> | 23 | <i>Minaye</i> |
| 2 | <i>Abyssinia Flowers</i> | 13 | <i>Holetta Roses</i> | 24 | <i>ODA Flowers</i> |
| 3 | <i>AQ Roses</i> | 14 | <i>J.J. Kothari</i> | 25 | <i>Rose Ethiopia</i> |
| 4 | <i>Dire Highland</i> | 15 | <i>Jerico Flowers</i> | 26 | <i>Seit Agro</i> |
| 5 | <i>Dugda Floriculture</i> | 16 | <i>Joe Flowers</i> | 27 | <i>Sheba Flowers</i> |
| 6 | <i>DYR Business</i> | 17 | <i>Joy Tech</i> | 28 | <i>Spirit</i> |
| 7 | <i>Enyi Ethio Rose</i> | 18 | <i>Linssen Roses</i> | 29 | <i>Summit</i> |
| 8 | <i>ET Highland</i> | 19 | <i>Mam Trading</i> | 30 | <i>Supra Floritech</i> |
| 9 | <i>Ethio Agri CEFT</i> | 20 | <i>Menagesha</i> | 31 | <i>Tal Flower</i> |
| 10 | <i>Ethio Dream</i> | 21 | <i>Meskel Flowers</i> | 32 | <i>Top Flower</i> |
| 11 | <i>Ethiopia Magical Farm</i> | 22 | <i>Metrolux</i> | 33 | <i>Ziway Roses</i> |




Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university, and that all source of materials used for the thesis have been duly acknowledged.

The examiners' comments have been dully incorporated.

Declared by:

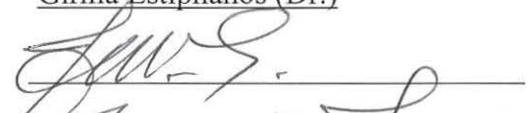
Name: Getachew Yirga

Signature: 

Date: 30/06/2009

Confirmed by Advisor:

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Date: June 30/2009

Place and date of submission: Addis Ababa, 30/06/2009