Econometric analyses of horticultural production and marketing in Central and Eastern Ethiopia

Promotor:	Prof. dr. ir. A.J. Oskam Hoogleraar Agrarische Economie en Plattelandsbeleid Wageningen Universiteit
Co-promotoren:	Dr. ir. C. Gardebroek Universitair Docent Leerstoelgroep Agrarische Economie en Plattelandsbeleid Wageningen Universiteit
	Dr. Tassew Woldehanna Assistant Professor at Department of Economics, Addis Ababa University, Ethiopia.
Promotiecommissie:	Prof. dr. ir. E.H. Bulte, Wageningen Universiteit Prof. dr. K. Karantininis, University of Copenhagen, Denmark Prof. dr. R. Ruben, Radboud Universiteit Nijmegen Dr. A. van Tilburg, Wageningen Universiteit

Dit onderzoek is uitgevoerd binnen de onderzoeksschool Mansholt Graduate School of Social Sciences

Moti Jaleta Debello

Econometric analyses of horticultural production and marketing in Central and Eastern Ethiopia

Proefschrift

ter verkrijging van de graad van doctor
op gezag van de rector magnificus
van Wageningen Universiteit
Prof. dr. M.J. Kropff
in het openbaar te verdedigen
op maandag 12 februari 2007
des namiddags te 13:30 uur in de Aula.

Econometric analyses of horticultural production and marketing in Central and Eastern Ethiopia.
PhD Thesis Wageningen University. -With ref. – With summaries in English and Dutch
Moti Jaleta Debello, 2007
ISBN: 90-8504-537-1

Key words: vegetables, food and cash crops, land and labour allocations, crop and market outlet choice, price information, farm households, Ethiopia.

To my grandma, Warqitu Fufa
(*circa 1910-2003)*

ABSTRACT

The central item of this research is to examine the development of less-favoured areas through commercializing small-scale agriculture that produces crops with export potential, particularly in horticulture.

First, the role of horticulture, along with other non-traditional agricultural commodities, in stabilizing the export income of Ethiopia is analyzed using a portfolio approach. Next, farm household land and labour allocation decisions to cash and food crop production are investigated using household survey data collected from Central and Eastern Ethiopia. Using the same survey data, crop and market outlet choice interactions at household level are analyzed to examine the impact of institutional arrangements on agricultural commercialization. Finally, farmers' bargaining power on tomatoes transacted at farm-gate under asymmetric price information is examined.

The study shows that horticultural products may stabilize export income at the macro-economic level and therefore it is worthwhile to explore the possibilities for growth of this sector. At household level, farm capital and motor pump ownership are the major elements, among others, influencing land and labour allocation decisions to cash crop production. For some cash crops, there is interdependence between the share of land allocated to a given crop and the share of the specific crop harvest sold at a farm-gate implying that institutional arrangements influence household crop choices and the level of commercialization. Results from the bargaining power analysis show that well informed farmers are more committed to their initial ask prices than other farmers during tomato price negotiations at a farm-gate. This implies that market price information enhances farmers' bargaining power on prices.

In general, institutional arrangements that enhance small-scale farmers' working capital, secure the existence of market outlets for vegetables and provide price information are needed to influence farm household land and labour allocation decisions towards cash crop production. The findings of this thesis help to understand the process of moving towards commercialized small-scale agriculture to bring rural development and better welfare to the rural poor and particularly for those living in less-favoured areas.

Key words: vegetables, food and cash crops, land and labour allocations, crop and market outlet choice, price information, farm households, Ethiopia.

ACKNOWLEDGEMENT

There are many individuals and institutions who contributed towards finalizing my PhD study and writing this thesis. Without their support, it would not be in this format this time. If I forgot to mention someone, it is not intentional and I am of course grateful to you all.

My warmest gratitude goes to my promoter Prof. Arie Oskam for accepting me as a PhD student and giving me critical comments starting from the draft research proposal till the final thesis script. Second, I would like to thank my co-promoter and daily supervisor Dr. ir. (Koos) Cornelis Gardebroek. Thank you Koos for keeping your office open any time I needed your help, for giving me critical and constructive comments on all of the chapters in this work, and for translating the summary of this thesis into Dutch. I also benefited from my co-promoter Dr. Tassew Woldehanna's comments on the research proposal, questionnaire development and during the final work on my thesis. Thank you Tassew a lot. I would also like to thank Dr. ir. Rien Komen with whom I started to work my PhD and who contributed a lot in giving a good direction to my research and later shifted to another job in the same University. Thanks Rien for allowing me to have the freedom of choosing my research areas. All Agricultural Economics and Rural Policy Group members deserve thanks for giving me their constructive comments during group presentations and for the good working atmosphere. Thanks to Dineke and Karen for organizing my travels and other administrative things, Wilbert for computer assistances, Henny, Ineke and Ingrid for your cooperation related to my PhD research project.

Difficult to choose where to start but my deepest gratitude goes to my Dutch contact family living in Bennekom: Rini and Gerrit Breman along with their family members (Bas, Anna, Machteld, Michel, and Benjamin). Your concern and care about myself and my family remains with me. Rini and Gerrit, our discussions on philosophy and principles of life had a lot of impact on how I should look at this world and myself in the world. A lot of thanks for inviting my wife and daughter for a three months stay in the Netherlands and hosting three of us at your house. Thanks for inviting me to live with you and hosting me for more than nineteen months at your home. That is very special of you. God bless you!

I would also like to thank Mirjam Oskam (with Arie) for the special Sunday morning breakfasts you have been organizing for international PhD students. It was a great opportunity for us to socialize with our professor outside the academic world, share experiences with each other and enjoy the long breakfast, *brunch*.

Obboleewwan maatii koof gargaarsa gochaa turtan, Amanuu, Waaqtolee, Dambalaa, Amsaaluu, Garbaa, Dr. Addunyaa, Obbo Gabayyoo Tarfaa fi maatii isaanii, Isheetuu, Tigist, Faxxanaa, Xiyyee, Fayyoo, Katamaa, fi bilbilaan humna anaaf kennitan, Mulunaa, Tafarraa, Diroo, Dhugaasaa, Misgaanuu, Bayyanaa, Dachaasaa fi kanneen biroon hundi keessan hedduu galatooma, Waaqayyo isin haa eebbisu.

I would like to acknowledge enumerators who helped me in data collection and farmers both around Haro-Maya and Ziway, who devoted their time in giving answers to the survey questionnaire. I am grateful to Ato Fituwi Tedla and Ato Neway, who are employees of the Ethiopian Horticultural Development Enterprise at Addis Ababa, for their valuable support in recording the daily tomato wholesale price data at the central

vegetable market and for their valuable discussions on the current status of horticultural marketing in the country. Thanks to the Ethiopian Customs Authority and Ethiopian Export Promotion Agency for providing export data for this study.

I am also thankful to my parents, Chaltu Tufa and Jaleta Debello, for sending me to school and keeping me there with great encouragement. I see this academic achievement as a great success to you as well.

My sincere thanks go to Shibire (my wife) for your understanding, encouragement and bearing the family responsibilities throughout my study and particularly while I was abroad. Thanks Jalane (my daughter), Roba and Robera (my twin sons) for your understanding and patience when I was away from home. With God's help, this is a turning point to be with you and build up our family life.

Finally, thanks to the Almighty God for making possible the once 'impossible' dream I had in mind some thirteen years ago. When all the possible gates seem closed, all these academic achievements in such a short time were not more than a dream if not an illusion at all. Thanks God for giving me the endurance, determination and guidance throughout the valleys and mountains of life. With your light, I saw my way!

November 2006, Wageningen

TABLE OF CONTENTS

ABSTRACT i

ACKNOWLEDGEMENT iii

LIST OF TABLES viii

LIST OF FIGURES ix

CHAPTER 1 INTRODUCTION 1

1.1 Background 1

1.2 Problem statement 3

1.3 Objective of the thesis 4

1.4 Methodological approach and data 5

1.5 Thesis outline 6

CHAPTER 2 DESCRIPTION OF THE STUDY AREA AND SURVEY DATA 7

2.1 Introduction 7

2.2 Description of the study area 7

2.3 Institutional arrangements 9

2.4 Survey data description 12

CHAPTER 3 THE ROLE OF NON-TRADITIONAL AGRICULTURAL COMMODITY EXPORTS IN ATTAINING EXPORT EARNINGS STABILITY 15

3.1 Introduction 15

3.2 The performance of Ethiopia's export sector 16

3.3 Data and analysis 19

3.4 Results of empirical analysis 22

3.5 Discussion and conclusions 26

CHAPTER 4 LAND AND LABOUR ALLOCATION DECISIONS IN THE SHIFT FROM SUBSISTENCE TO COMMERCIAL AGRICULTURE **27**

4.1 Introduction 27

4.2 The basic farm household model 29

4.3 Reduced form equations for land and labour allocation decisions 32

4.4 Data 33

4.5 Empirical models 34

4.6 Estimation results 40

4.7 Conclusions 47

CHAPTER 5 CROP AND MARKET OUTLET CHOICE INTERACTIONS AT HOUSEHOLD LEVEL **49**

5.1 Introduction 49

5.2 Analytical models 50

5.3 Data and empirical specification 54

5.4 Estimation results 57

5.5 Conclusions 60

CHAPTER 6 FARM-GATE TOMATO PRICE NEGOTIATIONS UNDER ASYMMETRIC INFORMATION **63**

6.1 Introduction 63

6.2 The theoretical price bargaining model 65

6.3 Empirical model and data 70

6.4 Estimation results 74

6.5 Conclusions 76

CHAPTER 7 CONCLUSIONS AND DISCUSSION **79**

7.1 Introduction 79

7.2 Summary of main conclusions 79

7.3 Discussion 81

7.4 Future research 83

REFERENCES 85

SUMMARY 91

SAMENVATTING (SUMMARY IN DUTCH) 94

APPENDICES 97

COMPLETED TRAINING AND SUPERVISION PLAN 99

CURRICULUM VITAE 101

LIST OF TABLES

Table 2.1 Distribution of sample households 13
Table 3.1 The share of agricultural commodities in total export income of Ethiopia 16
Table 3.2 The share of some agricultural commodities in the total exports (1997/98-2001/02) 17
Table 3.3 Covariance matrix for agricultural export commodity values (1997/98-2001/02). 24
Table 3.4 The marginal contributions of each agricultural export quantity to the total earnings instability 25
Table 4.1 Household participation in farmland rental market 33
Table 4.2 Labour market participation status of the sample households 34
Table 4.3 Motor pump ownership right of the sample households 34
Table 4.4 Descriptive statistics of variables used in estimations. 39
Table 4.5 Probability of land market participation as a buyer for cash and food crop production 42
Table 4.6 Land allocation for cash and food crop production 43
Table 4.7 Probability of labour market participation as a buyer for cash and food crop production 45
Table 4.8 Estimates of household labour allocation for both cash and food crop production 46
Table 5.1 Number of growers and farm size allocated to each type of vegetable crop per household 54
Table 5.2 Number of vegetable types grown per household 55
Table 5.3 Percentage share of each crop marketed at different market outlets 55
Table 5.4 Number of market outlets used per household per vegetable crop marketing 56
Table 5.5 Descriptive statistics of the variables used in estimation 57
Table 5.6 Simultaneous model estimation results explaining the size of farmland allocated to each vegetable crop 58
Table 5.7 Simultaneous model estimation results explaining the share of vegetable crops marketed at farm-gate 59
Table 6.1 Descriptive statistics of farm-gate tomato transaction data 72
Table 6.2 Tomato wholesale price information data 73
Table 6.3 Average tomato wholesale price at central vegetable market in Addis Ababa (Birr per kg) 74
Table 6.4 Estimates of factors explaining seller's commitment to the initial ask price and the variation in the initial ask-offer price spread. 74

LIST OF FIGURES

Figure 2.1 Geographic location of Lake Ziway and Lake Haro-Maya 8
Figure 2.2 Schematic diagram of weekly activities in the Haro Maya - Dire Dawa- - Djibouti chain 10
Figure 3.1 Ethiopia's annual export earnings 18
Figure 3.2 Variation in Ethiopia's export quantities, prices and values (1997/98-2001/02) 23
Figure 6.1 Daily tomato wholesale price at central vegetable market in Addis Ababa 64
Figure 6.2 A buyer and seller's overlapping valuations allowing trade occurrence. 66

CHAPTER 1

INTRODUCTION

1.1 Background

Nations across the world differ in their resource endowments and level of technology used in the production of goods and services. Given these conditions, engagement in international trade with nations specializing in the production of goods in which they have comparative advantages creates room for improving the welfare of the society as a whole. This theory traces back to the last half of the 18th century, the time when Adam Smith realized the importance of specialization and trade in his *Wealth of Nations*. Since then many economists advocate the contribution of international trade for welfare improvement (and in some cases, as the engine of growth) in the overall process of economic development (Alwang and Siegel, 1994; Coe and Helpman, 1995; Onafowora and Owoye, 1998; Arndt, 1999).

Sub-Saharan African countries are mainly exporting agricultural commodities in which they have comparative advantages due to cheap labour and tropical climate. Usually, the number of different agricultural commodities exported from a given country is limited. For instance, coffee alone constitutes more than 50 percent of the total agricultural export of Ethiopia. Different studies show that diversifying the export base towards non-traditional agricultural commodities is crucial to attain stability in export earnings of a country (e.g. Alwang and Siegel, 1994). In this regard, focusing on the potentials of less-favoured areas (LFAs)[1] could bring the desired win-win outcome in diversifying the export base and economic development in these areas. However, long-term development of LFAs through trade requires the development of markets and market related institutions and infrastructure (Oskam et al., 2004; Winters, 2004).

Less-favoured areas are far from homogenous in their resource endowments and agro-ecological circumstances. Such diversity usually calls for different development strategies (Pender, 2004; Ruben and Pender, 2004). For instance, for areas with good agricultural potential but imperfections in factor and/or product market, development strategies that stimulate households to shift their resource use from semi-subsistence

[1] For the definition of less-favoured areas (LFAs), see Oskam et al. (2004) and/or Ruben and Pender (2004).

farming towards production of high value and marketable commodities like dairy and horticultural products are crucial (Ruben and Pender, 2004). High value and labour intensive cash crop production, like horticulture, contributes towards better employment opportunities for landless farm households and as a result contribute towards reducing rural poverty (Oskam et al., 2004).

Central and eastern parts of the Oromia regional state of Ethiopia have relatively better agricultural marketing networks due to their location advantage in being closer to the best road networks in the country. For instance, the drought prone rift valley areas of Ethiopia have a number of lakes that can irrigate 50,000 hectares of land (Rahmato, 1999). The country as a whole has about 3.5 million hectares of irrigable land out of which only 4% is irrigated (Rahmato, 1999). In such potential areas for irrigation, the development of small-scale irrigation schemes with the aim of producing high-value horticultural crops has a number of advantages. It helps to reduce the impact of erratic rainfall on household income fluctuations and make use of land multiple times a year. Moreover, the development of a small-scale irrigation scheme does not require high skills for operation and maintenance (Rahmato,1999). Though such regional comparative advantages exist, household resource use in the production of commercial cash crops is minimal (CSA, 2002).

The lack of such a shift from subsistence to commercial farming may have different reasons like high risks (Fafchamps, 1992), high transaction costs (Omamo, 1998; Key et al., 2000), limited food markets (de Janvry et al., 1991), limited insurance options (Binswanger and Rosenzweig, 1986) and limited access to credit (Eswaran and Kotwal, 1986). In investigating the household resource allocation decisions between subsistence food crop and commercial cash crop production, this thesis focuses on the role of markets.

Though markets are indispensable in the process of agricultural commercialization (Pingali, 1997), transaction costs and other causes of market imperfections could limit the participation of farm households in different markets (de Janvry et al., 1991; Sadoulet and de Janvry, 1995; Key et al., 2000). This implies that markets could be physically available but not accessible to some of the farm households. Under such circumstances, farm households may tend to choose crops that they can easily sell at the accessible markets. Such tendency is much stronger for households producing perishable crops like fresh vegetables. However, there is no clear evidence in literature whether the two

decisions (crop and market outlet choices) are taken jointly at the same time during or before the planting period or successively one after another.

Whether transactions take place at a local market or at the farm-gate, the bargaining position of farmers is usually weak, particularly for perishable vegetable products (Sexton and Zhang, 1996). This could be due to the existence of large number of farmers (sellers) and limited number of merchants (buyers) in these markets. Besides the market structure, farmers and merchants may not have equal price information from the central market, which is used as a reference point to set prices at local markets or farm-gate transactions. A difference in price information results into different product valuations between the selling farmers and the buying merchants. The level of disparity in these valuations might depend on the level of information asymmetry as well.

The remaining part of this chapter is organized as follows. Section 1.2 presents problems that need to be looked at in the thesis. The general and specific objectives of the thesis are presented in section 1.3. Section 1.4 deals with the methodological approach and data used in the analysis. The overall outline of the thesis is presented in section 1.5.

1.2 Problem statement

It is common to see fluctuations in export income of countries mainly depending on the export of primary agricultural commodities. The problem is severe for countries like Ethiopia that obtain a big share of their export income from a single commodity. Diversifying the agricultural export base towards non-traditional high-value horticultural crops could increase export earnings and reduce fluctuations. However, except few countries like South Africa, Kenya, Zimbabwe and Ivory Coast (Singh, 2002), the success in horticultural export for most Sub-Saharan African countries is low. For instance, compared to Kenya and Zimbabwe (Dolan and Humphrey, 2001; Singh, 2002), the role of horticultural products in the export earnings of Ethiopia has been negligible (Brook, 1999). A World Bank study (2004) shows that Ethiopia's total horticultural export income in 2000 was about 2.8 million USD, which was only 2.2 percent of Kenya's export income from the same sub-sector in the same year. It is worthwhile to analyze the role of horticultural crops and other non-traditional agricultural export commodities with respect to gross export income and attaining stability in export income of Ethiopia.

With a long-run objective of promoting the participation of small-scale farmers in the production of non-traditional agricultural commodities for export like horticultural

crops, agricultural development policies need to focus on re-orienting the household resource use from the usual subsistence or semi-subsistence production towards more market oriented production and consumption decisions. In rural Ethiopia, the actual share of resources allocated to the semi-subsistence food production is still higher than the share of resources allocated to cash crops. It is interesting to investigate what economic factors explain household resource allocation decisions between cash and food crops. This knowledge is useful in formulating targeted policies that could help in shifting resources from food towards cash crop production.

It is well known that different household attributes put households under different production and marketing potentials. The market outlets that households would like to participate in might influence the type of vegetable crops they would like to grow and the size of farmland they would like to allocate to a specific crop. This could be due to the fact that production and marketing decisions of households are two sides of a coin. The two decisions go hand in hand as farmers produce what they could sell at an available market. Knowing the interaction patterns between the two decisions helps to understand what crop is sold at which market and whether the intention of selling at a particular outlet increases or decreases the size of farmland allocated to the specific crop.

In moving from subsistence towards cash crop production, the role of markets and market price information is substantial. Imperfections in markets and asymmetric market price information hinder the potential gain that could have been attained under the existence of markets with complete information. In this regard, marketing vegetable crops at farm-gate is an interesting process that has not been investigated much. Both buyers and sellers usually do not have equal market information on the vegetable prices at the central market. Under such circumstances, farm households selling vegetable crops at farm-gate deal with the trade-off between selling their crop harvests at higher possible prices and avoiding the risk of loosing product quality if the transaction fails by holding on to higher prices. An interesting issue in this regard is what factors could enhance sellers' bargaining position at the farm-gate transaction and how information flows facilitate farm-gate transactions to take place in a short period.

1.3 Objective of the thesis

The general aim of this thesis is to examine the development of less-favoured areas through commercializing small-scale agriculture that produces crops with export potential. Although the main focus is on behaviour of family farms in the shift from

subsistence to commercial farming, the research also tries to investigate the role of non-traditional agricultural export commodities, like fruits, vegetables, and flowers in stabilizing Ethiopia's export income.

The specific objectives are to:

i. Evaluate the contribution of horticultural crops in stabilizing the export earnings of Ethiopia.
ii. Analyze the behavior of farm households in resource allocation decisions to food and cash crop production.
iii. Examine the pattern of household decisions in crop and market outlet choices.
iv. Examine the bargaining power of vegetable producing farm households in farm-gate transactions under asymmetric price information.

1.4 Methodological approach and data

To meet the above-mentioned objectives, different theories and methodologies are used. A portfolio approach (Alwang and Siegel, 1994) is used to analyze the role of non-traditional agricultural commodities in stabilizing the variation in export earnings of Ethiopia. Annual export data obtained from the Ethiopian Export Promotion Agency on 11 agricultural export commodities for the period of 1997/98-2001/02 are used for the analysis.

To meet the remaining three objectives a combination of different micro-economic theories, survey data and various econometric techniques is used. A farm household model is used to investigate land and labour allocation decisions under different market participation regimes both in land and labour markets. Household survey data collected in 2003 from central and eastern Oromia region, Ethiopia, is used for the empirical investigations.

For the crop and market outlet choice interaction, a simultaneous equation model accounting for selection bias is estimated to test whether there is a simultaneity in the area of land allocated to a specific vegetable crop and the share of each crop marketed at a farm-gate. Data used in this analysis are obtained from the household survey indicated above.

A game-theoretic sequential bargaining model under asymmetric information is adapted to estimate farmer's (seller's) bargaining position in farm-gate price negotiations. A total of 66 farm-gate transactions recorded in three months time and a daily tomato

price registered at the central vegetable market in Addis Ababa for the same period are used to estimate factors affecting the bargaining position of sellers at farm-gate.

1.5 Thesis outline

Apart from what has been discussed in this introductory chapter, the remaining part of this thesis consists of six chapters. Brief descriptions of these chapters are presented below.

Chapter 2 describes the geographical locations, socio-economic situations and physical conditions of the study areas. It also summarizes the survey data used in the analysis of the forthcoming chapters and the strategies used in obtaining the sample households. The role of non-traditional agricultural commodities and specifically horticultural crops in stabilizing export earnings of Ethiopia is analyzed in Chapter 3. In Chapter 4 household land and labour allocation decisions in the shift from semi-subsistence to commercial agriculture are analyzed. The chapter considers household resource use patterns within the light of their respective factor (land and labour) market participation status. Chapter 5 assesses the pattern of crop and market outlet choice interactions at household level. It analyses whether there is simultaneity in allocation of farmland area to a given vegetable crop and the share of the crop harvest marketed at a farm-gate. Chapter 6 analyses farm-gate price negotiations and the role of price information on the farm household's bargaining position. Tomato transactions at the farm-gate are investigated in order to find factors that contribute to the bargaining position of vegetable producing households. Finally, Chapter 7 gives a general summary and conclusion of the whole research work with policy implications of the research findings.

CHAPTER 2

DESCRIPTION OF THE STUDY AREA AND SURVEY DATA

2.1 Introduction

This chapter describes the study area and the survey data used in analyzing the research objectives specified in the previous chapter. The chapter is organized as follows. Section 2.2 describes the study area. Institutional characteristics of the study area are presented in section 2.3 and survey data are described in section 2.4.

2.2 Description of the study area

This study focuses on the Haro-Maya and Ziway areas in the Oromia regional state of Ethiopia. Haro-Maya and Ziway are names of two lakes. Lake Haro-Maya is located in the East-Hararghe zone (about 500km East of Addis Ababa) whereas Lake Ziway is located in the East-Shoa zone (160km South of Addis Ababa). Their geographic location is given in figure 2.1. These two sites were chosen as our study area because they have good potential for vegetable production using irrigation and households living near the lakes have a long time experience in vegetable production and marketing activities.

Apart from their similarity in agricultural potential, the two research sites also differ in many aspects. To mention some: (1) *Organization of production*. Haro-Maya is a highland area with dense population and very small landholding per household (0.25ha). Chat, a mild narcotic stimulant plant, is the major perennial cash crop grown in the area. Sorghum, maize and haricot beans are the major cereal and legume crops whereas potato, beetroot and leek are the major vegetable crops produced. Intensive production of vegetable crops is practiced here. The purchase of variable inputs used for vegetable production is financed partially by selling chat. Ziway is located in a rift valley region with average altitude of 1600 meter above sea level. Cereal and livestock production are the main agricultural activities. Tomato, onion, kale and pepper are the major vegetables produced in this area. Maize, teff, wheat and beans are also grown as major cereal and legume crops. (2) *Market orientation.* Due to their difference in geographical location, the marketing channels of vegetable products also differ for the two sites. Vegetable products from Haro-Maya area are channeled to Harar and Jigjiga towns for domestic consumption and to Dire Dawa for both domestic consumption and export purposes.

Except flowers and green beans produced by commercial farms and exported to Europe, horticultural products from Ziway are mainly supplied to Addis Ababa for domestic consumption. (3) *Trading practices.* Farm-gate transactions are more prevalent around Ziway throughout the year whereas it is common only during the dry season around Haro-Maya. During the rainy season, there is a vegetable production boom around Haro-Maya and farmers have to supply their harvest to local markets and to temporary store houses of assembling merchants in Haro-Maya town. (4) *Payment arrangements.* Transactions around Haro-Maya are mostly on credit basis (especially between the assembler and the exporters) whereas at Ziway trade takes place mostly in cash. Assemblers at Haro-Maya are uncertain about prices paid by the exporters since these prices are based on what the consumers pay at Djibouti. Then, based on what the exporters pay to them, the assemblers pass down prices to the producers through the marketing channel. This reduces producers' bargaining power on prices.

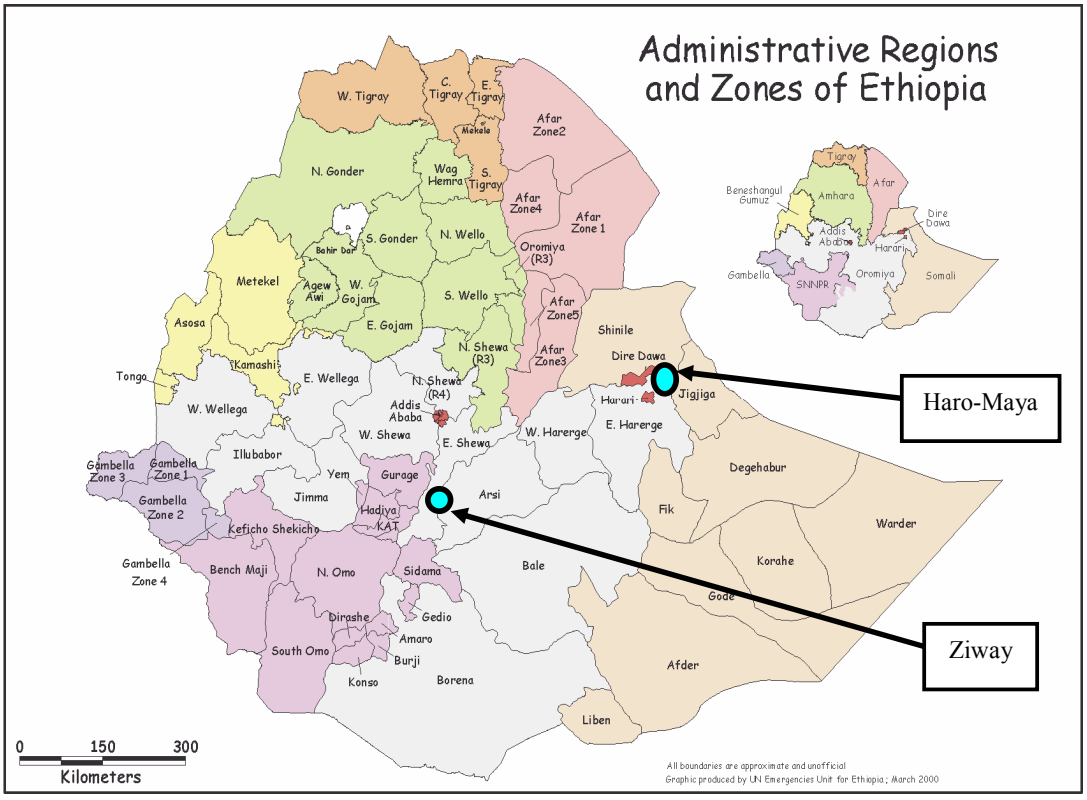

Figure 2.1 Geographic location of Lake Ziway and Lake Haro-Maya

2.3 Institutional arrangements

There are several local institutions that have an impact on vegetable production and marketing practices. Vegetable marketing channels, saving and credit services and water use arrangements are some of these institutions discussed below. Since this thesis does not explicitly analyze these institutional arrangements they are discussed in this chapter.

Vegetable marketing channels

Vegetable products from the two research sites have different marketing channels. How the two marketing channels are functioning at the two research sites is presented below.

The Haro Maya – Dire Dawa – Djibouti Chain. In this marketing chain, vegetable products are mainly assembled by merchants at "*Ganda Doora*" in Haro-Maya town, and by some merchants living in the villages *Finqile*, *Tiniqe* and *Addele.* Every Friday, assemblers get demand requests (*Talab*) with respect to type, quality and quantity for each vegetable crop demanded by exporters at Dire Dawa town. After assembling is finalized, grading and packing activities take place from Saturday till Monday night. The assembling merchants take the graded and packed vegetable products to Dire Dawa every Tuesday morning. The exporters check the quality and quantity of the products supplied to them by the assembling merchants. After taking notes on the amount of vegetables supplied by each merchant, exporters send the products to Djibouti on Tuesday afternoon by train. The payments are made most likely one week after the actual transactions were made at Dire Dawa. This happens because exporters are not willing to pay or set the transaction prices before being sure on the price that consumers at Djibouti are willing to pay.

Vegetable exporters to Djibouti have a strong clan tie among each other and this system of trading could not be penetrated for a long time. These exporters have family members or close relatives living in Djibouti acting as importers of vegetables. They send an import order and a sum of US Dollar equivalent to the ordered vegetable value to the exporters in Dire Dawa via the Commercial Bank of Ethiopia. The exporters at Dire Dawa send vegetable quantities equivalent to the US Dollar sum sent to them. This is the element that makes such a transaction an export trading. Otherwise, the way products are handled, how the product qualities are monitored, and all other activities are exactly the same to a trading practice taking place between two regions of the same country. Figure

2.2 summarizes the weekly activities in the Haro Maya-Dire Dawa- Djibouti marketing chain.

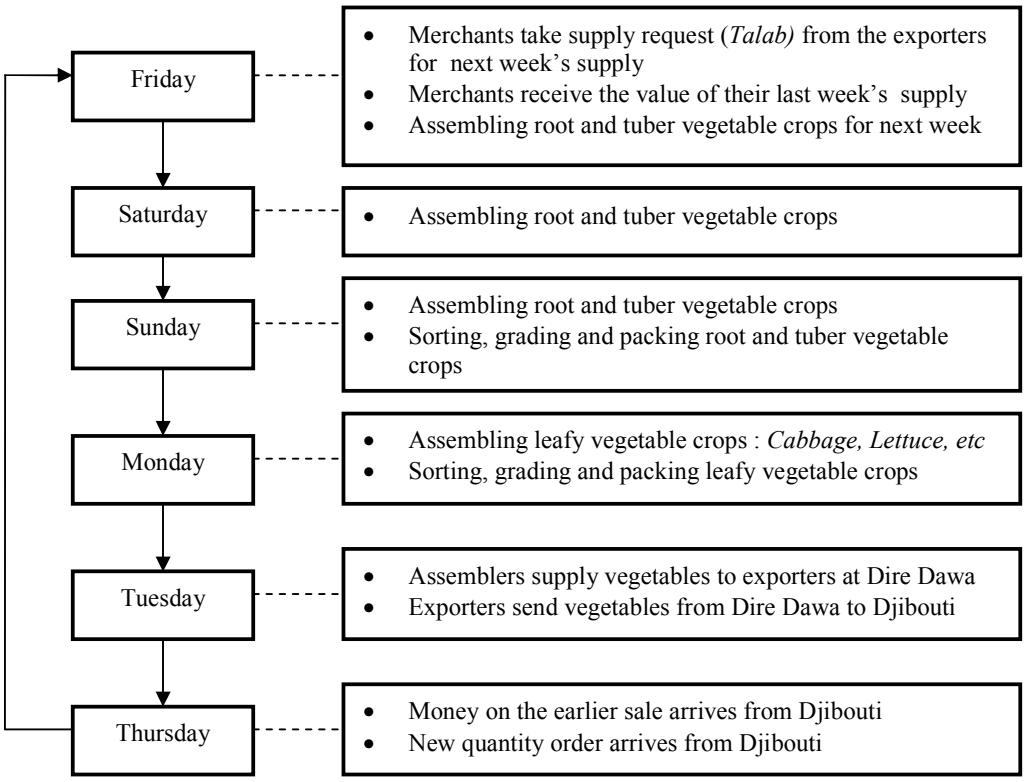

Figure 2.2 Schematic diagram of weekly activities in the Haro Maya - Dire Dawa - Djibouti chain

The Ziway – Addis Ababa Chain. This domestic chain starts at the farm-gate where the traders buy vegetables to supply to the central market at Addis Ababa. Competition among traders at farm-gate is poor though there exists a fierce competition at the central market in Addis Ababa. Merchants buy vegetables at farm-gate in the afternoon and transport the purchased vegetable products during the evening to sell them at the central vegetable market in Addis Ababa the next morning. The vegetable wholesale transaction at the central vegetable market in Addis Ababa is limited to the morning time (from 06:00 to 10:30 am).

Horticultural export from the central part. Export of horticultural crops from the central part of Ethiopia is mainly to European markets by cargo flights. High value horticultural products like flowers and green beans are exported by large export companies from the central part. As the production of flowers is high-tech in its nature, farm households are not engaged in this business. There are some attempts to involve

farm households in the green beans supply chain by using out-growers (contract farming) schemes but that is too limited to consider.

Saving and credit services

Saving and credit associations are missing in most villages. The vegetable marketing co-operative union that provided agricultural inputs on credit basis to its member households in the past was not operating anymore due to high default rates. During the survey the most reliable sources of credit were relatives, neighbours and friends. Except, *iqub*, which is a local institution serving as a Rotating Saving and Credit Association (ROSCA), formal saving institutions in any kind are missing around Ziway. A large amount of money obtained during vegetable harvest is either consumed, kept in liquidities, or used for investment in agricultural tools and motor pumps for irrigation purpose. Around Haro-Maya, there is a woman's saving and credit co-operative organized by Self-Help International, which is a community development oriented non-governmental organization.

Water use arrangements

Around Lake Ziway, farmers have their own association to use water pumps for irrigating their farm using two water pumps with 75 horse power donated by Self-Help International. Each household pays its fuel cost for the hours of motor usage and an additional 50 Birr[1] for the maintenance of the motor pump each year. Households are organized in sub-groups based on the location of their irrigated plots in order to facilitate the rotation of the motor pump service. There are also households that get motor pump services from their neighbors or relatives on goodwill or as an exchange for land or labour. Some households also rent in motor pumps for a specific period.

Around Haro-Maya, the surface water level is decreasing alarmingly and in some areas there is no more surface water and farmers have to dig wells (locally known as *Eela*) to get sub-surface water for irrigation. These wells are privately owned and usually adjacent to the vegetable plots.

[1] Birr is the Ethiopian currency (During this study, 1USD≈8.6Birr or 1EURO≈10Birr).

2.4 Survey data description

Data used in this thesis were collected from different places and at different economic levels. The collected data covers national agricultural commodity export data from the Ethiopian Export Promotion Agency, household survey data from Haro-Maya and Ziway areas, tomato price bargaining data collected at farm-gates around Ziway, and tomato wholesale price information from the central vegetable market at Addis Ababa. Brief descriptions of these different data sources are presented below. In the chapters where the data is used more detailed information on the contents of the data is given.

Agricultural export commodity data

Ethiopia's agricultural commodities export data for the year 1997/98-2001/02 was obtained from the Ethiopian Export Promotion Agency (EEPA). There is data on 11 agricultural commodities: namely, coffee, chat, hides and skins, oil seeds, pulses, cereals, fruits vegetables and flowers, cotton, live animals, spices, and tea. It includes the quantity and the corresponding monetary value of each agricultural commodity exported. This data is used in analyzing the role of non-traditional agricultural commodity exports in attaining stability in export income.

Household survey

A household questionnaire was conducted in summer 2003 at the two research sites, Haro-Maya and Ziway. The sample households for this study were selected randomly from households producing both vegetable and food crops. A total sample of 78 farm households from Ziway and 76 farm households from Haro-Maya were interviewed on their production and marketing activities. The distribution of the sample households over different peasant associations is presented in table 2.1.

A structured questionnaire based on the research objectives was used for the household survey. In the questionnaire, household characteristics, resource endowments, household land and labour use, factor and product market participation status are the major points of interest focused on.[2]

[2] The questionnaire used for household survey around Ziway is available at the following web site: http://www.aep.wur.nl/NR/rdonlyres/E96065D4-B91A-4D81-A152-3AEA412A28BF/27942/Questionnaire_Farmhousehold_Moti.pdf
Minor changes were made to this questionnaire when it was used around Haro-Maya because of the difference in the type of crops grown and farm implements used at the two research sites.

Table 2.1 Distribution of sample households

Zone	Woreda	Peasant Association	Number of respondents
East- Shoa *	Adami Tulu Jido Kombolcha	*Bochessa*	7
		Ilika Chelemo	6
		Negalign	5
	Dugda Bora	*Abono Gabriel*	1
		Bakale Girissa	11
		Dodo Wadera	6
		Dodota Dambal	6
		Gemo Shubi	5
		Gore Leman	2
		Malima Ber	12
		Tuchi Dambal	3
		Walda Makidala	3
		Wayo Gabriel	10
East-Hararghe	Haro-Maya	*Damota Jalala*	15
		Finkile	15
		Ifa Oromia	19
		Tinike	16
		Tuji Gabbisa	11
		Total	154

*Note: * East-Shoa is an administrative zone where Ziway is located. Lake Ziway lies at the East side of both Adami Tulu Jido Kombolcha and Dugda Bora districts.*

Survey at central vegetable market and farm-gate transactions

For the purpose of analyzing farm households' bargaining power on price negotiations at the farm-gate, a total of 66 farm-gate transactions were recorded in three months time around the Ziway area. This data consists of buyers' and sellers' characteristics, perception on product quality under transaction, whether the seller has recent information on the central market tomato prices, the initial ask prices demanded by the sellers and the initial offer prices offered by the buyers, the final transaction prices, etc.[3] During the same period of recording the farm-gate tomato transaction data, the daily tomato wholesale prices at the central vegetable market in Addis Ababa were recorded by the Ethiopian Horticultural Development Enterprise with particular attention to tomatoes supplied from Ziway area.

[3] List of questions used in recording the farm-gate transaction data is available at the following web site: http://www.aep.wur.nl/NR/rdonlyres/E96065D4-B91A-4D81-A152-3AEA412A28BF/27943/Questionnaire_Farmgate_Moti.pdf

CHAPTER 3

THE ROLE OF NON-TRADITIONAL AGRICULTURAL COMMODITY EXPORTS IN ATTAINING EXPORT EARNINGS STABILITY[1]

3.1 Introduction

Export growth is a crucial issue for the development of a nation's economy. In addition to export growth, the stability in the export earnings is also important since instability disturbs the development planning of a country (Stanley, 1999). Most of the export earnings instability comes from world market price fluctuations and external shocks that directly affect the export volume like weather factors and pests and diseases. Both factors have a significant effect on export earnings instability. For countries like Ethiopia that mainly depend on primary agricultural commodities for their export earnings and with minimum capacity to establish agricultural processing industries (vertical diversification) that add value to primary goods and produce quality export products, horizontal diversification of the export base seems indispensable to tackle the export income instability problem (Alwang and Siegel, 1994; Bigman, 2002). This argument is supported by so-called structuralists who advocate export diversification because the reliance on a few primary products leads to declining terms of trade and earnings instability (Stanley, 1999). Note that this view contrasts with the classical economic idea that countries should specialize given their comparative advantage in resource base and other opportunities in trade (Stanley, 1999). In the case of Ethiopia, the classical economists' line of argument is not totally against horizontal diversification. This is due to the fact that Ethiopia has diverse agro-ecological zones that can easily fit to the production of different agricultural export commodities with minimum adjustment to the existing production systems.

Diversification of the export base does not necessarily result in stable export income (Alwang and Siegel, 1994). To attain export earnings stability diversification should aim at commodities with stable income and products with earning fluctuations that are negatively correlated with the earnings instability in commodities with the largest share in the total export income. The objective of this chapter is to analyze the variability in the agricultural export mix of Ethiopia in recent years and to investigate how export earnings can be stabilized by diversification. Agricultural export products that contributed much to

[1] Paper by Moti Jaleta and C. Gardebroek, revised and resubmitted to the *Journal of International Agricultural Trade and Development.*

export earnings variability and commodities that helped to stabilize export income are identified. To meet this objective a portfolio analysis, as developed by Markowitz (1959) and adapted by Love (1979) and Alwang and Siegel (1994) is performed. This chapter enriches the existing body of literature discussing the role of non-traditional agricultural export commodities. Moreover, this chapter is relevant to policy makers since it sheds light on the importance of these commodities in attaining export income stability.

The chapter is structured as follows. In section 3.2 the overall performance of Ethiopia's export sector is briefly reviewed and special attention is paid to the role of non-traditional agricultural export commodities. Section 3.3 discusses the research methodology. In section 3.4 the analysis results are presented. General discussion and conclusions drawn from the analysis are presented in section 3.5.

3.2 The performance of Ethiopia's export sector

Agricultural commodity export is almost the only source of export earnings for Ethiopia (Keyzer et al., 2000; Befekadu et al., 2001). For instance, the share of agriculture in total export value was 98% in 1997/98[2] although it declined to 86% in 2001/2002 (see table 3.1). The decline in the share of agricultural exports can be explained from both the demand and supply side. From the demand side, there was a tremendous decline in the world market prices for agricultural export commodities, especially coffee, in recent years. Weather, diseases, and other external factors represent supply side factors that explain the cut in the volume of agricultural export. The trade ban on live animals from East Africa by the Middle East Arab countries due to the Rift Valley Fever[3] and the drought during 2002 are some of these non-price external shocks.

Table 3.1 The share of agricultural commodities in total export income of Ethiopia

	Year				
	1997/98	1998/99	1999/00	2000/01	2001/02
Percentage Share	97.61%	95.30%	92.24%	89.93%	86.25%

In addition to dependency on agricultural commodity exports, about 76% of Ethiopia's total export earnings is directly coming from only three agricultural

[2] Ethiopian Fiscal Year is from July 8th to July 7th of the next year. Ethiopian New Year is on September 11.
[3] Rift Valley Fever is a cattle disease that occurred in the Rift Valley region of Kenya and Tanzania. Following the outbreak of this disease in 1998, the Middle East Arab countries put a ban on import of live animals, meat and meat products from East African countries. This ban was lifted later gradually.

commodities: coffee, chat[4], and hides and skins (see table 3.2). Moreover, in 2000 about 76.1% of Ethiopia's export was traded with Europe and Asia whereas other African countries and America had only shares of 18.0% and 5.6%, respectively (Berhanu et al., 2002). National or regional trade policies imposed on imported commodities have a detrimental income instability effect on exporting countries with more concentrated direction of trade than with diversified ones. Such a large concentration of export income from only a few primary agricultural commodities and a limited number of trade partners (Berhanu et al., 2002) makes export income vulnerable to price and policy shocks that may increase variation in export revenues.

Table 3.2 The share of some agricultural commodities in the total exports (1997/98-2001/02)

Commodities	**Average share (%)**	**Cumulative %**
Coffee	53.26	53.26
Chat	11.99	65.24
Hides & Skins	10.65	75.89
Oil seeds	7.39	83.28
Pulses	3.45	86.73
Cereals	1.61	88.33
Fruits, vegetables and flowers	1.27	89.61
Cotton	1.06	90.66
Live animals	0.18	90.85
Spices	0.66	91.51
Tea	0.07	91.57
Others	8.43	100.00
Total	100.00	

Source: Ethiopian Export Promotion Agency (EEPA) 2002.

Figure 3.1 presents the annual export earnings of Ethiopia in million Birr for the period 1980 to 2002. During the centrally planned economic system from 1980 to 1990, export income was almost constant. After a short period of declining export earnings in 1991 and 1992, a transition period after the overthrow of the socialist government, export earnings started to increase following the 1992's monetary devaluation policy and a structural adjustment program. Export earnings increased till 1998, the time when the war

[4] Chat is a mild narcotic plant produced in the Eastern, Southern and South Western parts of Ethiopia.

between Eritrea and Ethiopia broke out. Starting from the year 1998, there is a slightly downward trend in the export earnings with some annual fluctuations in the amount.

Looking at commodity specific export performance of Ethiopia, coffee, with the largest share in the total export value, was varying both in terms of quantity and price during 1997/98-2001/02[5]. There was a declining trend in coffee price by 2.84 Birr/kg/year whereas the quantity was declining by 2302 metric tons, on average.

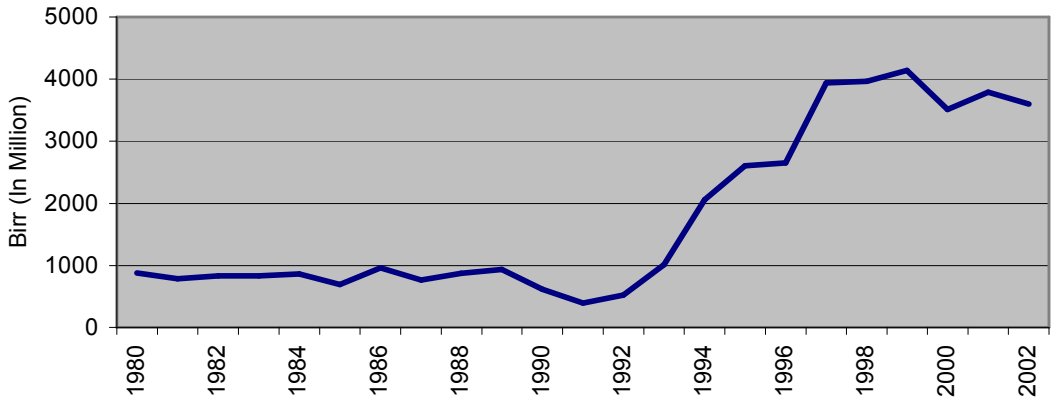

Figure 3.1 Ethiopia's annual export earnings

(*Source: Ethiopian Custom Authority, 2003*)

Chat was accepted very recently as an official export product for Ethiopia. It appeared to be the second largest agricultural commodity in the average annual export earnings' share of the country. Being preceded by chat, the export of hide and skin lost its historical second largest share in the total export income and became the third. Oil seeds, pulses and cereals rank fourth, fifth and sixth respectively in the total share. Fruits-vegetables and flowers appeared to be in the seventh place.

Recently, promoting the production and export of horticultural products (fruits, vegetables and flowers) has caught the attention of the federal government of Ethiopia (Desalegn, 2002). Yet, the share of horticultural export income is one of the lowest in the total export earnings. On average, horticultural export constitutes 1.27% of the total Ethiopian export value (see table 3.2). But there is a tendency of positive growth in the export of this sub sector, i.e., from 0.80% of the total export value in 1997/1998 to 2.21% in 2001/2002.

[5] A period for which commodity specific export income data is available.

Moreover, the share of Ethiopia in total Sub-Sahara African (SSA) countries' horticultural export is only 0.2% (Desalegn, 2002). Compared with Kenya, Desalegn indicates that Ethiopia's share in the total green beans export from the SSA countries is only 4.2% whereas Kenya's share is 48%. Moreover, not only the share, but also the number of horticultural products exported to other countries (except Djibouti[6]) is limited. Based on information from the International Trade Center (ITC), Desalegn (2002) states that flower and green beans are the only significant horticultural export commodities of Ethiopia from around 44 different horticultural products that are traded in the world market.

3.3 Data and analysis

Data

This study uses annual export data collected by the Ethiopian Customs Authority and compiled by the Ethiopian Export Promotion Agency (EEPA) for the period of five years (1997/98-2001/2002). After separating the agricultural and non-agricultural export commodities and considering the share of each commodity in the total export value, eleven (groups of) agricultural export commodities are selected for the analysis. These commodities are; cereals (CERL), chat (CHAT), coffee (COFF), cotton (COTT), fruits-vegetables and flowers (FRVF), hides and skins (HDSK), live animals (LAN), oil seeds (OLSD), pulses (PULS), spices (SPIC), and tea (TEA). The quantities are all in 100 thousand tons and the values are in 100 million Birr.

Method of analysis

To analyze the current mix of exports of Ethiopia a portfolio analysis is performed. This approach was developed by Markowitz (1959) who used it to analyze financial markets. Love (1979) modified Markowitz's model to investigate trade diversification. Alwang and Siegel (1994) developed the model further and introduced the concept of marginal analysis. The portfolio approach is used to determine the mix of agricultural export commodities that stabilizes the fluctuating earnings and promotes export growth. Although the portfolio approach is criticized for the implicit assumptions that the nation's assets are fixed and easily reallocated without any cost in the short-run (Stanley, 1999),

[6] Export to Djibouti is without any grading and standardization procedure especially on the export of vegetable commodities. The vegetable trade with Djibouti is similar to trade between two regions of a country except for the existence of two currencies.

the use of marginal analysis to identify the contribution of each commodity to the total export variation is insightful.

The objective function in the portfolio approach is either to minimize risk given a desired level of income or to maximize income subject to a variance constraint. Mathematically

$$\underset{X_i}{Min}\ \mathrm{var}(R_T) \quad \text{subject to: } \sum_{i=1}^{N} X_i P_i \geq R^* \tag{3.1}$$

or

$$\underset{X_i}{Max} \sum_{i=1}^{N} X_i P_i \quad \text{subject to: } \mathrm{var}(R_T) \leq V^* \tag{3.2}$$

where var(R_T) is the total export revenue variance, X_i is the quantity of export commodity i, P_i is the world market price of i^{th} export commodity (which is an expected price and not a choice variable since Ethiopia is a price taker), and V^* and R^* are target levels of variance and revenues.

The variance of total export earnings, var(R_T), is expressed as

$$\mathrm{var}(R_T) = \sum_{i=1}^{N} w_i^2\ \mathrm{var}(R_i) + 2\sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j\ \mathrm{cov}(R_i, R_j) \qquad for\ (i \neq j) \tag{3.3}$$

where w_i is the share of commodity i in the total export value $(=P_iX_i/\Sigma P_iX_i)$, R_i is export earnings from commodity i (i.e. $R_i = P_iX_i$), var(R_i) is the variance of export earnings from commodity i and cov(R_i, R_j) is the covariance between export earnings from commodity i and j. From equation (3.3) it follows that there are two important factors that determine the overall variance of export earnings: the weighted sum of variances of individual export products and the weighted sum of covariances between export earnings of different export commodities. The first term indicates that overall earnings variance can be reduced by increasing the share of export products with small earnings variance. Note that variation in export earnings may be due to variation in prices and/or quantities. Therefore, it is interesting to compare the earnings variation of individual products with their respective variation in prices and quantities in order to learn what the cause of individual

variation is. The second term of equation (3.3) is also interesting. A negative covariance between R_i and R_j helps to reduce the overall variation in export earnings since the relative income movement for the two export commodities (i and j) is in opposite direction. In other words, a reduction in the export earnings of commodity i is compensated by an income increment from commodity j, or vice versa.

Countries that are assumed to be price takers in the world market for their agricultural export commodities should focus on the volume of export in aiming at relatively stable export earnings. Planning for different volumes and combinations of export commodities can mitigate the variation in annual export earnings due to commodity price fluctuations. Therefore, it is important to investigate the contribution of each commodity's export volume on the instability of total export earnings.

To assess the effect of marginal changes in export volumes on variability, we can use the following procedure developed by Alwang and Siegel (1994). First, take the first derivative of the variance of total export earnings with respect to the share of each export commodity. This is specified as

$$\frac{\partial Var(R_T)}{\partial w_i} = 2w_i Var(R_i) + 2\sum_j w_j Cov(R_i, R_j) \tag{3.4}$$

In this equation, the first component on the right hand side is always positive whereas the second one depends on the co-variances of R_i and R_j. If the sum of all the co-variances is negative in sign and larger than the first component in magnitude, then an increase in the share of the i^{th} commodity decreases the total export earnings variability.

Second, we need to compute the change in the share of each export commodity due to the change in its own volume of export. This is specified as (see appendix A3 for a derivation)

$$\frac{\partial w_i}{\partial X_i} = (1 - w_i)\frac{P_i}{\sum P_j X_j} \tag{3.5}$$

Then, by using the chain rule, we have

$$\frac{\partial Var(R_T)}{\partial X_i} = \frac{\partial Var(R_T)}{\partial w_i} * \frac{\partial w_i}{\partial X_i} = (1 - w_i)\frac{P_i}{\sum P_j X_j}\left\{2w_i Var(R_i) + 2\sum_j w_j Cov(R_i, R_j)\right\} \tag{3.6}$$

Equation (3.6) gives the marginal change in the overall export earnings variation due to a unit change in the volume of i^{th} export commodity. This marginal change can be converted into an elasticity and expressed as

$$\in_{X_i}^{Var(R_T)} = \frac{\partial Var(R_T)}{\partial X_i} \frac{X_i}{Var(R_T)} \tag{3.7}$$

This elasticity measures how a one percent change in the volume of the i^{th} export commodity results in a percentage change of the total export earnings variability (Alwang and Siegel, 1994).

3.4 Results of empirical analysis

This section presents the results of the empirical analysis based on the portfolio model given in section 3.3. First, export income variation is compared to variation in the two different sources for variability in export income, viz. prices and volumes by calculating coefficients of variation (CV) for the different commodities. The advantage of using the coefficient of variation is that units of measurement do not affect it. This analysis connects to the first part of equation (3.3), the weighted sum of individual earnings variances. From figure 3.2 it follows that most of the variations in export earnings are due to variation in quantities rather than prices of export goods. This finding is consistent with previous studies (Alwang and Siegel, 1994). Only for coffee the price variation is higher than variation in export quantity. Some explanations for the variability in export quantities are fluctuating weather conditions, outbreaks of diseases and pests and lack or impossibility of storage. Import regulations including sanitary and phytosanitary controls imposed on exports from developing countries could also contribute to variability in export quantities.

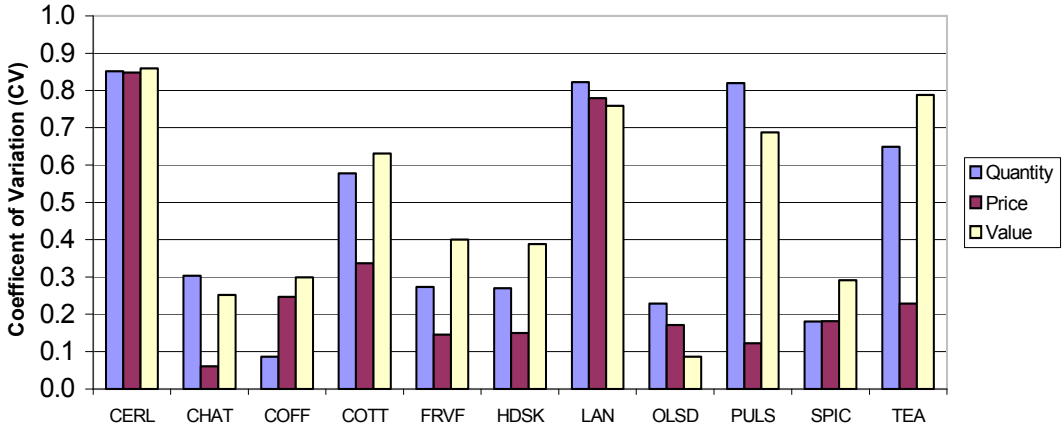

Figure 3.2 Variation in Ethiopia's export quantities, prices and values (1997/98-2001/02)

For cereals and live animals, all the price, quantity and value coefficient of variations are high (>0.75). Coffee has the lowest coefficient of variation in its quantity of export among all agricultural export commodities (0.09) and most of the variation in coffee export income (0.3) is due to its price (CV of 0.25). In general, the variation in prices of agricultural export goods is low compared to variation in quantities. Eight of the eleven agricultural export commodities (chat, pulses, fruits-vegetables and flowers, hides and skins, oil seeds, spices, tea and coffee) have CV's for price of less than or equal to 0.26 whereas only three export commodities (coffee, oil seeds and spices) have coefficient of variations for export quantities of less than 0.26.

Table 3.3 presents covariances of the selected export products. The second part of equation (3.3) indicates that is important to investigate whether covariances are positive or negative, since negative covariances help to reduce overall variation in export earnings.

Table 3.3 Covariance matrix for agricultural export commodity values (1997/98-2001/02).

	CERL	CHAT	COFF	COTT	FRVF	HDSK	LAN	OLSD	PULS	SPIC	TEA
CERL	0.2550										
CHAT	0.1197	1.245									
COFF	-2.460	-3.842	36.000								
COTT	0.0799	0.1898	-1.290	0.0581							
FRVF	0.0538	0.0056	-0.8015	0.0162	0.0353						
HDSK	0.7463	0.1786	-5.8981	0.1909	0.1090	2.347					
LAN	-0.0212	0.0003	0.2300	-0.0089	-0.0053	-0.0579	0.0028				
OLSD	-0.0031	-0.2628	0.9379	-0.0454	-0.0051	-0.0449	0.0015	0.0569			
PULS	0.1601	-0.2348	-2.408	0.0139	0.1565	0.2593	-0.0177	0.0338	0.7692		
SPIC	0.0184	0.0671	-0.3765	0.0141	0.0073	0.0349	-0.0013	-0.0151	0.0179	0.0050	
TEA	-0.0077	-0.0104	0.0719	-0.0020	-0.0012	-0.0236	0.0003	0.0020	-0.0021	-0.0008	0.0004
Total	-1.087	-2.544	20.16	-0.7835	-0.4303	-2.160	0.1124	0.6276	-1.252	-0.2289	0.0266

Export earnings from coffee, live animals, oil seeds and tea have a positive covariance with the total export earnings. In other words, export earnings from these commodities have contributed to the total export income variability. For coffee this is of course not surprising since this is the major export product of Ethiopia, dominating total export revenues. The fluctuating and declining coffee price in the world market is therefore a major explanation for the total fluctuations in export income. Export income from agricultural commodities like cereals, chat, cotton, fruits-vegetables and flowers, hides and skins, pulses and spices contributed towards reducing the total export earnings instability as their annual export incomes co-vary negatively with the total export income. Export income from these products also co-varies negatively with export earnings from coffee. This implies that if these products would gain in share a more stable export portfolio would be obtained.

The covariances of export earnings are analyzed in more detail by looking at the relations between prices and export volumes. This is done by calculating correlation coefficients, which have the advantage of being unit free. Moreover, assuming that prices and volumes are normally distributed, the significance of the correlation coefficients can be tested. With respect to volumes nine correlation coefficients were found to be significantly different from zero at the 10% critical level. Negative volume correlation exists between coffee and cereals, coffee and cotton, coffee and spices, chat and oilseeds, and spices and oil seeds. Significant positive correlation is found for cereals and hides and skins, pulses and fruits and vegetables, spices and chat, and spices and cotton. Negative or positive volume correlation may be due to random production conditions but

also due to production decisions by farmers who change their production plans. Price correlation is in this sense more interesting since it is exogenous to a country and its producers. Five price correlation coefficients were found to be statistically different from zero (again assuming normality). Chat and cotton, oilseeds and pulses and tea and pulses had positive price correlation coefficients. Export prices of fruits-vegetables-flowers and spices were both negatively correlated with the export price of coffee in the given period. This finding is interesting given the dominant position of coffee in the current export mix and the observed price decline of coffee.

Table 3.4 gives the marginal contributions and elasticities of the agricultural export quantities in the total earnings instability.

Table 3.4 The marginal contributions of each agricultural export quantity to the total earnings instability

Commodity	Marginal Contribution*	Elasticity**	Rank in stability	Rank in share
Cereals	-0.5795	-0.0042	4	6
Chat	-4.6431	-0.0377	2	2
Coffee	8.7743	0.7695	11	1
Cotton	-0.3538	-0.0014	5	8
Fruits, veg. and flowers	-0.0586	-0.0009	6	7
Hides and skins	-6.8569	-0.0494	1	3
Live animals	0.0787	0.0001	9	10
Oil seeds	0.1330	0.0062	10	4
Pulses	-0.2301	-0.0082	3	5
Spices	-0.1025	-0.0002	7	9
Tea	0.0271	$4.04*10^{-6}$	8	11

*Note: *The marginal contribution is computed from equation (3.6) above*
*** The elasticity is computed as indicated in equation (3.7) above*

The marginal contribution indicates the overall change in the export income variation of Ethiopia due to an increment in the volume of the corresponding commodity. For instance, increasing the volume of coffee export by 100000 metric tons increases the total export income instability by 8.77 units on average. The column with elasticities gives percentage changes. In ranking the commodities in terms of their contribution towards reducing the total export income instability, hide and skin comes first whereas chat and pulses are the second and the third, respectively. An increase in the products with a high stability rank would have led to more stable export earnings in the period surveyed. For comparison, the fourth column gives the ranking of export goods based on the share in the current export mix as given in table 3.2.

3.5 Discussion and conclusions

Most developing countries, including Ethiopia, are depending on the export of primary and traditional agricultural commodities for their foreign currency earnings. However, the world market prices for these commodities are fluctuating and even declining from time to time. Added to export volume fluctuations, such price fluctuations exacerbate export income instability. Therefore, it is important to examine the extent of total export income variability, major commodities contributing to this instability, and potential commodities that would mitigate the earnings instability.

A large amount of variation in Ethiopia's export income is attributed to fluctuations in coffee export income. This is due to the fact that the share of coffee in total export earnings is more than half and that the price of coffee in the world market was rapidly declining in the period used in this study. The dominating effect of coffee earnings on total earnings stresses the need for a more balanced export portfolio.

Looking at sources of variation for individual products it was found that all agricultural commodities except coffee have higher coefficients of variation in their export volumes than their respective export prices. In other words, the lack of a stable supply of most export commodities has a more substantial effect on their earnings instability than fluctuations in world market prices. Products with relatively low variation (both in prices and volume) are spices and oilseeds.

Earnings of most agricultural export products had a negative covariance with earnings of coffee exports, thereby reducing the overall instability in earnings. Export volumes of cereals, cotton and spices had a strong negative correlation with the volume of coffee. Fruits and vegetables had a strong negative price correlation with coffee.

The marginal analysis in the portfolio approach indicates that hide and skin, chat, pulses, cereals, cotton, and fruits-vegetables and flowers contributed positively to the overall stability in the total export earnings. Increasing the quantity of these export commodities can reduce the total earnings instability in the future. This finding supports the recent promotion of the horticultural sector in Ethiopia by the government.

Overall, it can be concluded that there are various export products (traditional and non-traditional) that lead to a more balanced export portfolio, either because of negative volume or price correlation. One should note however that past price and volume fluctuations may change in the future. In other words, the results of this analysis are not a blueprint for the most optimal portfolio. The main lesson to be learned is that a more balanced export portfolio is possible leading to stable export earnings.

CHAPTER 4

LAND AND LABOUR ALLOCATION DECISIONS IN THE SHIFT FROM SUBSISTENCE TO COMMERCIAL AGRICULTURE[1]

4.1 Introduction

Farm households in developing countries mostly operate under imperfect factor and/or product markets resulting from high transaction costs, shallow or thin markets for factors and/or products, price risks and risk aversion, or limited access to market information (Sadoulet and de Janvry, 1995:149-150). Under such circumstances, production and consumption decisions taken at farm household level are far from separable (Singh et al., 1986; Taylor and Adelman, 2002). Specially when there are high transaction costs to participate in a factor or product market, farm households prefer to be self-sufficient in production and/or consumption of that particular factor or product. In these cases, the value of the factor or product in which a household is self-sufficient is evaluated at a household specific endogenous or shadow price. This internal price has an implicit effect on the outcome of optimal resource allocation decisions of households in other markets (de Janvry et al., 1991; Skoufias, 1994).

In addition to market failures resulting in endogenous prices for non-tradable factors or products at a household level, markets may exist for other factors or products in which the buying and selling decision prices of households are discontinuous due to high transaction costs prevailing in these markets (Omamo, 1998; Woldehanna, 2000; Key et al., 2000). This discontinuity in decision prices occurs due to the fact that transaction costs put a wedge between market prices at which households are willing to buy and sell the same factor or product considering all the searching, negotiation, monitoring and enforcement costs. Note that for risk averse farmers this price wedge may be widened by price risks. Due to price risks farmers will mark-up purchase prices positively whereas they mark-up selling prices negatively (Sadoulet and de Janvry, 1995:150).

Given all these market features, farm households in developing countries earn far less than the potential income they could have attained under perfect markets. For instance, areas around Lake Ziway in Central and Lake Haro-Maya in Eastern Ethiopia

[1] Paper by Moti Jaleta and C. Gardebroek, accepted as a book chapter in '*Sustainable Poverty Reduction in Less-favoured Areas,*' CAB International, (*forthcoming*).

have good potential for cash crop production. However, households in these areas are still engaged in producing both cash and food crops using their limited land and labour resources. Though it is believed that cash crops can help these households to earn more profit per unit of resource used, a complete shift of land and labour towards cash crop production is hardly seen and the share of land allocated to cash crop is still minimal. Of the total farmland cultivated by the sample households from both Ziway and Haro-Maya areas covered under this study, only 32.5% percent is covered by cash crops during the 2002/03 production period. The lack of a complete or partial shift towards specialized high value cash crop production is linked to households' resource use behavior under market imperfections (de Janvry et al., 1991; Omamo, 1998).

The overall objective of this chapter is to assess farm households' land and labour allocation decisions to cash and food crop production in these two regions in Ethiopia. This analysis contributes to identifying variables that influence farm household decisions in shifting resources from subsistence food production towards market oriented cash crop production, which is important given current food self-sufficiency policies and poverty reduction strategies for Ethiopia. Although regions in Ethiopia differ in their natural conditions and human interference the country as a whole can be considered as a less-favoured area. Important to recognize is that the indication of a less-favoured area not only refers to natural and bio-physical conditions but also to constraints originating from lack of human interference. Areas with good agricultural potential that are currently used for low value production are therefore also included in this condition (Kuyvenhoven et al., 2004).

To attain the above-mentioned objective, a theoretical non-separable farm household model is used as a starting point. This model gives a detailed explanation of households' land and labour allocation decisions between cash and food crop production activities taking into account market imperfections due to high transaction costs in the markets. Based on the optimal land and labour allocation decisions derived from the model's first-order conditions, an empirical model is formulated and estimated. A switching regression model with endogenous switching (Maddala, 1983:223-228) is used to investigate differences in input allocation between participants and non-participants in land and labor markets. This methodology differs from the 'standard' Heckman two-step procedure that is often mechanically applied in studies like this. The advantage of the switching regression model with endogenous switching is that both regimes are estimated jointly and that one can test for differences in impact of variables in both regimes easily.

The remainder of the chapter is structured as follows. Section 4.2 describes the non-separable household model that underlies our analysis. From this model it follows which variables have to be used in the empirical model. Section 4.3 discusses the specification of the reduced form equations that are based on the theoretical model. The data used is discussed in section 4.4. This section also presents some basic statistics on land and labour market participation for food and cash crop production. Section 4.5 deals with technicalities of our estimation procedure. The switching regression model with endogenous switching is discussed here, as well as calculation of price indices used. Estimation results are given in section 4.6 and conclusions and implications are presented in section 4.7.

4.2 The basic farm household model

Since first developed by Singh et al. (1986), non-separable farm household models were used frequently to address research questions related to the complex behaviour of farm households under missing or imperfect markets (de Janvry et al., 1991; Sadoulet and de Janvry, 1995; Key et al., 2000). The theoretical model described in this section is adapted from the work of Woldehanna (2000).

In building up our theoretical farm household model the following two basic assumptions are made. First, there is at least one imperfect factor or product market for rural farm households. Second, due to these market imperfections the production and consumption decisions of peasant households are non-separable (Sadoulet and de Janvry 1995). Given these assumptions, the optimization problem of households is to maximize utility subject to liquidity, technology, commodity balance and non-negativity constraints:

$$\underset{c,q,x,A,L}{Max}\ U(C_f, C_m, l; z_u) \tag{4.1}$$

Subject to:

$$\sum_i \left[\left(p_i - d_i^s \right) s_i - \left(p_i + d_i^b \right) b_i \right] - p_x X + T + R \geq 0 \qquad i \in (c, f, m, L_c, L_f, A_c, A_f) \tag{4.2}$$

$$G_i(q_i, X_i, L_i, A_i, K_i, W_i, z_{qi}) \geq 0 \quad ; \qquad i \in (c, f) \tag{4.3}$$

$$q_i + e_i + b_i - s_i - X_i - C_i \geq 0 \qquad i \in (c, f, m, L_c, L_f, A_c, A_f) \tag{4.4}$$

$$C_f,\ C_m,\ l,\ q_c,\ q_f,\ X_f,\ X_c,\ L_f,\ L_c,\ A_c,\ A_f,\ W,K \geq 0 \tag{4.5}$$

where $U(.)$ is household utility, which is a function of household consumption of food, C_f, consumption of manufactured goods, C_m, and leisure, l, and household specific characteristics, z_u, commonly denoted as taste shifters. In the constraint equations (4.2)-(4.5), s_i and b_i are quantities of the i^{th} commodity sold and bought, respectively, at market prices p_i that are adjusted by transaction costs for selling (d_i^s) and buying (d_i^b). Commodities include cash crops (c), food crops *(f)*, manufactured goods (m), labour (L) and land *(A)*. Buying and selling transaction costs are assumed to be different for the same household and the same commodity. p_x is price for variable input X (that comprises seed, fertilizer, herbicides, pesticides and fuel for irrigation). T is net transfers received including remittances,[2] and R is credit available to the household[3]. Produced quantity of crop i is denoted by q_i, K_i is capital employed on the farm, W_i refers to water use for irrigation and z_{qi} represents farm characteristics like soil type or fertility index.

In equation (4.4), for a given commodity, the sum of home produced, initially endowed and purchased quantity should not be less than the sum of what the household consumed, sold or used as an input. This commodity balance holds for outputs (food and cash crops), manufactured goods and inputs (land and labour).

The farm household decision prices both in factor and product markets incorporate transaction costs associated with the marketing of factors and products. When factors and/or products are non-tradable for a given farm household, decision prices of these factors and/or products are the endogenous shadow prices of these non-traded commodities. Thus, the decision prices are given as (de Janvry et al., 1991; Key et al., 2000)[4]

$$p_i^* = \begin{cases} p_i + d_i^b & \text{Buying price} \\ p_i - d_i^s & \text{Selling price} \\ \widetilde{p}_i = \mu_i / \lambda & \text{Self - sufficient (autarkic) price} \end{cases} \qquad (4.6)$$

[2] The net transfer includes net surplus from livestock marketing and used to finance crop production.
[3] Credit includes the values of variable inputs (like fertilizer, pesticides, etc) obtained on credit and the potentially available credit for production and consumption purposes.
[4] Note that price mark-ups in this model originate from transaction costs. These mark-ups may also be due to (price) risk effects (e.g., Sadoulet and de Janvry, 1995:112-126). However, risk is not modeled explicitly in this paper since that would make the model too complicated.

The Lagrangian associated with the constrained maximization problem is given as:

$$\Gamma = U(C_f, C_m, l; z_u) + \lambda\left[\sum_i \left[\left(p_i - d_i^s\right)s_i - \left(p_i + d_i^b\right)b_i\right] - p_x X + T + R\right]$$
$$+ \sum_i \phi_i\left[G_i\left(q_i, X_i, L_i, A_i, K_i, W_i; z_{qi}\right)\right] + \sum_i \mu_i(q_i + e_i + b_i - s_i - X_i - C_i) \qquad (4.7)$$
$$i \in (c, f, m, L_c, L_f, A_c, A_f)$$

Note that λ, ϕ and μ_i are the Lagrange multipliers for the liquidity constraint, the production technology constraint and the commodity balance constraints, respectively. These Lagrange multipliers can be interpreted as shadow prices so that λ stands for the shadow value of liquidity to a household and μ_i is the shadow value for an additional unit of a commodity (e.g. including land or labour).

The first-order Kuhn-Tucker conditions of the above constrained maximization problem give an interior solution for the optimal quantities and the household specific decision prices for both tradable and non-tradable factors and products. Using these Kuhn-Tucker conditions land and labour allocation decisions at a household level are analyzed. Rewriting the first-order Kuhn-Tucker conditions for land and labour gives:

$$\phi_i \frac{\partial G_i(.)}{\partial Z_i} = \begin{cases} \lambda(p_i + d_i^b) & \text{for households renting in } Z_i \\ \mu_i & \text{for households self-sufficient in } Z_i \\ \lambda(p_i - d_i^s) & \text{for households renting out } Z_i \end{cases} \qquad (4.8)$$

where $Z_i \in \left(L_c, L_f, A_c, A_f\right)$. From equation (4.8) one can derive that households equate the marginal revenue of an input with the corresponding valuation for that input. The valuation of an input depends on the status of a household in an input market, i.e. whether the household is a net seller, net buyer or self-sufficient in that market. For households facing high transaction costs in input markets, renting in an input for production of a given crop is feasible only when the marginal revenue product of this input is high enough to compensate the marginal cost, which is the effective renting in price marked up by household liquidity constraint. In addition to the effective input costs indicated, renting in an input is almost impossible for households badly constrained by liquidity shortage as the complementary farm inputs used to increase input productivity also increase the liquidity constraint to a household (Woldehanna, 2000). If there is no input transaction in

the household, the optimal input allocation is determined by equality of the marginal value product of the input and shadow value of the input to the household.

4.3 Reduced form equations for land and labour allocation decisions

The presence of the Lagrange multipliers in the endogenous prices of equation (4.8) prevents solving these first-order conditions. Therefore, reduced form equations based on these optimality conditions are specified in this section. These equations are used to estimate parameters involved in farm household land and labour allocation decisions between cash and food crops.

The optimal allocation of inputs between cash and food crops is mainly determined by the marginal revenue products of inputs used for the production of these alternative crops. The marginal revenue product of farm input by itself is a function of the marginal product of the input in use for the production of crop *i* (which is also a function of other complementary inputs used in the production process) and the household decision prices of the alternative outputs, which is a function of output market associated transaction costs and household characteristics governing household taste and preferences.

The marginal product of farm input for crop *i* can be derived from the production technology specified in equation (4.3). By substituting this marginal product of farm input in equation (4.8) we get input demand for the production of the i^{th} crop by each household. Considering that farm households are participating in factor and product markets, the optimal demand for farm input (Z_i^*) to produce the i^{th} crop is given in reduced form as:

$$Z_i^* = Z_i(p_f, p_c, p_{A_i}, d_f^b, d_f^s, d_c, d_{Ai}, p_x; K, W, T, R, z_q) \tag{4.9}$$

Since the equality of marginal revenue product and marginal cost incorporates the effective input and output prices and the marginal product of a given factor is a function of all inputs used, the demand for each input should be derived simultaneously from the system of Kuhn-Tucker's first-order conditions. These simultaneously derived demands for factor inputs are defined in terms of the exogenous factor and product prices, household specific transaction costs, fixed inputs and farm characteristics.

However, when households are not participating in some of the factor and/or product markets, prices associated to these factors and/or products are shadow prices for

these households and these shadow prices are a function of the observable market prices, viz. experienced prices of other netputs for which they do participate in the market or in case of non-participation for another netput the average price, and household and farm characteristics (Dutilly-Diane et al., 2003). Therefore, for such households, allocation of farm inputs for the i^{th} crop is expressed in a functional form as:

$$Z_i^* = Z_i(p_c, p_f, p_x, d_c; K, W, T, R, z_q, z_u) \tag{4.10}$$

4.4 Data

The data used in this study was collected in 2003 by conducting a household survey at two research sites in Ethiopia: around Lake Haro-Maya (500km East of Addis Ababa) and Lake Ziway area (160km South of Addis Ababa) both in the Oromia Regional State of Ethiopia. A total sample of 154 farm households were included in the survey whereas 78 of them were around Ziway and the remaining 76 were from Haro-Maya. Farm households were randomly selected from the cash crop producing households living in these areas. The two study sites were selected intentionally because of their potential in vegetable production and difference in vegetable market destination. Vegetable products from Haro-Maya area are channelled to Djibouti for export whereas vegetable products from Ziway area are traded at Addis Ababa (central/domestic market).

The sample households from the two research sites also differ in their market participation status in different markets. Households around Haro-Maya participate less in the land rental market than households around Ziway both for cash and food crop production (see table 4.1). This might be due to relatively small holdings around Haro-Maya and the covering of farmland by perennial crops (i.e., *chat*). This plantation of perennial crops around Haro-Maya does not allow mobilizing land towards more productive activities through renting in or out.

Table 4.1 Household participation in farmland rental market

	Number of sample households renting farmland					
	in for		out for		autarkic in land for	
	cash	*food*	cash	*food*	cash	*food*
Ziway	25	*28*	12	*3*	41	*47*
Haro-Maya	11	*0*	0	*1*	65	*75*
Total	36	*28*	12	*4*	106	*122*

Note: the sample sizes are 78 for Ziway and 76 for Haro-Maya.

The proportion of farm households participating in the labour market is higher for the sample from Ziway area. More households hire agricultural labour for cash crop production though labour is hired for food crop productions too. Participation in off-farm and non-farm work is also higher for Ziway area. Most of the households working off-farm are engaged in either petty trade or fishing activities by family members (see table 4.2).

Table 4.2 Labour market participation status of the sample households

	Hired labour				Work off or non-farm jobs	
	For food crops		*For cash crops*			
	count	*%*	*count*	*%*	*count*	*%*
Ziway	67	*85.9*	76	*97.4*	34	*43.5*
Haro-Maya	49	*64.7*	39	*51.3*	20	*26.3*
Total	116	*75.3*	115	*74.7*	54	*35.1*

Of all sample households from Haro-Maya, 32% of them did not use a water pump. Most of these households dug wells near their plots and used buckets to get the water up from the wells to irrigate their plots. However, more than half of the sample households at both research sites have a motor pump for private usage, i.e., they have either bought it or rented it in for a specific production period (see table 4.3 for details). From the 154 sample households at both research sites, 20 percent of the households are net buyers in food crops whereas about 33 per cent are autarkic in food crops. The remaining 47 percent are net sellers in food crop markets.

Table 4.3 Motor pump ownership right of the sample households

Type of ownership right	Haro-Maya		Ziway	
	Count	*%*	Count	*%*
Does not use motor pump	25	32.9	1	1.3
Goodwill of neighbours or relatives	6	7.9	2	2.6
Exchange for resource (land or labour)	3	4.0	9	11.5
Share with others as a cooperative	0	0.0	25	32.1
Rented	13	17.1	14	18.0
Owned through purchase	29	38.2	27	34.6

4.5 Empirical models

As indicated in equations (4.9) and (4.10), the quantity of land and labour allocated by each farm household for the production of either cash or food crops is, among other factors, a function of market prices for these resources. However, these market prices are observable only when households are participating in the corresponding markets.

Therefore, household market participation status plays a crucial role in modeling the household land and labour allocation decision behavior. If households do not participate in say the land market, it is the unobserved shadow price which is relevant for land allocation decisions and not the rental land price. Approximating the unobserved shadow price by a set of household characteristics leads to the specification of a switching regression model with different specification for participants and non-participants. Since participation may be affected by self-selection the appropriate estimation procedure is a switching regression model with endogenous switching (Maddala, 1983:223-228).

In explaining the switching regression model with endogenous switching the model is presented in a simplified form. The discussion focuses on land allocation, although the same specification holds for labour allocation. Since the number of sample households that fall into the category of net sellers in land does not allow us to estimate land allocation, we focus on deriving land allocation equations for net buyers and autarkic households in land (see table 4.1). Similarly, almost all of the sample households are either net buyers or autarkic in labour for the production of both crops (see table 4.2). Therefore, labour allocation is estimated only for these two groups as well.

Defining the market participation decision (y_j) as a dummy variable:

$$y_j = \begin{cases} 1 & if \quad Z_j\gamma \geq u_j \\ 0 & otherwise \end{cases} \tag{4.11}$$

where Z_j is a vector of variables explaining whether a given household is a net buyer or autarkic in a factor market, and u_j is an error term with zero mean and $\text{var}(u_j) = 1$.

Based on a household's status in the land market, household land allocation can be given in two separate equations for a specific crop as:

$$A_j^b = X_{1j}\beta_1 + \varepsilon_{1j} \qquad iff \qquad Z_j\gamma \geq u_j \tag{4.12}$$

$$A_j^a = X_{2j}\beta_2 + \varepsilon_{2j} \qquad iff \quad Z_j\gamma < u_j \tag{4.13}$$

where A_j^b and A_j^a are land allocation by net buyers and households autarkic in land respectively for production of a specific crop (either cash or food). X_{1j} and X_{2j} are

explanatory variables for land allocation in the two categories, β_1 and β_2 are parameters to be estimated, and ε_{1i} and ε_{2i} are error terms with $\text{cov}(\varepsilon_{1j}, \varepsilon_{2j}) = \sigma_{12}$, $\text{cov}(\varepsilon_{1j}, u_j) = \sigma_{1u}$, and $\text{cov}(\varepsilon_{2j}, u_j) = \sigma_{2u}$. The expected values of ε_{1i} and ε_{2i} conditional on the household's market participation status are given as (Maddala, 1983:224):

$$E[\varepsilon_{1j} \mid u_j \leq Z_j\gamma] = -\sigma_{1u}\frac{\phi(Z_j\gamma)}{\Phi(Z_j\gamma)} \tag{4.14}$$

and

$$E[\varepsilon_{2j} \mid u_j \geq Z_j\gamma] = \sigma_{2u}\frac{\phi(Z_j\gamma)}{1-\Phi(Z_j\gamma)} \tag{4.15}$$

Then, the self selection corrected land allocation equations for net buyers and households autarkic in land are given as:

$$A_j^b = X_{1j}\beta_1 - \sigma_{1u}\frac{\phi(Z_j\gamma)}{\Phi(Z_j\gamma)} + \xi_{1j} \tag{4.16}$$

$$A_j^a = X_{2j}\beta_2 + \sigma_{2u}\frac{\phi(Z_j\gamma)}{1-\Phi(Z_j\gamma)} + \xi_{2j} \tag{4.17}$$

where ξ_{1j} and ξ_{2j} are the new error terms with zero mean, $\phi(Z_j\gamma)$ and $\Phi(Z_j\gamma)$ are, respectively, the density and cumulative normal distribution function of the probability that household *j* participates in land rental market as a buyer.

One can estimate equation (4.16) and (4.17) each separately by using Heckman's two stage procedure (Heckman, 1979) as is done in many studies. However, Maddala (1983: 227) suggests that it is sometimes more fruitful to estimate the two equations (4.16) and (4.17) simultaneously by using all the observations in A_j. The merit of this simultaneous estimation is that one can test which coefficients are different in the two estimation equations. In our case this is relevant since it indicates which variables have a

significant different impact in both regimes. In other words, we can learn how allocation behaviour changes in going from non-market participation to participation.

By combining the expected values of land allocation in both categories, we get:

$$\begin{aligned} E(A_j) &= E(A_j \mid Z_j\gamma \geq u_j).pr(Z_j\gamma \geq u_j) + E(A_j \mid Z_j\gamma \leq u_j).pr(Z_j\gamma \leq u_j) \\ &= \beta_1' X_{1j}\Phi_j + \beta_2' X_{2j}(1-\Phi_j) + \phi_j(\sigma_{2u} - \sigma_{1u}) \end{aligned} \tag{4.18}$$

where $\phi_j = \phi(Z_j\gamma)$ and $\Phi_j = \Phi(Z_j\gamma)$. When some of the variables in X_{1i} and X_{2i} are the same, like we have in equations (4.9) and (4.10), we can rewrite equation (4.18) by sub-dividing the vector of explanatory variables into sub-groups based on whether they appear in both equations or just in one equation alone. Thus, by specifying $X_{1j} = [X_{11j}\ X_{12j}]'$ and $X_{2j} = [X_{12j}\ X_{22j}]'$ where X_{12j} are variables that appear in both regimes, equation (4.18) can be rewritten as:

$$E(A_j) = \beta_{11}' X_{11j}\Phi_j + (\beta_{12}' - \beta_{21}')X_{12j}\Phi_j + \beta_{21}' X_{12j} + \beta_{22}' X_{22j}(1-\Phi_j) + \phi_j(\sigma_{2u} - \sigma_{1u}) \tag{4.19}$$

β_{11} and β_{22} are vector of parameters for variables that only appear in X_{11} and X_{22} respectively, $\beta_{12}' - \beta_{21}'$ measures whether there is a different impact of variables in participation and non-participation regimes.

Estimation results can be obtained using a two stage estimation procedure (Maddala 1983: 227). First, parameters for market participation (γ) are estimated by a probit ML estimation procedure. From the estimated probit coefficients for market participation ($\hat{\gamma}$), both ϕ_j and Φ_j are computed for each observation. Finally, equation (4.19) is estimated by regressing A_j on X_j, $\hat{\phi}_j$ and $X_j\hat{\Phi}_j$ using OLS.

Based on the reduced form land and labour allocation equations (4.9) and (4.10), variables used in estimation are presented in table 4.4. Household head's age and education are considered since household heads usually make farm resource allocation decisions. Number of dependents in a family may influence household's taste and preference in consumption and the effect is expected to be higher particularly for households not participating in markets as the focus of land and labour allocation for these households is to satisfy the household consumption internally. Livestock wealth

measured in Tropical Livestock Unit (TLU) is assumed as a proxy for the wealth status of a household. Exogenous income and credit available to a household usually affect household's liquidity position and also the demand for farm inputs as well. Value of agricultural tools, motor pump ownership, and distance from the nearest local market are considered as a proxy for household's farm capital, access to irrigation water, and transaction costs, respectively. A dummy for regional difference is also included when the model is estimated using data from both regions.

To be specific in line with notations in equation (4.19), X_{11} stands for land price for households participating in land market, $X_{12} = X_{21}$ refers to age and education of household head, livestock wealth, available family labour for agricultural use, farm capital, credit available, exogenous income, distance to local market, price indices for cash crop, food crop and fertilizer. Number of dependents in a household is represented by X_{22}.

Since there are a number of crops grown and various inputs are used in production, aggregating input and output prices is important. Though price variation is not expected much in cross-section data, there is variation observed among the sample households on factors and products marketed. This variation could be due to variations in the nature of markets, quality of input or output marketed, period of a year when the item is marketed, individual bargaining power in the markets, or else. The variation in land rental prices is mainly due to the location of farmland and its proxy to the water sources which mostly determine the type of crop grown on the farmland.

Price indices are calculated for two category of outputs (cash and food crops) and inputs (fertilizer and other chemicals). Cash crop consists of tomato, onion, cabbage, and pepper for households around Ziway and potato, beetroot (reddish), leek and carrot for households around Haro-Maya[5]. Maize, wheat, teff, haricot bean and sorghum are considered in the food crop category. The first three are dominant around Ziway but only maize and sorghum for households around Haro-Maya.

[5] Chat is produced as a cash crop around Haro-Maya but is not included here because chat is a perennial crop and hardly competes with other crops at least for land in a short-run. However, its effect on the allocation of land and labour via household income is included like the income from livestock for households around Ziway

Table 4.4 Descriptive statistics of variables used in estimations.

Variables	Units of measurement	Ziway				Haro-Maya			
		Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Household head's age (**age**)	*years*	39.37***	10.46	20	62	32.53	7.05	21	56
Household head's education (**edu**)	*years*	5.12**	3.02	1	12	4.18	3.14	0	12
Family labour (**famlab**)	*AE* [a]	2.73***	1.25	1	7.25	2.04	0.79	1	4
Number of dependents in a family (**dependt**)		2.18	1.87	0	9	1.97	1.19	0	5
Livestock wealth owned by a household (**tlu**)	*TLU* [b]	5.32***	5.60	0	38.6	1.75	1.06	0	6.05
Exogenous income (**exincome**)	*1000Birr* [c]	1.37	1.43	0	6	1.44	1.70	0	10.9
Value of agricultural materials owned (**vagrmtn**)	*1000Birr*	1.12***	1.94	0.05	15.12	0.38	0.27	0.08	1.47
Credits available to a household (**credit**)	*1000Birr*	0.61	1.21	0	6	0.18	0.63	0	5
Dummy for motor pump ownership (*1=yes, 0=no)* (**Pump**)		0.35	0.48	0	1	0.38	0.49	0	1
Distance of the nearest market form a homestead (**nstmktkm**)	*km*	2.93	3.43	0.01	18	2.74	1.87	0.02	7
Price index for cash crops (**prindexcc**) [e]		-0.60	0.39	-1.70	0.78	-0.31***	0.22	-0.89	0.73
Price index for food crops (**prindexfc**)		-0.01	0.07	-0.38	0.14	0.01***	0.04	-0.08	0.25
Fertilizer price index for cash crops (**fertprindexcc**)		-0.02	0.12	-0.57	0.23	0.02**	0.13	-0.22	0.78
Fertilizer price index for food crops (**fertprindexfc**)		-0.01	0.04	-0.14	0.13	0.01*	0.08	-0.41	0.12
Land rental price for cash crop production (**landricpr**)	*Birr*	184.88	49.05	50	330	198.75**	34.16	120	350
Land rental price for food crop production (**landrifpr**)	*Birr*	75.64	29.17	25	220	75.64	0	75.64	75.64
Owned land available for cash crop (**ownlncc**)	*Qarxi* [d]	2.25***	2.16	0	9	1.38	1.21	0	8
Owned land available for food crops (**ownlnfc**)	*Qarxi*	9.90***	9.77	0	64	2.53	1.16	0	9

NOTES: **, **, and *** indicates a sub sample mean significantly larger than the other sub sample mean at 10% , 5% and 1% significance levels, respectively.*

[a] *Adult Equivalent (8hrs work per day per adult)*

[b] *TLU indicates Tropical Livestock Unit .*

[c] *Birr is Ethiopian currency (1Euro=10Birr during the study period).*

[d] *Qarxi is a local unit for farmland measurement (1Qarxi= 0.25ha or a one-day farm plot with two oxen draft power).*

[e] *Price indices are reported in their natural logarithm.*

Since households participate in different markets to buy and/or sell the same crop, there is no unique price for most of the crops marketed. Thus, average prices for each crop, weighted by the quantity of each crop marketed in different markets at the market specific prices, are considered. After obtaining the average prices for each crop, Divisia price indices are computed (Higgins, 1986):

$$\ln P_j^k = \tfrac{1}{2}\sum_i^g (r_{ij}^k + \bar{r}_{ij})(\ln P_{ij}^K - \overline{\ln P}_{ij}) \tag{4.20}$$

where P_j^k is the price index for the j^{th} aggregate for household k, r_{ij}^k is the share of the i^{th} item in the value of the j^{th} aggregate for the k^{th} household, $\bar{r}_{ij}$ is the average value of the share of the i^{th} item in the j^{th} aggregate on all households, $\ln P_{ij}^k$ is the natural log of the price of the i^{th} item in the j^{th} aggregate for household k, $\overline{\ln P}_{ij}$ is the average of the natural log of the price of the i^{th} item in the j^{th} aggregate on all households, and g is the number of items in the j^{th} aggregate. The base of the index is the average value of the sample. For households without observation, the average value of the other households with observation is considered (Higgins, 1986).

4.6 Estimation results

Based on equations presented in section 4.5, estimation results for land and labour market participation equations and the endogenously switching regression model for household land and labour allocation are presented in this section. The first subsection presents estimation results of household farmland allocation where household labour allocation is presented in the subsequent subsection.

Household farmland allocation

The probit estimation results presented in table 4.5 show that farm household decisions to rent in land for cash crop production are strongly influenced by motor pump ownership. Cash crops are mostly produced using irrigation water pumped up with motor pumps from lakes in the region. Family labour availability for agricultural use significantly increases the probability of households to rent land in for cash crop production. Land market participation as a buyer decreases in size of farmland holding. Elderly household

heads are usually the ones that have the use right contract with the government on land. Thus, young household heads obtain land for crop production either by renting in or arranging sharecropping contracts with elderly household heads. There is a significant regional effect in explaining the probability of renting in land. Households around Ziway are more involved in renting land in. Distance from local market significantly decreases household's probability of being a buyer in land market for food crop production around Ziway. Although the number of significant explanatory variables is limited, the LR test indicates that the included variables overall do contribute in explaining land renting in decisions.

For households renting in land, table 4.6 shows that high land rental prices go together with relatively low areas rented in for cash crops. Note that for food crops land price has no significant effect on allocation of land for land market participants. In most cases, households with larger farm capital use more land for cash crops in Haro-Maya and food crops around Ziway. At Haro-Maya, households with higher exogenous income, mostly income from *Chat* sale, operate both cash and food crops on relatively larger farmland areas. Households owning a motor pump allocate more land to cash crop production (see table 4.6 for details). Since food crops are usually produced during the rainy season, motor pumps are not used in food crop production. This is also reflected in the estimation results.

There is a positive and significant effect of household heads' age and education as well as livestock wealth on land allocation for cash crop production for households that participate in the land market. The effect of available family labour on land allocation for cash crop production is stronger for autarkic households in land. Surprisingly, distance to local market has no significant effect on land allocation to cash crops, although the parameters have the expected negative sign. Distance to nearest market has a significant impact on land allocation for food crops. For Ziway the effect is negative, which is counterintuitive. This impact is positive for households around Haro-Maya who are mainly depending on their own farm for food crop production. Results further show that sample selection has a significant impact in the land allocation equations for cash crops using pooled data and for food crops in Ziway.

Table 4.5 Probability of land market participation as a buyer for cash and food crop production

	land for cash			land for food
landbuyerhr	Pooled (142)	H-Maya (76)	Ziway (66)	Ziway (75)
Age	**-0.06***	-0.03	-0.47	0.03
	(0.03) [a]	*(0.17)*	*(0.31)*	*(0.02)*
Edu	0.06	-0.16	0.08	**-0.17****
	(0.07)	*(0.29)*	*(0.26)*	*(0.07)*
Tlu	-0.06	-2.60	-0.31	0.00
	(0.09)	*(2.33)*	*(0.33)*	*(0.04)*
Famlab	**0.69*****	-1.02	**4.71***	**-0.51****
	(0.25)	*(1.39)*	*(2.86)*	*(0.20)*
Dependt				0.22
				(0.14)
Exincome	-0.01	0.38	-1.53	0.02
	(0.13)	*(0.77)*	*(1.25)*	*(0.14)*
Vagrmtn	0.29	-2.23	-0.58	0.08
	(0.55)	*(4.38)*	*(1.49)*	*(0.17)*
Credit	0.20	-1.10	2.35	-0.12
	(0.21)	*(1.41)*	*(2.78)*	*(0.20)*
Pump	**1.05****	4.75	7.44	0.30
	(0.41)	*(3.96)*	*(5.79)*	*(0.44)*
region *(1=Ziway, 0=H-Maya)*	**1.25****			
	(0.60)			
Nstmktkm	0.05	-1.73	0.75	**-0.12***
	(0.07)	*(2.04)*	*(0.52)*	*(0.07)*
Prindexcc	-0.48	-1.70	-2.57	0.70
	(0.60)	*(1.71)*	*(2.18)*	*(0.58)*
Prindexfc	-1.34	5.49	-6.86	4.89
	(3.13)	*(15.72)*	*(8.09)*	*(3.49)*
fertprindexcc/fc	-0.40		18.87	-6.34
	(2.16)		*(14.57)*	*(4.63)*
landricpr (landrifpr)	0.00	0.03	-0.02	0.00
	(0.00)	*(0.02)*	*(0.01)*	*(0.01)*
ownlnhr/fc	**-1.49*****	-6.08	**-5.92***	**-0.05***
	(0.29)	*(5.99)*	*(3.45)*	*(0.03)*
Constant	-0.85	8.24	8.99	1.00
	(1.37)	*(13.94)*	*(5.72)*	*(1.08)*
LR chi2(15)	*97.42*	*48.5*	*71.72*	*29.86*
Prob > chi2	*0.000*	*0.000*	*0.000*	*0.012*
Pseudo R2	*0.61*	*0.77*	*0.82*	*0.30*

Note: ***, ** and * *refer to 1%, 5% and 10% significance levels, respectively.*

[a] *Standard errors are given in parentheses*

Table 4.6 Land allocation for cash and food crop production

Variables	Pooled (142)	cash		food	
		H-Maya (76)	Ziway (66)	H-Maya (75)	Ziway (75)
Age	0.00	0.03	-0.06	**-0.04***	**1.12*****
	(0.02)	*(0.02)*	*(0.06)*	*(0.02)*	*(0.18)*
Edu	-0.02	0.01	-0.19	0.01	**-0.88***
	(0.07)	*(0.04)*	*(0.19)*	*(0.05)*	*(0.45)*
Tlu	0.05	-0.03	0.01	-0.01	**-0.58****
	(0.05)	*(0.16)*	*(0.09)*	*(0.14)*	*(0.27)*
Famlab	**0.52****	0.25	0.41	0.23	**-8.72*****
	(0.22)	*(0.20)*	*(0.56)*	*(0.19)*	*(1.34)*
Dependt	0.00	-0.02	0.00	-0.01	**2.92*****
	(0.14)	*(0.10)*	*(0.29)*	*(0.12)*	*(1.03)*
Vagrmtn	**0.75****	**2.07*****	0.75	0.67	**3.48*****
	(0.30)	*(0.58)*	*(0.53)*	*(0.58)*	*(0.81)*
Credit	-0.29	-0.01	-0.47	-0.13	**-3.85*****
	(0.29)	*(0.31)*	*(0.64)*	*(0.21)*	*(1.21)*
Exincome	-0.01	**0.18***	-0.19	**0.21****	0.23
	(0.15)	*(0.11)*	*(0.38)*	*(0.09)*	*(1.13)*
Pump	**0.94****	**0.72****	1.18	0.19	3.16
	(0.46)	*(0.29)*	*(1.06)*	*(0.30)*	*(2.06)*
Nstmktkm	-0.04	-0.02	-0.01	**0.26*****	**-1.57*****
	(0.07)	*(0.08)*	*(0.14)*	*(0.08)*	*(0.27)*
Prindexcc	-0.63	0.51	-0.76	-0.16	**23.58*****
	(0.78)	*(0.61)*	*(1.73)*	*(0.59)*	*(4.12)*
Prindexfc	-6.23	-2.48	-1.52	2.94	**89.53*****
	(4.44)	*(3.77)*	*(9.83)*	*(3.34)*	*(18.31)*
fertprindexcc(fc)	0.26	0.93	1.62	1.71	**-144.32*****
	(1.54)	*(0.85)*	*(4.49)*	*(1.78)*	*(38.69)*
age_phi	**0.11***	0.05	0.01		**-1.68*****
	(0.06)	*(0.19)*	*(0.11)*		*(0.31)*
edu_phi	**0.47*****	-0.44	**0.94****		-1.15
	(0.15)	*(0.31)*	*(0.35)*		*(1.01)*
tlu_phi	**0.46*****	1.30	**0.52****		**2.93*****
	(0.13)	*(1.92)*	*(0.21)*		*(0.63)*
famlab_phi	**-1.53****	-1.99	-0.99		**7.95****
	(0.61)	*(1.79)*	*(0.90)*		*(3.34)*
dependt_-phi	**-0.97****	-0.25	-0.52		-1.98
	(0.41)	*(1.00)*	*(0.65)*		*(1.63)*
vagrmtn_phi	**0.80***	-5.49	1.07		**-6.11****
	(0.42)	*(5.65)*	*(0.73)*		*(2.40)*
Credit_phi	0.32	-0.40	0.42		**7.99****
	(0.60)	*(2.14)*	*(1.04)*		*(3.20)*
exincome_phi	**0.53***	0.63	0.57		0.08
	(0.27)	*(0.70)*	*(1.04)*		*(2.38)*
nstmktkm_phi	**0.57****	0.06	0.41		
	(0.23)	*(0.77)*	*(0.38)*		
prindexcc_phi	0.17	-5.29	2.73		**-42.32*****
	(1.47)	*(3.58)*	*(2.68)*		*(9.44)*
prindexfc_phi	**26.38*****	9.64	17.81		**-102.63****
	(8.98)	*(32.35)*	*(14.64)*		*(45.31)*
fertprindexcc(fc)_phi	**-8.35***	-11.68	-14.84		**198.79****
	(4.97)	*(7.77)*	*(10.13)*		*(76.36)*
landric(rif)pr_phi	**-0.02*****	0.00	**-0.03****		-0.03
	(0.01)	*(0.02)*	*(0.01)*		*(0.04)*
$(\sigma_{2u} - \sigma_{1u})$	**-3.85****	0.29	-3.97		**-36.05*****
	(1.53	*(1.03)*	*(3.68)*		*(12.32)*
Constant	0.68	-0.56	4.47	**1.89****	**28.39*****
	(0.98	*(0.70)*	*(3.11)*	*(0.91)*	*(6.16)*
F(k, n-1)	*16.46*	*4.31*	*5.92*	*1.93*	*10.02*
Prob > F	*0.000*	*0.000*	*0.000*	*0.044*	*0.000*
R-squared	*0.80*	*0.72*	*0.81*	*0.29*	*0.84*
Adj R-squared	*0.75*	*0.55*	*0.67*	*0.14*	*0.76*

Household labour allocation

Probit estimation results in table 4.7 show that, for households around Haro-Maya, labour market participation to hire labour for cash crop production is positively influenced by exogenous income and negatively by food crop prices. Around Haro-Maya, the probability that households hire labour for food crop production decreases with the distance to local markets. High cash crop prices also have a significantly reducing effect on the probability to hire labour for food crop production. Around Haro-Maya, high food crop prices reduce the probability to hire labour for cash crop production. Around Ziway participation in the labour market to hire labour for food crop production is significantly lower for older household heads.

Labour allocation estimates for cash and food crop production for both Haro-Maya and Ziway areas are presented in table 4.8. The amount of labour allocated to cash crop increases with motor pump ownership. Farm capital also has a significantly positive effect on labour allocation to cash crop production around Ziway area. To explain more, the effect of motor pump ownership on labour allocation can be seen from its indirect effect on the expansion of the labour intensive cash crop production. Farm capital also increases both land and labour productivity and help households to employ more of these resources for higher profit.

Higher cash crop prices have a reducing effect on household labour allocation to food crop production around Ziway. The effect is even higher for households participating in the labour market to hire labour for food crop production. Once households are participating in the labour market to hire labour for cash crop production household head's education and farm capital have a positive and significant effect on the size of labour that households allocate to cash crop production. In food crop productions both around Haro-Maya and Ziway, households with larger livestock wealth allocate more labour to food crop productions and the impact of livestock wealth on allocating labour for food crop is higher for autarkic households in labour for food crops. The impact of sample selection is limited for the labour allocation equations. It only is significant for food crop labour allocation using pooled data.

Table 4.7 Probability of labour market participation as a buyer for cash and food crop production

	labour for cash		Labour for food		
Variables	Pooled (154)	H-Maya (76)	Pooled (164)	H-Maya (76)	Ziway (78)
Age	-0.02	0.00	-0.02	-0.01	**-0.06*** **
	(0.02)	*(0.03)*	*(0.02)*	*(0.03)*	*(0.03)*
Edu	0.06	0.08	0.03	0.06	-0.14
	(0.05)	*(0.06)*	*(0.04)*	*(0.07)*	*(0.09)*
Famlab	-0.24	-0.07	0.03	-0.25	0.35
	(0.18)	*(0.26)*	*(0.15)*	*(0.29)*	*(0.26)*
Tlu	-0.09	-0.29	**0.21** **	0.20	0.19
	(0.08)	*(0.19)*	*(0.09)*	*(0.27)*	*(0.12)*
Region	**2.71*** **		-0.10		
	(0.70)		*(0.35)*		
Nstmktkm	0.06	0.09	**-0.08***	**-0.42*** **	0.14
	(0.08)	*(0.10)*	*(0.05)*	*(0.12)*	*(0.11)*
Vagrmtn	**1.00***	0.00	0.37	**1.83***	0.56
	(0.59)	*(0.71)*	*(0.30)*	*(1.03)*	*(0.49)*
Credit	-0.29	-0.78	0.07	0.10	0.13
	(0.20)	*(0.51)*	*(0.17)*	*(0.31)*	*(0.27)*
Exincome	**0.27** **	**0.53*** **	0.13	0.02	-0.25
	(0.12)	*(0.16)*	*(0.11)*	*(0.18)*	*(0.24)*
Prindexcc	-0.12	-0.96	**-1.41*** **	**-1.82***	**-2.79*** **
	(0.60)	*(0.83)*	*(0.50)*	*(0.94)*	*(1.06)*
Prindexfc	-3.34	**-13.06** **	-1.65	-2.49	0.62
	(4.21)	*(6.59)*	*(2.87)*	*(4.59)*	*(4.94)*
Fertprindexcc/fc	1.25	1.46	-1.86	-3.05	-10.32
	(1.12)	*(1.40)*	*(2.08)*	*(3.00)*	*(8.42)*
Constant	0.03	-0.82	0.10	0.69	0.72
	(0.87)	*(1.09)*	*(0.67)*	*(1.30)*	*(1.29)*
LR chi2(12)	*68.35*	*23.77*	*37.66*	*33.13*	*22.33*
Prob > chi2	*0.000*	*0.014*	*0.000*	*0.001*	*0.022*
Pseudo R2	*0.39*	*0.23*	*0.22*	*0.34*	*0.35*

Table 4.8 Estimates of household labour allocation for both cash and food crop production

	labour for cash			labour for food		
Totlabhr	Pooled (154)	H-Maya (76)	Ziway (78)	Pooled(154)	H-Maya (76)	Ziway (78)
Age	-0.54	0.29	1.03	-0.10	1.5	-12.6
	(4.90)	*(1.76)*	*(3.27)*	*(2.40)*	*(1.04)*	*(12.4)*
Edu	**-29.78***	8.13	10.25	18.50	1.1	**-67.1****
	(15.94)	*(6.48)*	*(10.63)*	*(11.68)*	*(5.52)*	*(31.4)*
Famlab	58.19	18.06	-24.25	45.54	-9.0	95.0
	(63.01)	*(24.48)*	*(26.24)*	*(40.35)*	*(11.81)*	*(125.9)*
Dependt	9.52	-13.63		-24.82	10.2	-91.8
	(41.34)	*(14.39)*		*(22.71)*	*(12.08)*	*(61.2)*
Tlu	9.83	-20.17	-4.85	**65.55***	**36.1****	**158.6****
	(34.13)	*(17.24)*	*(5.35)*	*(33.50)*	*(17.03)*	*(83.4)*
Pump	**99.18*****	21.94	**205.41*****			
	(35.91)	*(14.63)*	*(60.84)*			
Nstmktkm	-27.40	6.15	8.31	**-19.85***	-21.0	**134.1****
	(25.78)	*(9.91)*	*(8.53)*	*(11.43)*	*(13.03)*	*(61.6)*
Vagrmtn	-354.48	65.24	**97.68*****	**155.80***	104.0	305.3
	(242.46)	*(84.02)*	*(20.12)*	*(92.28)*	*(94.71)*	*(193.9)*
Credit	**109.52***	-20.05	**-47.92***	30.48	**119.1****	73.5
	(61.32)	*(20.68)*	*(28.09)*	*(49.51)*	*(56.92)*	*(113.7)*
Exincome	-38.19	30.72	2.55	48.55	**-26.9****	-63.9
	(54.28)	*(27.44)*	*(20.75)*	*(36.95)*	*(13.33)*	*(95.8)*
Prindexcc	168.10	10.97	37.20	-235.77	-46.9	**-1561.9***
	(191.24)	*(54.73)*	*(81.54)*	*(162.64)*	*(62.13)*	*(791.8)*
Prindexfc	100.16	111.23	494.49	-670.48	**-668.2*****	5.2
	(752.96)	*(238.51)*	*(429.71)*	*(556.81)*	*(242.87)*	*(2694.0)*
fertprindexcc/fc	17.88	206.13	29.52	9.45	-84.3	-2844.0
	(520.81)	*(228.12)*	*(234.63)*	*(636.69)*	*(192.27)*	*(3562.7)*
age_phi	1.74	0.23		-1.75	**-2.9****	8.4
	(5.74)	*(2.93)*		*(3.05)*	*(1.34)*	*(12.1)*
edu_phi	**40.04****	-15.77		**-26.55***	-1.4	**59.0***
	(19.18)	*(10.85)*		*(15.07)*	*(7.44)*	*(30.9)*
famlab_phi	-69.24	3.14		-38.89	**34.2***	-74.7
	(75.01)	*(43.81)*		*(50.29)*	*(18.21)*	*(132.0)*
dependt_phi	-19.47	36.59		38.83	-20.6	**112.6***
	(47.43)	*(25.23)*		*(26.16)*	*(17.38)*	*(64.7)*
tlu_phi	-12.67	16.41		**-63.83***	**-43.3****	**-153.5***
	(34.74)	*(26.05)*		*(33.79)*	*(19.78)*	*(83.6)*
nstmktkm_phi	35.22	-9.13		16.85	**34.4***	**-137.9****
	(27.91)	*(18.06)*		*(12.82)*	*(17.85)*	*(62.7)*
vagrmtn_phi	**466.08***	-59.78		-124.97	-128.6	-277.3
	(244.13)	*(142.43)*		*(93.81)*	*(111.88)*	*(193.0)*
Credit_phi	**-169.68****	59.35		-19.14	**-149.2****	-49.5
	(74.42)	*(67.00)*		*(58.68)*	*(69.12)*	*(121.3)*
exincome_phi	36.72	-14.97		-56.86	**41.1*****	33.6
	(60.06)	*(25.25)*		*(40.55)*	*(14.18)*	*(98.2)*
prindexcc_phi	-174.24	80.58		167.50	70.4	**1448.6***
	(226.35)	*(95.01)*		*(176.11)*	*(94.08)*	*(794.7)*
prindexfc_phi	297.53	-76.41		843.20	**1052.8*****	134.1
	(859.97)	*(592.81)*		*(651.10)*	*(359.67)*	*(2808.2)*
fertprindex_phi	5.19	-186.95		-6.88	92.8	2808.6
	(648.61)	*(344.85)*		*(752.72)*	*(219.30)*	*(3655.4)*
$(\sigma_{2u} - \sigma_{1u})$	20.88	58.05		**-581.70****	-122.1	-386.4
	(223.50)	*(79.30)*		*(227.38)*	*(119.81)*	*(381.7)*
Constant	96.46	-20.48	125.75	**174.56****	65.5	156.5
	(122.06)	*(61.57)*	*(163.70)*	*(72.61)*	*(46.57)*	*(111.9)*
F(k,n-1)	*6.64*	*2.35*	*6.27*	*7.21*	*3.27*	*3.31*
Prob > F	*0.000*	*0.005*	*0.000*	*0.000*	*0.000*	*0.000*
R-squared	*0.58*	*0.56*	*0.54*	*0.58*	*0.62*	*0.61*
Adj R-squared	*0.49*	*0.32*	*0.45*	*0.50*	*0.43*	*0.43*

4.7 Conclusions

Farm household resource allocation decisions are complex especially when household production and consumption decisions are non-separable. This is a feature of households producing outputs both for own consumption and marketing purposes. Such households are neither completely commercialized nor subsistent in production, but in between. To assist these households in moving towards more commercial oriented production strategies, it is important to study and understand their behaviour in market participation and resource allocation decisions. This chapter examines these behavioural decisions of farm households in the context of Ethiopia's rural economy where both cash and food crop production is practiced. Based on the estimation results, some general conclusions can be drawn.

Farm households that own large farm capital and have exogenous income sources are allocating more land and labour to cash and food crop productions. The more farm capital employed on a given farm, the more productive land and labour are. This increased productivity of land and labour at household level encourages households to rent in (hire) more land (labour) as the marginal benefit from renting (hiring) factors from local markets is attractive compared to the market and marketing costs of these resources.

Since cash crops are mostly produced using irrigation, motor pump availability plays a central role. Thus, enabling farm households to use water resources for irrigation and producing relatively high value vegetable crops to be sold can increase household annual income and their overall level of welfare. Moreover, the production of labour intensive vegetable crops has an income distribution effect for landless households depending on labour markets for their livelihood. In doing so, the shift from subsistence to commercial farming contributes towards the general objectives of sustainable poverty reduction in rural areas.

CHAPTER 5

CROP AND MARKET OUTLET CHOICE INTERACTIONS AT HOUSEHOLD LEVEL[1]

5.1 Introduction

Farm households make a number of decisions in their daily activities. In cash crop production, households decide which (combination of) cash crop(s) to grow and at which market(s) to sell their crop harvests. Different market outlets that households may consider are selling at the farm-gate, selling at a local market or selling at a central market. Both crop and market outlet choices are household specific and depend on several attributes like household characteristics, farm resource endowments and access to different market outlets. Effective market prices expected at different market outlets and household's ability to transport their harvest to these different market outlets can also affect household crop and market outlet choices (Fafchamps and Hill, 2005).

A farm-gate transaction usually happens when crops are scarce in their supply and highly demanded by merchants or when the harvest is bulk in quantity and inconvenient for farmers to handle and transport to local markets without losing product quality. A large volume farm-gate transaction also attracts buyers as it helps to get fresh products with more homogeneous quality. For crops like tomato, farm-gate transactions are important as grading and packing are done on the farm under the supervision of the buyer. Therefore, households are expected to base their crop choice on their production capacity, their ability to transport the harvest themselves and their preferred market outlet.

At first glance, crop specific market outlet choice seems a post harvest decision in its nature. However, it could also be decided when farmland is allocated to a specific crop during or before a planting period. The larger the area a household allocates to a given crop, the higher the quantity of harvest expected and the higher the cost of transportation to a local market. Thus, households might consider growing a specific crop relatively on a larger area if they expect that they can sell the crop harvest at the farm-gate. Such considerations are important especially in fresh vegetable production in the absence of storage facilities that could help to spread the selling over time with a minimum loss in quality.

[1] Paper by Moti Jaleta and C. Gardebroek, submitted to *Review of Agricultural Economics.*

From these premises we can formulate the hypothesis that crop and market outlet choices at a farm household level are interdependent. Examining the interaction between crop and market outlet choice is the core of this chapter. Understanding farm household behavior in crop and market outlet choice interaction helps to develop market outlets that could bring maximum benefit to households through orienting household resource use towards specific crop types with relatively higher income per unit of resource used. Moreover, different market outlets require different types of production and marketing chain arrangements. For instance, compared to the shallow local market that does not allow larger volume supply of a given crop at a time, farm-gate and central market transactions require a larger volume of vegetable supply. The underlying difference in the nature of market outlets and household's preference for different production and marketing chain arrangements explain the level of households' commercialisation. Thus, examining the relationship between crop and market outlet choices at household level helps to understand the process of agricultural commercialisation.

This chapter is divided into five sections. Section 5.2 presents two alternative analytical models used and tested in this chapter. Data used for the analysis are described in section 5.3. Estimation results are discussed in section 5.4 and conclusions and implications are presented in section 5.5.

5.2 Analytical models

When there are alternatives to choose from, economic theory tells that agents choose what maximizes their expected utility given the existing situations. However, how these choices are made in time is usually not considered. Some choices are made jointly whereas others are made in successive steps considering all information on the previous decisions. With particular attention to crop and market outlet choices, farm households may successively decide on the crops to be grown, size of farmland allocated to each crop chosen and where to sell the expected crop harvest. Alternatively, households may decide on which vegetables to grow, farmland allocation and market outlet jointly and simultaneously.

Two possible frameworks for crop and market outlet choice interactions are considered in this analysis. The first is a fully recursive model in which households first decide on the allocation of farmland across vegetable crops they would like to grow and then, when the crops are ready for marketing, choose a market outlet. In choosing a market outlet different factors are considered including the size of farmland allocated to a specific vegetable crop. The second framework is a simultaneous model that assumes household

decisions on the size of farmland allocation to a particular crop and market outlet choice to sell the specific crop are jointly made before or during a planting period. Detailed specifications for both models are presented below though we finally use the simultaneous model in estimation as the fully recursive model is embedded in it.

Fully recursive model

A fully recursive market outlet choice model that incorporates the effect of crop choice and size of farmland allocated to the chosen crop is specified as:

$$cr_j^* = X_1\beta_j + \varepsilon_{1j} \tag{5.1}$$

$$A_j = X_2\gamma_j + E[\varepsilon_{2j} \mid cr_j^* > 0] \tag{5.2}$$

$$mr_{jk} = X_3\delta_{jk} + \mu_{jk}A_j + E[\varepsilon_{3jk} \mid cr_j^* > 0] \tag{5.3}$$

where cr_j^* is the probability that a household grows crop j, A_j is the area allocated to crop j, mr_{jk} is the share of crop j marketed at outlet k, and X_i, β_{ij} and ε_{ij} refer to a vector of explanatory variables, a vector of parameters and the disturbance term of equation i, respectively. Note that the area allocated to crop j (A_j) is included in the market outlet choice equation to test the hypothesis that area allocated to a specific crop affects the outlet chosen for that crop.

Instead of using the quantity of vegetable crops marketed at different outlets, the share of each vegetable crop marketed at outlet k is considered in this analysis. This is because quantity does not tell how much a given household is dependent on a given market outlet for a specific crop. Moreover, the quantity of vegetables available for marketing is directly related to the allocated crop area. From the total volume of a given vegetable crop produced and available for marketing, households might sell some share at farm-gate whereas the remaining could be sold at local and/or central market(s). Thus the share of a given crop marketed at a given outlet is related to the share of the same crop marketed at the remaining other two alternative outlets, i.e., $\sum_{k=1}^{3} mr_{jk} = 1$, where k={farm-gate, local market, central market}.

Writing the above equations in a more specific functional form, the area allocated to crop j, conditional on the probability that crop j is grown by a household, $pr(cr_j = 1)$, is given as:

$$A_j = \begin{cases} X_2\gamma_j + \varepsilon_{2j} & iff \;\; cr_j^* > 0 \\ 0 & otherwise. \end{cases} \tag{5.4}$$

where X_2 are explanatory variables influencing the household's decision in allocating land for a crop j. The area allocation across vegetable crops accounting for the crop selection bias is specified as:

$$A_j \left| cr_j^* > 0 = X_2\gamma_j + \rho_j\lambda_j(X_1\beta_j) + u_j \right. \tag{5.5}$$

where $\lambda_j(X_1\beta_j) = \dfrac{\phi(X_1\beta_j)}{\Phi(X_1\beta_j)}$ is the probability of growing crop j and u_j is a normally distributed disturbance term $u_j \sim N(0,\sigma_j^2)$. Moreover, we assume $\text{cov}[u_i, u_j] = 0 \;\; for \; i \neq j$.

The share of crop j marketed at outlet k, conditional on household's decision to grow crop j, $mr_{jk} \left| cr_j^* > 0 \right.$, is given as:

$$mr_{jk} \left| cr_j^* > 0 = X_3\delta_{jk} + \mu_{jk}A_j + \rho_{jk}\lambda_j(X_1\beta_j) + \varsigma_{jk} \right. \tag{5.6}$$

Simultaneous model

In specifying the crop and market outlet choice interactions as a simultaneous equation model, it is assumed that area of land allocated to a specific crop and the share of a particular crop harvest marketed at a given outlet are jointly decided in the planting period. This joint and simultaneous decision model is specified as:

$$A_j \left| cr_j^* > 0 = X_2\gamma_j + \alpha_{jk}mr_{jk}^+ + \rho_j\lambda_j(X_1\beta_j) + u_j \right. \tag{5.7}$$

$$mr_{jk} \left| cr_j^* > 0 = X_3\delta_{jk} + \mu_{jk}A_j + \rho_{jk}\lambda_j(X_1\beta_j) + \varsigma_{jk} \right. \tag{5.8}$$

where γ_j, δ_{jk}, α_{jk}, μ_{jk}, ρ_j, and ρ_{jk} are the structural equation parameters to be estimated. Note that mr_{jk}^{+} in (5.7) is not directly observed at the time of planting a specific vegetable crop but using the principle of rational expectations (Varian, 1992:265), the expected market share equals the actual market share plus an expectation error with zero mean, i.e., $E[mr_{jk}^{+} \mid \Theta] = mr_{jk}$ where Θ is the market information available during the planting period.

The reduced form equations of the simultaneous structural equations above can be written as (Maddala, 1983:245):

$$A_j^{*} = X_2\Psi_1 + X_3\Psi_2 + \Psi_3\lambda_j(X_1\beta_j) + \upsilon_j \tag{5.9}$$

$$mr_{jk}^{*} = X_2\theta_1 + X_3\theta_2 + \theta_3\lambda_j(X_1\beta_j) + \upsilon_{jk} \tag{5.10}$$

where Ψ_i and θ_i are parameters of the reduced form equations and defined in terms of the structural equation parameters as:

$$\Psi_1 = \frac{\gamma_j}{1-\mu_{jk}\alpha_{jk}}, \qquad \Psi_2 = \frac{\alpha_{jk}\delta_{jk}}{1-\mu_{jk}\alpha_{jk}}, \qquad \Psi_3 = \frac{\alpha_{jk}\rho_{jk}+\rho_j}{1-\mu_{jk}\alpha_{jk}}, \qquad \theta_1 = \frac{\mu_{jk}\gamma_j}{1-\mu_{jk}\alpha_{jk}},$$

$$\theta_2 = \frac{\delta_{jk}}{1-\mu_{jk}\alpha_{jk}}, \quad \theta_3 = \frac{\rho_j\mu_{jk}+\rho_{jk}}{1-\mu_{jk}\alpha_{jk}}, \text{ and } \quad \mu_{jk}\alpha_{jk} \neq 1.$$

The identification problem of the simultaneous equation (5.7) and (5.8) is solved by considering at least one additional explanatory variable in X_3 that is not included in X_2 and vice versa (Maddala, 1983:233) and $\mu_{jk}\alpha_{jk} \neq 1$ (Amemiya, 1974).

A three-stage estimation procedure is followed to obtain parameters of the structural simultaneous equations. First, the probability of growing a specific crop is estimated using a Probit ML method. Second, Inverse Mills ratios obtained from the Probit estimation are used with all the exogenous variables in both equations to estimate the reduced form equations by Ordinary Least Squares (OLS). Finally, the predicted values of area allocation and share of harvest marketed at a specific outlet obtained from the reduced form equations are used in the structural equations (Maddala, 1983:245; Hassan, 1996).

From the simultaneous model specified in equations (5.7) and (5.8), one can see that the decision making procedure corresponds to the recursive model when $\alpha_{jk} = 0$. In such a case, the size of farmland allocated to a given crop may affect household market outlet choices (viz. if μ_{jk} is significantly different from zero) and not the other way round, i.e., the

simultaneous equation model turns to be equivalent to the fully recursive model specified in equation (5.5) and (5.6). Therefore, we estimate only the simultaneous equation model, and based on the significance level of α_{jk}, the estimation results are interpreted in either of the two model contexts.

5.3 Data and empirical specification

Household survey data collected in 2003 from Ziway and Haro-Maya areas in Ethiopia is used for this analysis. The survey includes a sample of 154 farm households: 78 from Ziway and 76 from Haro-Maya. Both areas have different market channels. Vegetable products from Ziway area are mainly transported to the central vegetable market at Addis Ababa whereas products from Haro-Maya are assembled by local merchants at Haro-Maya town. These local vegetable assembling merchants transport the vegetable products to Dire Dawa and hand it over to their customers who export the products to Djibouti. Detailed descriptions of the data set are given in the following two subsections.

Crop choice and land allocation across vegetable crops

Of the total sample households around Ziway, 93.6% of them grow tomatoes on an average plot size of 2.71 *qarxi* per household. Around Haro-Maya, potatoes are widely grown in terms of area coverage and number of growers. It is grown by 90.7% of the sample households and, on average, 0.85 *qarxi* of farmland is allocated to potatoes. Table 5.1 gives the number of growers and area allocated to each type of vegetable crop per household.

Table 5.1 Number of growers and farm size allocated to each type of vegetable crop per household

Vegetable type	Number of growers				Area allocation (*qarxi*)					
	Haro-Maya [a]		Ziway		Haro-Maya			Ziway		
	count	%	count	%	Mean	Std. Dev.	Max [b]	Mean	Std. Dev.	Max
Tomatoes	0	0	73	93.6	0	0	0	2.71	3.38	25
Onion	14	18.4	21	26.9	0.13	0.29	1	0.71	1.57	8
Cabbage	23	30.3	0	0	0.17	0.34	2	0	0	0
Kale	0	0	20	25.6	0	0	0	0.32	0.67	3
Pepper	0	0	15	19.2	0	0	0	0.33	1.02	8
Potatoes	69	90.7	0	0	0.85	0.58	4	0	0	0
Beetroot	29	38.2	0	0	0.29	0.52	3	0	0	0
Leek	11	14.5	0	0	0.10	0.28	1.5	0	0	0
Carrot	7	9.2	0	0	0.05	0.20	1.5	0	0	0

Note: [a] 78 households from Ziway and 76 from Haro-Maya.
[b] Minimum is zero for all vegetable types

Households either produce a single vegetable crop or a combination of them at the same time. As the sample households are drawn from a population of households growing vegetables for cash income purpose, all the sample households produce at least one vegetable crop (see table 5.2). The maximum number of vegetable types grown per household is three. It is worth noting that an area of 0.25 *qarxi* per crop is used in this study as a minimum for vegetable production to be recorded in the dataset. There are a number of households growing more vegetable types but on smaller plots that are not convenient for accounting purpose.

Table 5.2 Number of vegetable types grown per household

Number of crops grown [a]	Haro-Maya		Ziway		Total	
	count	%	count	%	count	%
1	25	32.9	38	48.7	63	40.9
2	28	36.8	26	33.3	54	35.1
3	23	30.3	14	18.0	37	24.0

Note: [a] vegetables grown on less than 0.25 qarxi (i.e., less than 0.0625ha) are not considered.

Market outlet choice

Households use a combination of both local market and farm-gate transactions in order to sell their vegetable products, though the share of products marketed at farm-gate and local market differs across crops. Tomato and onion around Ziway are mostly traded at farm gate (80.6% and 77%, respectively) whereas kale and pepper are traded at local markets (66.3% and 86.7%, respectively). For Haro-Maya, almost all vegetables grown are mostly traded at the local market, i.e., farmers have to transport their vegetable harvest to the local market or to vegetable assemblers located at Haro-Maya town. For details, see table 5.3.

Table 5.3 Percentage share of each crop marketed at different market outlets

Vegetable type	Haro-Maya				Ziway			
	No. of producers	Farm-gate	Local market	Central market	No. of producers	Farm-gate	Local market	Central market
Tomatoes	0				73	80.6	8.8	10.6
Onion	14	21.8	78.2	0.0	21	77.0	6.3	16.7
Cabbage	23	23.2	76.8	0.0	0			
Kale	0				20	23.7	66.3	10.0
Pepper	0				15	13.3	86.7	0.0
Potatoes	69	15.6	84.4	0.0	0			
Beetroot	29	19.1	77.5	3.4	0			
Leek	11	30.8	69.2	0.0	0			
Carrot	7	4.1	95.9	0.0	0			

Transporting vegetables to local markets is a farmer's task. This is usually difficult when there is excess supply of vegetable products as excess supply leads to high cost of transportation and, particularly around Haro-Maya, transactions are made on credit basis when there is excess vegetable supply in this area. Farmers receive the value of their harvest from the merchants after their harvest is sold at Djibouti market by exporters to whom the merchants (assemblers) sell. Therefore, when there is a bulk of harvest, farmers are more concerned with getting rid of their harvests than thinking about better prices. All the marketing risks are in that case covered by the producers as the producer is receiving the remainder of the market value received at the final destination.

Pepper is the only vegetable crop solely marketed at a single market outlet by all growers. All other vegetable crops were mostly marketed using a single outlet but some households used a combination of two outlets (see table 5.4). From the sample households, there is no one that sold a given vegetable crop in three of the available outlets (farm-gate, local market and central market in Addis Ababa for Ziway area or in Dire Dawa for Haro-Maya area). Either they go for a single outlet or a combination of two outlets per crop.

Table 5.4 Number of market outlets used per household per vegetable crop marketing

Vegetable type	Haro-Maya					Ziway				
	No. of growers	Single outlet		Two outlets		No. of growers	Single outlet		Two outlets	
		Count	*(%)*	*Count*	*(%)*		*Count*	*(%)*	*Count*	*(%)*
Tomatoes	0					73	60	*(82.2)*	13	*(17.8)*
Onion	14	8	*(57.1)*	6	*(42.9)*	21	19	*(90.5)*	2	*(9.5)*
Cabbage	23	14	*(60.9)*	9	*(39.1)*	0				
Kale	0					20	17	*(85.0)*	3	*(15.0)*
Pepper	0					15	15	*(100)*	0	*(0.0)*
Potatoes	69	52	*(75.4)*	17	*(24.6)*	0				
Beetroot	29	19	*(65.5)*	10	*(34.5)*	0				
Leek	11	9	*(81.8)*	2	*(18.2)*	0				
Carrot	7	6	*(85.7)*	1	*(14.3)*	0				

Choice of explanatory variables

Several factors could affect household decisions in area of farmland allocation across different crops and where to sell their products. Household head's age and education are considered as a proxy to the experience in and skill of production and marketing management. Available family labour could play an important role in area allocation when there is a shortage of hired labour. Labour availability could also influence the market outlet choices as some crops may require more labour to transport to local markets. Livestock wealth in Tropical Livestock Unit is taken as a proxy to the household wealth

status and financial liquidity. Different crops have different levels of input requirements demanding for financial liquidity that could be made available by selling livestock.

Market outlet choice could be affected by the availability of markets at farm-gate and household's capability to transport vegetable harvests to local market. Moreover, outlet choice could also be affected by quantity of the harvest available for marketing, which is a function of area allocated for a given crop. Distance to the local market affects both the accessibility and transportation costs. Ownership of a cart and a cart pulling animal to transport vegetables to local markets also may affect household's crop choice and the degree of participation in local market to sell vegetable crops. Since market choice shares are perfectly related and most households consider only two outlet options only the equation for the share of farm-gate transactions is estimated. In other words, the dependent variable is defined as the share of crops marketed at the farm-gate. Carrot and pepper are dropped from the estimation in both area allocation and share of crops marketed at farm-gate due to insufficient variation in the share of these two crops marketed at farm-gate. Only one of the seven households producing carrot and two of the fifteen households producing pepper sold carrot and pepper at farm-gate, respectively.

Descriptive statistics of the variables included in estimating the share of each crop marketed at farm-gate are presented in table 5.5.

Table 5.5 Descriptive statistics of the variables used in estimation

Variables	Haro-Maya (76)				Ziway (78)			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Age of household head	32.5	7.0	21	56	39.4	10.5	20	62
Household head's education *(years)*	4.2	3.1	0	12	5.1	3.0	1	12
Available family labour *(Adult equivalent)*	2.0	0.8	1	4	2.7	1.3	1	7.3
Livestock wealth *(TLU)*	1.7	1.1	0	6.1	5.3	5.6	0	38.6
Number of carts owned	0.0	0.2	0	1	0.8	0.6	0	3
Distance to local market *(km)* [a]	9.3	6.4	3	35	7.8	4.1	0.2	25
Farm capital *(1000Birr)*	0.4	0.3	0.1	1.5	1.1	1.9	0.1	15.1
Motor pump ownership *(1=yes, 0=no)*	0.4	0.5	0	1	0.4	0.5	0	1
Experience in vegetable production *(years)*	13.5	6.6	3	30	11.1	7.4	1	28

Note: [a] The nearest market where households can possibly sell their vegetables

5.4 Estimation results

The overall estimation results show that there is a simultaneity between crop specific farmland allocation and market outlet choice decisions for crops around Ziway (table 5.6). The effect of outlet choice on the size of crop specific farmland allocation is significant in

the case of tomato, onion and kale production around Ziway. Decision to sell kale at farm-gate significantly reduces the size of farmland allocated to kale production as kale is mainly sold at local markets on weekly basis. Matured kale leaves are collected every week and transported to local markets.

Table 5.6 Simultaneous model estimation results explaining the size of farmland allocated to each vegetable crop

Variables	Tomato	Potato	Onion		Cabbage	Kale	Beetroot	Leek
	Ziway	*H-Maya*	*H-Maya*	*Ziway*	*H-Maya*	*Ziway*	*H-Maya*	*H-Maya*
Age of household head	-0.017	-0.003	-0.036	0.305**	0.004	0.225**	0.036	0.031
	(0.044)	*(0.014)*	*(0.032)*	*(0.141)*	*(0.021)*	*(0.090)*	*(0.026)*	*(0.029)*
Household head education *(years)*	0.347**	-0.034*	0.079	1.375*	0.097*	0.603**	0.026	-0.055
	(0.168)	*(0.019)*	*(0.067)*	*(0.707)*	*(0.056)*	*(0.281)*	*(0.034)*	*(0.050)*
Livestock wealth *(TLU)*	0.051	-0.002	-0.129	0.097	-0.149	0.051	0.298***	-0.602*
	(0.061)	*(0.074)*	*(0.216)*	*(0.121)*	*(0.141)*	*(0.049)*	*(0.107)*	*(0.337)*
Farm capital *(1000Birr)*	-0.058	0.627	1.160	-0.261	1.238**	0.023	-0.168	0.005
	(0.220)	*(0.465)*	*(0.794)*	*(0.574)*	*(0.590)*	*(0.231)*	*(0.515)*	*(0.582)*
Motor pump ownership (1=yes)	1.093	0.025	-0.684	3.576***	0.396	1.921***	0.942***	0.892**
	(0.687)	*(0.192)*	*(0.482)*	*(1.165)*	*(0.296)*	*(0.574)*	*(0.278)*	*(0.368)*
Experience in vegetable production *(years)*	0.112**	0.013	0.021	-0.074	0.014	0.075	0.012	0.007
	(0.055)	*(0.020)*	*(0.032)*	*(0.089)*	*(0.031)*	*(0.047)*	*(0.025)*	*(0.035)*
Available family labour *(Adult equivalent)*	0.039	0.015	0.266	2.442*	0.337*	-0.827*	-0.158	-0.368
	(0.271)	*(0.126)*	*(0.242)*	*(1.398)*	*(0.192)*	*(0.495)*	*(0.159)*	*(0.277)*
Farm size *(Qarxi)*	0.117***	0.094**	0.001	-0.004	-0.120	-0.139***	0.062	0.171*
	(0.031)	*(0.042)*	*(0.110)*	*(0.045)*	*(0.093)*	*(0.050)*	*(0.071)*	*(0.092)*
Share of vegetable marketed at farm-gate	9.425***	0.132	-1.069	14.977*	0.498	-6.367*	0.064	0.405
	(3.119)	*(1.005)*	*(1.011)*	*(8.806)*	*(0.700)*	*(3.222)*	*(0.978)*	*(0.360)*
Constant	-10.163**	0.196	-0.622	-39.179*	-1.929*	-8.874***	-2.478***	-1.130
	(4.630)	*(0.347)*	*(1.027)*	*(20.090)*	*(1.064)*	*(3.284)*	*(0.621)*	*(0.843)*
No. of obser. [a]	*78*	*76*	*76*	*78*	*76*	*78*	*76*	*76*
LR chi2(9)	*44.53*	*30.57*	*12.28*	*25.86*	*16.36*	*31.04*	*46.64*	*19.01*
Prob > chi2	*0.000*	*0.000*	*0.198*	*0.002*	*0.060*	*0.000*	*0.000*	*0.025*

Note: Standard errors in parenthesis.
****, ** and * refer to 1%, 5% and 10% significance level, respectively.*
[a] *The number of observations in area allocation is the whole sample size per research site as crop specific area allocation is observable and zero areas per crop are included in the estimation.*

Area allocation to onion and kale production around Ziway as well as beetroot and leek production around Haro-Maya are positively and significantly affected by motor pump ownership. As tomatoes and potatoes are the major vegetable crops around Ziway and Haro-Maya, respectively, the size of farmland allocated to these crops increases with the

overall farmland size of the households. Total farm size also has a positive effect on the area allocated to leek around Haro-Maya and a negative effect on kale around Ziway. Available family labour for agricultural use positively influences the size of farmland households allocate to onion and cabbage productions whereas the effect is negative for kale production. The effect of farm capital on the crop specific area allocation is only significant for cabbage.

Table 5.7 presents estimation results obtained from the simultaneous equation model relating the share of vegetables marketed at farm-gate with crop specific area allocation.

Table 5.7 Simultaneous model estimation results explaining the share of vegetable crops marketed at farm-gate

Variables	Tomato	Potato	Onion		Cabbage	Kale	Beetroot	Leek [a]
	Ziway	*H-Maya*	*H-Maya*	*Ziway*	*H-Maya*	*Ziway*	*H-Maya*	*H-Maya*
Age of household head	-0.007	0.012	-0.419***	-0.023	-0.027	0.094**	0.031	0.009
	(0.005)	*(0.019)*	*(0.107)*	*(0.014)*	*(0.020)*	*(0.043)*	*(0.031)*	*(0.010)*
Household head education *(years)*	-0.038**	-0.015	0.269***	-0.109**	-0.043	0.341**	0.036	0.189**
	(0.017)	*(0.037)*	*(0.060)*	*(0.050)*	*(0.040)*	*(0.127)*	*(0.044)*	*(0.058)*
Available family labour *(Adult equivalent)*	-0.009	0.373**	0.682	-0.181**	0.086	-1.069*	-0.189	
	(0.039)	*(0.175)*	*(0.372)*	*(0.065)*	*(0.272)*	*(0.502)*	*(0.220)*	
Livestock wealth *(TLU)*	-0.001	0.012	-1.568***	-0.008	-0.392*	-0.389*	0.080	0.565**
	(0.009)	*(0.107)*	*(0.407)*	*(0.025)*	*(0.203)*	*(0.197)*	*(0.194)*	*(0.162)*
Number of carts owned	-0.190**	-0.021	-0.648	0.065	0.184	0.577	0.143	
	(0.084)	*(0.617)*	*(0.417)*	*(0.281)*	*(0.741)*	*(0.465)*	*(0.588)*	
Distance to local market (*km)*	0.002	0.016	-0.305***	0.007	0.008	0.707*	0.031	0.080***
	(0.011)	*(0.016)*	*(0.082)*	*(0.018)*	*(0.023)*	*(0.380)*	*(0.021)*	*(0.015)*
Crop specific area allocation *(Qarxi)*	0.062**	-1.497**	-4.106***	0.077	-0.172	6.217*	-0.216	0.365
	(0.025)	*(0.672)*	*(1.055)*	*(0.108)*	*(1.298)*	*(3.348)*	*(0.744)*	*(0.510)*
Constant	1.229***	-0.323	15.225***	2.516***	1.448	-9.991**	-1.277	-3.092***
	(0.264)	*(0.718)*	*(3.488)*	*(0.705)*	*(0.911)*	*(3.640)*	*(1.171)*	*(0.714)*
Number of observations [b]	*73*	*69*	*14*	*21*	*23*	*20*	*29*	*11*
LR chi2(7)	*17.73*	*10.86*	*22.46*	*10.97*	*10.08*	*18.59*	*4.4*	*22.36*
Prob > chi2	*0.0132*	*0.145*	*0.002*	*0.140*	*0.184*	*0.010*	*0.7327*	*0.000*

Note: Standard errors in parenthesis.
****, ** and * refer to 1%, 5% and 10% significance level, respectively.*
[a] *In estimating the share of leek marketed at farm-gate, the number of carts owned and available family labour are dropped due to their lack of variation for leek producing households.*
[b] *The number of observations in each estimation is limited to the number of sample households growing the specific crop since the share of each crop marketed at farm-gate is only observed if it is grown.*

Results in table 5.7 show that area allocation has a significant effect on the share of tomatoes, potatoes, onion and kale crops marketed at farm-gate. The signs of these significant effects differ across crops based on their region specific dominance in production. For tomato and kale, which are grown around Ziway, the shares of these crops marketed at farm-gate positively increase with increasing size of farmland allocated to these crops. However, for potato and onion products around Haro-Maya, the more farmland allocated to these crops the lower the share of these crops marketed at farm-gate. This is due to the fact that Haro-Maya has a water shortage for irrigation purposes and most vegetables are produced relatively on a larger area during the rainy season than the dry season. This excess availability of vegetables supply during the rainy season around Haro-Maya put local merchants in a good position as they do not need to go for a farm-gate transaction since farmers themselves are willing to supply to their temporary store-houses located at the local market. Though tiresome, farmers have to transport their vegetables to the merchants' temporary store-houses to avoid product losses due to lack of buyer. These transactions between farmers and merchants at local store-houses are usually made on credit arrangements in such a way that farmers will be paid a price based on what the final consumers pay for the product under transaction.

Thus, vegetable growing farmers around Haro-Maya choose to produce either during the dry season at a high cost of water for irrigation with cash transactions at farm-gate or during the rainy season at a high cost of transporting the harvest to the merchants' store-house with credit transactions.

5.5 Conclusions

Farm households make a number of decisions in their farm management and marketing practices. What size of farmland to allocate to a given crop and where to sell the crop harvest are few of the production and marketing decisions made at household level. These two decisions are the central decisions when crops are particularly produced for marketing purpose. Based on different situations, households might decide on two of them successively or simultaneously.

This chapter examines whether there is an interaction between crop area allocation decisions and market outlet choices at the farm-household level. From the estimation results it follows that crop area allocation decisions are related to market outlet choices for some vegetable crops. There is a simultaneity between area allocation and share of crops marketed at farm-gate for tomato, onion and kale crops around Ziway. The effect of crop

specific area allocation on the share of crops marketed at farm-gate is significant and negative for potatoes and onion around Haro-Maya and positive for tomatoes and kale around Ziway.

The simultaneity between area allocation and the share of crops marketed at a farm-gate implies that household preference to trade at a particular market outlet influences farm household land allocation decisions to a particular crop. In other words, institutional arrangements and their accessibility to farm households play a role in commercializing small-scale agriculture through their effect on household production and marketing decisions. On the other side, the absence of strong simultaneity for most vegetable crops implies that the household market outlet choices are more supply driven than demand driven, i.e., choosing outlets after considering the amount of vegetable products available for marketing. In general, creating institutions like marketing cooperatives and contract farming could possibly help to overcome the problem of missing institutional arrangements.

CHAPTER 6

FARM-GATE TOMATO PRICE NEGOTIATIONS UNDER ASYMMETRIC INFORMATION[1]

6.1 Introduction

The textbook case of perfect competition is full of strong assumptions like large number of buyers and sellers, complete information, free entry and exit and price taking by all agents (MasCollel et al., 1995:311-343). This ideal situation, however, does not exist in the real world. When market participants do not have equal information on prices, quality and quantities of the item under transaction and the number of trading agents in the market, there is an incentive for better informed agents to uphold information and maximize their private benefits (Sobel and Takahashi, 1983; Cramton, 1984; Srivastava et al., 2000).

Access to market information helps both buyers and sellers in setting their prices for the product under transaction. Trade may occur when the buyer's maximum reservation price exceeds the seller's minimum acceptable selling price. However, how a buyer and a seller share the margin between quoted prices is dependent on various factors among which the relative bargaining power of both agents is an important one (Sexton and Zhang, 1996; Sexton et al., 2005). An agent with relatively more bargaining power due to, for instance, better market information or low cost of delay is expected to obtain the highest share of the margin (Cramton, 1984). Cramton shows that agents with high cost of delay reveal information faster and get a smaller share from the margin in bargaining. E.g. in their study on the Californian lettuce market, Sexton and Zhang (1996) found that buyers obtained the lion's share of the surplus generated from lettuce production and sale. Farmers never obtained more than 14.5 percent. The unbalanced share results from the farmer's impatience in bargaining over prices due to the perishable nature of their vegetable supply (Perry, 1986).

According to Cramton (1984), incomplete information leads to bargaining inefficiency, which increases as private valuations are more uncertain. In contrast to the complete information case where buyers and sellers know the size of marketing surplus to share, the presence of uncertainty on the trading partner's valuation impedes efficient negotiations and motivates higher initial ask prices and lower initial offer prices resulting in

[1] An adapted version of this chapter is forthcoming in *Agricultural Economics* 36(2007): 243-249.

an extended bargaining process (Chatterjee and Samuelson, 1983; Samuelson, 1984; Yilankaya, 1999; Srivastava et al., 2000).

Lengthy price negotiations are usually common to reveal the private reservation prices and to come to an agreement on a given specific transaction price. Such price negotiations are traditional for farm households growing tomatoes in central Ethiopia and merchants buying tomatoes at farm-gate for wholesale at the central vegetable market in Addis Ababa.

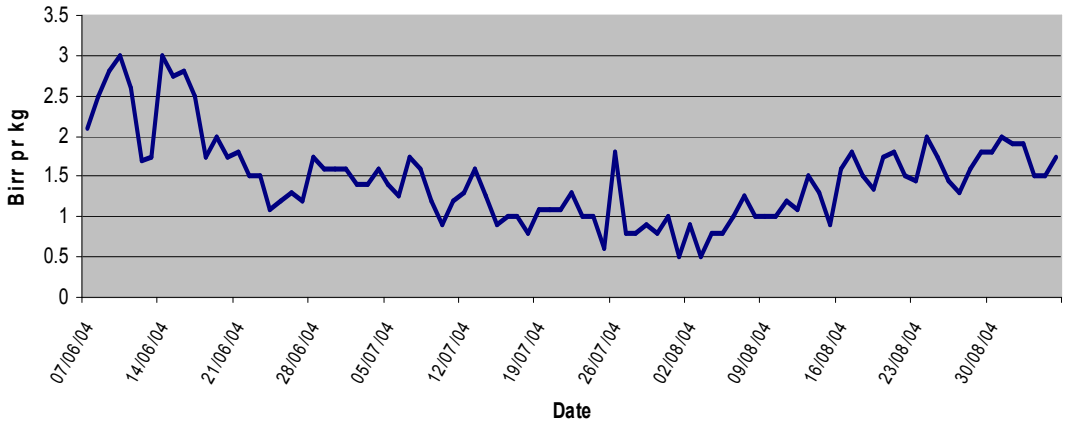

Figure 6.1 Daily tomato wholesale price at central vegetable market in Addis Ababa (07 June 2004 – 05 September 2004).

Source: Horticultural Development Enterprise, Addis Ababa

One of the possible reasons for uncertainty on the trading partner's valuation is the fluctuating tomato wholesale price at the central vegetable market (see figure 6.1). Lack of accurate central market price information and the perishable nature of tomato products affect farmers' valuation for their tomatoes and bargaining power. When farmers cannot wait for better prices by storing their harvest they are forced to accept a lower price to avoid the risk of not selling. Resulting low vegetable prices have a direct impact on the next period household resource allocation decisions on food and cash crop production.

The objective of this chapter is to assess how tomato prices are determined at farm-gate and to estimate factors explaining the variation in bargaining power in negotiations on tomato prices. A detailed set of variables including information on central market prices is used to explain bargaining power and the spread in the initial ask and offer prices.

The remainder of this chapter is organized as follows. Section 6.2 develops a bilateral bargaining model adapted to farm-gate tomato marketing practices taking place in Central Ethiopia. Section 6.3 presents the empirical model and data used for this analysis.

Estimation results are discussed in section 6.4 and the overall conclusions of the outcomes are given in section 6.5.

6.2 The theoretical price bargaining model

In building up the theoretical price bargaining model, the following basic assumptions are made. Tomato producers and merchants buying tomato directly from the producers at farm-gate have different valuations for the same tomatoes under transaction. There are various reasons for this difference in valuation of which information asymmetry is one. Tomato buyers and sellers may not have similar price information or may get their price information from different sources. Unlike coffee, there is no centralized vegetable price information disseminated via public media to rural Ethiopia. In addition, tomato buyers and sellers have different estimates for costs incurred in transporting products to the central market. Profit margins expected by merchants and what producers usually consider as a reasonable profit margin for merchants may not be identical. Equally important is the difference between seller's and buyer's expectations on the direction of tomato price movements at the central market.

These issues all confirm that there are valuation differences between tomato producers and tomato purchasing merchants on the same tomato harvest under transaction. Buyers' and sellers' private valuations can be specified as:

$$V_{i,t} = P^{c}_{i,t-1} - \tau_i - \pi_i + E_i[\theta_{i,t+1}] \quad ; \; i = b, s \tag{6.1}$$

where $V_{i,t}$ is agent i's valuation on transaction date t, $P^{c}_{i,t-1}$ is private information on tomato prices at the central market on the previous day (viz. true or expected price), τ_i is agent i's estimate for a unit transportation and handling costs to bring the tomatoes to the central vegetable market, π_i is expected profit margin that a trader earns, $E_i[\theta_{i,t+1}]$ is the expectation on the future tomato wholesale price movements at the central vegetable market, t is the date of transaction at the farm-gate and the subscript i refers to either a buyer or a seller of the tomatoes under transaction.

Assume that sellers' and buyers' valuations are uniformly distributed within the range of maximum and minimum valuations, $V_b \in [\underline{v}_b, \overline{v}_b]$ and $V_s \in [\underline{v}_s, \overline{v}_s]$, respectively and these distributions are also common knowledge. Figure 6.2 gives a simple scheme for a

uniformly distributed valuation function with overlapping valuations so that trade can take place.

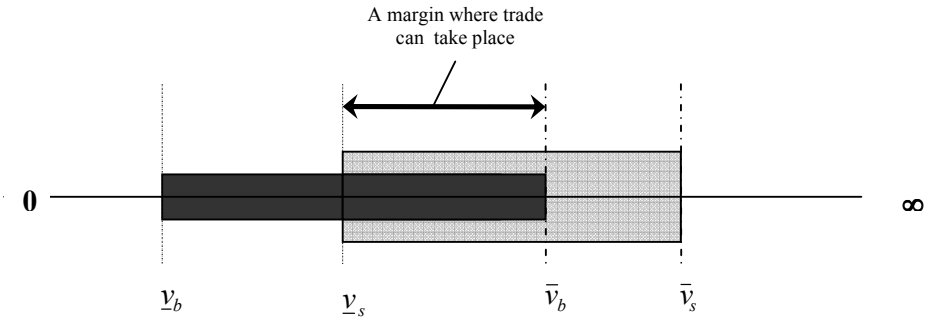

Figure 6.2 A buyer and seller's overlapping valuations allowing trade occurrence.

Normally, trade only occurs if the maximum affordable buying price is higher than the minimum acceptable selling price $(\bar{v}_b \geq \underline{v}_s)$. Thus, for a transaction to take place, the transaction price (P^*) that both parties agree upon as a final transfer price should be between these two reservation prices, i.e., $P^* \in [\underline{v}_s, \bar{v}_b]$. The exact point where the final transfer price lies depends on the agents' (the buyer and seller's) relative bargaining power which is determined by economic and non-economic/psychological factors (Kreps, 1990:551).

Assuming a linear bargaining rule (Chatterjee and Samuelson, 1983), the final price, P^*, is set at:

$$P^* = \alpha_s \, p_{s,1} + (1 - \alpha_s) p_{b,1} \tag{6.2}$$

where $p_{s,1}$ and $p_{b,1}$ refer to the seller's initial ask price and buyer's initial offer price, respectively, and $\alpha_s \in [0,1]$ indicates how close the final transaction price is to the seller's initial ask price. This α_s can also be interpreted as the relative bargaining power of a seller, where a higher α_s means relatively more bargaining power for the seller than for the buyer. In that case the seller negotiates more aggressively to bring the final transfer price close to his own initial ask price, $p_{s,1}$. If the final transaction price is equal to the seller's initial ask price then $\alpha_s = 1$. In other words, in subsequent rounds of the price negotiation process the seller did not deviate from his initial ask price. The reverse is true for a low α_s.

In that case the buyer has more bargaining power with the extreme case of $\alpha_s = 0$ where the final price equals the initial price quoted by the buyer. When trade occurs at the final transfer price (P^*), the payoff for a seller is $(P^* - \underline{v}_s)$ while it is $\left(\overline{v}_b - P^*\right)$ for a buyer.

Buyer's offer and seller's ask price setting strategies are a function of their own valuations and whether these valuations are common knowledge to both parties or not. Moreover, price setting strategies differ when bargaining is just a one-shot game under complete information or a game that allows sequential bargaining to reveal private information over time. How sellers and buyers set their ask and offer prices under both situations is presented below.

To start with the complete information case, assume that both buyers and sellers are maximizing their payoff by choosing an offer and ask price conditional on the fact that these chosen prices allow a transaction to take place. Thus, the buying merchant's objective function is given as:

$$\underset{p_b}{Max}\{\overline{v}_b - p_b\} prob\left(p_b \geq \underline{v}_s\right) \tag{6.3}$$

where $prob\left(p_b \geq \underline{v}_s\right) = \frac{p_b - \underline{v}_s}{\overline{v}_b - \underline{v}_s}$. By substituting $\frac{p_b - \underline{v}_s}{\overline{v}_b - \underline{v}_s}$ into equation (6.3) and optimizing the objective function over p_b, the first order condition gives us:

$$\frac{\overline{v}_b - 2p_b + \underline{v}_s}{\overline{v}_b - \underline{v}_s} = 0 \tag{6.4}$$

Referring to the earlier assumption $\overline{v}_b > \underline{v}_s$, the equilibrium offer price for a buyer is:

$$p_b = \tfrac{1}{2}(\underline{v}_s + \overline{v}_b) \tag{6.5}$$

Similarly, the producer/seller's objective function is:

$$\underset{p_s}{Max}\{p_s - \underline{v}_s\} prob\left(p_s \leq \overline{v}_b\right) \tag{6.6}$$

where $prob(p_s \le \bar{v}_b) = \frac{\bar{v}_b - p_s}{\bar{v}_b - \underline{v}_s}$, and by substituting for the probability and optimizing the objective function over p_s, we get:

$$p_s = \tfrac{1}{2}(\underline{v}_s + \bar{v}_b) \tag{6.7}$$

This equilibrium ask-offer price is attained when both trading partners have common knowledge on the valuations and both know that there will be no more trade once negotiations failed (Gibbons,1992:155). The equilibrium is efficient as it has been reached without any cost of delay and also shares the existing marketing surplus equally into two, $P^* = p_s = p_b = \tfrac{1}{2}(\underline{v}_s + \bar{v}_b)$, and $\alpha_s = 0.5$.

However, when both agents have private valuations and these are not exactly known to their trading partners, such an efficient trading equilibrium does not exist (Chatterjee and Samuelson, 1983). With this two-sided uncertainty, both the buyer and the seller have an incentive to hide information on their individual valuations. These hidden valuations can only be learned by the trading partners if multi-stage bargaining is allowed to communicate some of their private information before an agreement can be reached (Crawford, 1982; Cramton, 1984).

A simple multi-stage bargaining model with incomplete information is developed below to show the strategic initial ask and offer prices made by a seller and a buyer based on their expectations and what they learned from the equilibrium history of the game. The equilibrium of such a game with an infinite horizon was derived by Cramton (1984).

For a quantity of tomatoes under transaction, let's assume that a seller and a buyer have private valuations of V_s and V_b, respectively. Though the buyer does not know the exact valuation of the seller, he assesses that seller's valuation is given by the distribution $F(V_s)$ on $[\underline{v}_s, \bar{v}_s]$. Similarly, the seller assesses the buyer's valuation given by the distribution $G(V_b)$ on $[\underline{v}_b, \bar{v}_b]$. Also assume that both the buyer and the seller have a cost of delaying the bargaining process. δ_s and δ_b are the seller's and the buyer's discount factor for a delayed agreement, with $0 < \delta_s, \delta_b < 1$. The cost of delay for a seller could be loss of product quality, if he has to wait for another buyer, or the risk of not transacting at all. For the buyer it is mainly the risk of not having a full truckload at the next transport to the central market. For both parties there is also a potential cost of not trading in case of high central market prices. Another assumption is that both the buyer and the seller follow

a bargaining strategy which is sequentially rational and must be the best response to the other's strategy, given their probabilistic beliefs on the state of the world (Cramton, 1984; Kreps, 1990).

In sequential bargaining a seller with private valuation V_s maximizes his payoff by choosing an ask price $p_{s,n}$ at each period n of the bargaining process. The optimization problem is specified as:

$$\underset{p_{s,n}}{Max} \ \left(p_{s,1} - V_s\right)\left(G(\overline{v}_b) - G(\hat{v}_{b,1})\right) + \sum_{n=2}^{N} \delta_s^{n-1}\left(p_{s,n} - V_s\right)\left(G(\hat{v}_{b,n-1}) - G(\hat{v}_{b,n})\right) \tag{6.8}$$

where $p_{s,n}$ is what the seller asks at period n dependent on his private valuation, V_s, discount factor, δ_s, and his belief about the buyer's valuation at period n, $\hat{v}_{b,n}$. For ease of notation the ask price $p_{s,n}(V_s, \delta_s, \hat{v}_{b,n})$ is written as $p_{s,n}$. $G(\hat{v}_{b,n})$ refers to the probability distribution of seller's belief on the buyer's valuation at period n.

The seller's optimization problem is subject to the sequential rationality assumption that states that a buyer accepts the ask-price at period n if:

$$V_b - p_{s,n} \geq \delta_b[V_b - p_{s,n+1}(V_s, \hat{v}_{b,n})] \tag{6.9}$$

Equation (6.9) indicates that a buyer accepts what a seller offers at period n if he rationally believes that the payoff at period n is higher than the discounted payoff at period $n+1$, given the buyer's belief on what the seller offers the next period.

Though cumbersome, it is possible to compute the optimal ask prices at each period using the first order conditions. For our interest, it is enough to show that the first initial seller's ask and buyer's offer prices are not equal under a sequential bargaining game with asymmetric information. See Appendix A6 for a simplified Perfect Bayesian Equilibrium prices adapted from the work of Sobel and Takahashi (1983) and Gibbons (1992: 219-224).

When the initial ask price is higher than the initial offer price, $p_{s,1} > p_{b,1}$, and there is a final transfer price P^* that both agents finally agree upon after N periods of price negotiations and this final transfer price lies within the acceptable range for trade to occur, $P^* = p_{s,N} = p_{b,N} \in [\underline{v}_s, \overline{v}_b]$, then by rewriting equation (6.2) given above, one can specify

α_s, i.e. the seller's commitment to his initial ask price as a proxy to his bargaining power as:

$$\alpha_s = \frac{P^* - p_{b,1}}{p_{s,1} - p_{b,1}} \tag{6.10}$$

A seller is fully committed when $\alpha_s = 1$, i.e., $P^* = p_{s,1} = p_{s,N}$ and a buyer is fully committed to his initial offer as a final price when $\alpha_s = 0$, i.e., $P^* = p_{b,1} = p_{b,N}$. Generally, α_s is a proxy to the seller's bargaining power where $\alpha_b = 1 - \alpha_s$ is for a buyer. The intuition is that agents with relatively more bargaining power can have strong commitment to their initial ask/offer prices.

Besides focusing on α_s, we also consider the size of the difference between the initial ask and offer prices, $\Delta = p_{s,1} - p_{b,1}$. This difference indicates the extent of uncertainty prevailing in estimating the actual valuation of the corresponding trading partner.

6.3 Empirical model and data

Empirical model

In order to estimate to what extent tomato sellers and buyers at farm-gate stick to their initial price quotes, α_s can be regressed on different attributes expected to have an effect on the seller's bargaining power. Similar procedure can be followed for the spread between the initial ask and offer prices (Δ) as well. The attributes used in the two estimations may consist of both economic and non-economic factors. Since $\alpha_b = 1 - \alpha_s$, there is no need to estimate the buyer's bargaining power as it can be inferred from the estimation results of the seller's bargaining power. The functional form is given as:

$$X = \beta_0 + \beta_1 Z + \chi I + \gamma R + \kappa G + \mu \overline{Q} + u \tag{6.11}$$

where X represents α_s and Δ, respectively as defined in the previous section. Z includes personal characteristics of buyers and sellers like age and education, I refers to information related variables like access to the central vegetable market price information and number of potential buyers visited tomato seller during the last one week, R stands for

variables explaining the economic relationship between a buyer and a seller like whether they traded with each other before and, in case they did, how many times, etc. G refers to agent's tomato quality perception and if there is any quality perception difference between the buyer and the seller, $\overline{Q}$ is quantity of tomatoes under transaction, which is fixed during the transaction period. $\beta_0, \beta_1, \chi, \gamma, \kappa,$ and μ are parameters to be estimated and u is a disturbance term.

Sellers' and buyers' characteristics influence their respective bargaining power as they contribute towards better market understanding and processing of information. The more an agent is informed, the less uncertain he is on market prices and the better able to form price expectations and trade efficiently in a short time span. Long experience in trading with each other can facilitate trade as it helps to build trust between buyers and sellers. Buyers and sellers with the same quality standard have a similar valuation for a product under transaction as compared to trading partners with different quality perceptions. Difference in quality perceptions widens the difference between initial ask and offer prices and extends the bargaining process. Tomato growers located further from the main road are expected to have less bargaining power. They may be visited less often by potential buyers and know that buyer's transportation costs from their farm may be higher. If they realize that they have less bargaining power this may also lead to a smaller spread in initial ask and offer price since farmers will bid less aggressively. In the literature, it is shown that sellers supplying a bulk volume of perishable products usually have less bargaining power (Sexton and Zhang, 1996). On the other hand buyers prefer purchasing a larger volume of products at once as it reduces transaction costs and also helps them to get products with homogeneous quality as compared to assembling smaller quantities from different farms. Thus, buyers are expected to commit themselves less to their initial offer prices while transacting on larger volumes of tomato products.

Data

Data used for this analysis was collected in 2004 both from the central vegetable market in Addis Ababa and at different farms around Lake Ziway (about 160km south of Addis Ababa). Average daily wholesale tomato prices with particular attention to tomatoes supplied from the Ziway area were collected at Addis Ababa whereas the negotiations on tomato price formation at farm-gate were recorded by trained enumerators. In recording the negotiations, the enumerators only had an observing task and never interfered in the

negotiation process. The data consists of 66 transactions recorded in 87 days (at most two transactions per day) from 62 farm households selling tomato at farm-gate and 27 buyers in all of the 66 transactions. Descriptive statistics on the recorded farm-gate transaction data are presented in table 6.1.

Table 6.1 Descriptive statistics of farm-gate tomato transaction data

Variables	Mean [a]	Std. Dev	Min	Max
Seller's characteristics				
age *(years)*	36.52	11.90	18	67
education *(years)*	5.35	3.43	0	12
Buyer's characteristics				
age *(years)*	34.03	8.02	20	60
education *(years)*	9.02	3.16	1	12
Tomato quality assessment *(0=low, 1=medium, and 2=high)*				
by sellers	1.68	0.59	0	2
by buyers	1.47	0.68	0	2
Difference in quality assessment [b]	0.21	0.45	0	2
Tomato quantity under transaction *(1000kg)*	5.20	7.75	0.2	40
Distance of the tomato farm from the main road *(km)*	1.31	0.70	0.2	5
Earlier trade relationship between buyer and seller *(1=yes, 0=No)*	0.44	0.50	0	1
Number of earlier trades made with each other *(0,1, 2, 3, 4= if >3 times)*	1.38	1.71	0	4
Who spoke out the transaction price first? *(0=Seller, 1=Buyer)*	0.30	0.46	0	1
Final price both the seller and the buyer agreed upon? *(Birr per kg)*	0.94	0.30	0.22	1.6
Number of potential buyers visited a seller during the last 7 days	2.35	1.78	0	10
Seller's information on central market price *(1=yes, 0=no)*	0.36	0.48	0	1
Seller's initial ask price *(Birr per kg)*	1.19	0.37	0.25	2
Buyer's initial offer price *(Birr per kg)*	0.84	0.25	0.22	1.6
Final price both the seller and the buyer agreed upon *(Birr per kg)*	0.94	0.30	0.22	1.6
Ask-offer spread (Δ) *(Birr per kg)*	0.35	0.29	0	1.2
Seller's commitment (α_s) [c]	0.26	0.28	0	1

Notes: [a] 66 observations.
[b] Seller's product quality estimate minus buyer's estimate. If the difference is 0, there is consensus on quality. If positive, either the seller overestimated or the buyer underestimated the quality.
[c] Calculated using equation (6.10). Only 57 observations since there are 9 transactions with equal initial ask and offer prices.

On average, the final farm-gate transaction price of 0.94 Birr per kg is closer to the average buyer's initial offer price (0.84 Birr per kg) than to the farmer's initial ask price (1.19 Birr per kg). The average relative bargaining power of sellers, which is calculated using equation (6.10), is 0.26, indicating that on average the final transaction price depends for 26 percent on the initial seller's ask price and for 74 percent on the initial buyers' offer price. Another interpretation is that on average buyer's bargaining power is almost 3 times stronger than sellers' bargaining power. The fact that sellers on average

have to give in about 3 times as much as buyers to their initial price quotes could be due to the fact that sellers ask higher initial prices because of their uncertainty on the valuations of their corresponding buyers. Another explanation could be that they stick less to their initial ask price since they have higher cost of delaying the transaction than buyers. Table 6.1 also indicates that the spread in the relative bargaining power of sellers is substantial. The standard deviation is 0.28 and the two extreme values are also attained. The minimum value of zero indicates that some sellers directly accepted the buyer's initial offer. This could be because these sellers had no choice than selling for the offered price, or because they thought it was a good offer anyway. The maximum value of one indicates that the final transaction price in some cases equals the seller's initial ask price. The spread between seller's initial ask and buyer's initial offer prices varies to a maximum of 1.2 Birr per kg and it is larger in magnitude than the average farm-gate tomato price of 0.94 Birr per kg. Such a wide spread in initial ask and offer prices implies longer negotiations to settle the final transaction price. Note that this margin between the initial offer and ask price is not the actual surplus from transaction, since we do not know the actual valuations of both parties but only their quoted prices. The initial ask and initial offer prices cannot expected to be the actual valuations of the agents since both parties may use strategies to buy at lower and sell at higher prices.

Data on sellers' information about tomato wholesale prices is summarized in table 6.2. Sellers had tomato wholesale price information from the central vegetable market only in 23 of the 66 transactions recorded. The price information ranges from the date of transaction to seven days earlier. The information deviation from the actual price has a wide range though the mean is close to zero (see table 6.2 for details).

Table 6.2 Tomato wholesale price information data

Variables	Mean [a]	Std. Dev	Min	Max
Seller's central market price information *(Birr per kg)*	1.29	0.42	0.40	2.40
Actually recorded wholesale price at central market *(Birr per kg)*	1.15	0.40	0.40	1.80
Difference between actual and informed prices *(Birr per kg)*	-0.14	0.42	-0.90	0.60
How recent is the price information? *(days ago)*	1.30	1.72	0	7
How reliable is the source of information? *(1=very reliable, 2=reliable, 3=less reliable, 4=not reliable)*	1.78	1.09	1	4

Note: [a] 23 observations

Table 6.3 presents descriptive statistics of tomato wholesale prices at the central market in Addis Ababa for a period of three months, from 07 June 2004 to 05 September 2004. Tomato product quality is broadly categorized into three types: first, second, and third grades. Price variation is the same for the first and second grades whereas the third

grade has a relatively smaller price variation. The average margin of tomato prices is higher between the second and third grades than the first and the second one.

Table 6.3 Average tomato wholesale price at central vegetable market in Addis Ababa (Birr per kg)

Average prices	Obs	Mean	Std. Dev.	Min	Max
1st grade	91	1.47	0.54	0.50	3.00
2nd grade	91	1.28	0.54	0.40	2.75
3rd grade	81*	1.04	0.48	0.40	2.50

Note: * On some days tomatoes with grade 3 quality had not been supplied to the central market from Ziway Area.

6.4 Estimation results

Estimation results of factors explaining both the seller's bargaining power and the variation in the initial ask-offer price spread are presented in table 6.4. As indicated section 6.2, the relative deviation of initial ask (offer) price from the final price is considered as a proxy for sellers' (buyers') bargaining power. The closer an agent's initial price is to the final price, the more bargaining power he has.

Table 6.4 Estimates of factors explaining seller's commitment to the initial ask price and the variation in the initial ask-offer price spread.

Explanatory variables	Seller's commitment (α_s)		Ask-offer spread (Δ)	
	Coefficients	Std. Err.	Coefficients	Std. Err.
Seller's age	0.006	0.004	0.003	0.003
Buyer's age	-0.002	0.004	0.012***	0.003
Seller's education	0.005	0.012	-0.004	0.010
Buyer's education	0.001	0.012	0.000	0.008
Difference in quality assessment between buyer and seller	-0.196**	0.079	0.257***	0.063
Distance of the tomato farm from the main road	-0.074*	0.042	-0.007	0.035
Earlier trade relationship between buyer and seller	0.060	0.070	-0.018	0.051
Who spoke out the transaction price first	-0.279***	0.081	-0.192***	0.062
Seller's information on central market price	0.165**	0.068	0.045	0.052
Previous day tomato price at central market	0.153**	0.070	0.054	0.054
Tomato quantity under transaction *(1000kgs)*	0.003	0.004	0.009**	0.004
Number of buyers visited a seller during the last 7 days	0.029	0.021	0.006	0.016
Constant	-0.065	0.276	-0.283	0.207
Number of observations [a]	57		66	
F-Value	3.97		8.52	
Prob > F	0.000		0.000	
R-squared	0.52		0.66	
Adj R - Squared	0.39		0.58	

Note: [a] Nine observations are dropped because of equality in the initial ask and offer prices.

*, **, and *** indicate 10 per cent , 5 per cent and 1 per cent significance level, respectively.

A difference in tomato quality perception between a seller and a buyer has a significant negative effect on sellers' bargaining power. The sellers' commitment to their

initial ask price decreases ceteris paribus by 19.6 percent, on average, when the buyer perceives the quality of tomatoes under transaction lower than the seller's quality perception by one grade. Sellers usually consider their harvests as a good quality where buyers are exposed to different product types and have their own judgments based on different scales as compared to the sellers that at most compare their harvest with their neighbors.

Distance of the tomato farm to the main road has a significant impact on seller's bargaining power. The farther the tomato farm from the main road, the less bargaining power a seller has as expected. On average, the seller's commitment to his initial price quote decreases by 7.4 percent for a kilometer distance of the farm from the main road.

In the bargaining process, there is a significant bargaining power loss to a seller when the buyer speaks his offer price first. The seller then may demand a higher price but buyers apparently stick to their initial offer. The seller's commitment to his initial ask price decreases by 27.9 percent when the buyers speak out the negotiation price first.

When sellers have central market price information, which is the case in 35 percent of the observations, they are more committed to their initial ask prices as compared to the situation under which they do not have these price information. Having central market price information increases α_s by 16.5 percent. When this info is not available, a seller depends on the buyer's initial offer price as a signal to set his initial prices and he is less committed to this initial ask price.

If tomato prices were high the previous day at the central vegetable market, there is a significant positive effect on seller's bargaining power of 15.3 percent (see table 6.4). So, even if the seller is not informed about the central market price his bargaining power increases since the informed buyer is more eager to buy and in bargaining will move more towards the seller's ask price.

Whether the seller made a transaction before with this buyer and, if he did, the number of transactions they had together before do not significantly influence the seller's bargaining power. Personal characteristics like sellers' and buyers' age and education also do not significantly affect the bargaining power.

As mentioned earlier, the size of the difference between the seller's initial ask and buyer's initial offer prices indicates the extent of uncertainty in estimating the trading partner's valuation. The intuition is that the more uncertain agents are about their trading partner's valuation, the wider the initial ask-offer spread is. Estimation results show that the spread is significantly higher when there is a difference in quality perception of buyers and

sellers. Differing by one quality degree increases the ask-offer spread by 0.26 Birr per kg. The less consensus buyers and sellers reach on the quality of the tomato product, the wider the initial ask-offer spread is. Both buyers and sellers quote initial prices that could support their own quality perception.

The initial ask-offer price spread is 0.19 Birr per kg smaller when the buyers speak out the negotiation price first. When a buyer speaks out first, a seller could use the buyer's initial offer price as a signal in order to set his strategy to quote his initial ask price. However, if the seller speaks out first, he would quote a relatively higher initial ask price due to uncertainty on the valuation of the buyer leading to a larger ask-offer price spread.

The ask-offer price spread is higher when an older buyer is negotiating. This could be related to the experience of older buyers who may quote lower initial offer prices as a best strategy to buy the tomato products at a relatively lower price. The spread between initial ask and offer price is also significantly influenced by the quantity transacted, although the quantity effect is very small. An increase in the quantity of tomatoes transacted by 1000 kg leads to an increase in the spread of initial ask and offer prices of 0.009 Birr per kg. When trading on a large volume, both sellers and buyers are keen on better selling and buying prices as a small margin in price could result into a substantial higher total benefit. Sellers also expect that buyers are more interested in a large volume from one farm than buying smaller quantities from a number of farms to fully load their truck. Buying a larger volume from one farm reduces transaction costs and gives a homogeneous quality.

6.5 Conclusions

When there are private valuations of products under transaction and these valuations are not known to the other trading partner, there is an incentive to hide information and seek for higher benefits from a transaction. This chapter examines the relative bargaining power of tomato buyers and sellers by regressing the relative deviation from initial quotes to the final trading price on a set of economic variables using farm-gate transaction data from central Ethiopia. The spread in initial ask and offer prices is also investigated as this is an indicator for the uncertainty both parties have on each other's valuations.

On average we found that sellers give in about three times as much as buyers to their initial price quotes, although this differs a lot from case to case. Sellers' commitment to their initial ask price increases when they are informed about the central market prices but also when prices on the central market were high the previous day. Sellers' access to

wholesale price information implies that buyers and sellers have similar price information, which leads to more similar valuations on the tomato product under transaction. However, when the buyer does not know whether the seller has the central market information or not, the buyer still keeps setting relatively lower initial offer prices as a best strategy to start the negotiation. As a result, the initial ask and offer price spread could remain the same. This implies that transmitting the daily vegetable wholesale price information to the potential vegetable producing areas via radio, internet or mobile phones could help both vegetable producers and buyers to have common knowledge on the central market prices. In this regard, establishing and supporting farmers' vegetable marketing co-operative unions could also help to bridge the price information gap, facilitate the price information transmission process, and when there is a shortage of buyers at farm-gate, assist farmers in assembling and transporting their vegetable products to the central market.

When buyers speak out a transaction price first, which happens in about one third of the investigated transactions, this has a dramatic effect on the price negotiations. Seller's bargaining power decreases substantially, but also the spread in initial ask and offer prices decreases. Apparently the buyers that speak out first give an important signal on the value of the transacted tomatoes that is used by the seller in quoting his initial ask prices.

Estimation results did not clearly show an effect of a large quantity of tomato product under transaction on the seller's bargaining power. The bulk argument may not hold due to perishable nature of tomatoes. Sellers like to get a high price but also consider the risk of loss if trade would not occur timely due to holding on to high prices. On the other hand, when there is a bulk quantity of tomato under transaction, buyers have the advantage of reduced transaction costs and can secure the purchase of homogenous quality from one farm. Since the overall benefit from a slightly better price on a bulk transaction is high, the initial ask and offer price spread is higher for larger volumes of tomatoes, although the effect is modest. Different quality perceptions of buyers and sellers logically increase the spread between what the farmers demand and what traders offer as a transaction price. An interesting finding in this study is that the sellers in that case stick less to their initial price quotes than buyers do. This can be explained from the knowledge that buyers have on quality of other tomato supply. The fact that the sellers' bargaining power is affected by distance from the main road implies that basic infrastructural developments like improving local road networks connecting vegetable farms with the main roads contributes towards increasing farmer's bargaining power over farm-gate prices.

CHAPTER 7

CONCLUSIONS AND DISCUSSION

7.1 Introduction

The chapters three to six dealt with specific research objectives mentioned in chapter one. This final chapter gives an integrated summary of the major findings from these chapters. With this purpose, this chapter is organized as follows. Section 7.2 discusses main conclusions drawn from the empirical analyses performed in each individual chapter. Section 7.3 discusses the linkages among the specific chapters, and how these chapters address the overall objective of commercializing small-scale agriculture for the development of less-favoured areas. Suggestions for future research are given in section 7.4.

7.2 Summary of main conclusions

The first specific objective of this thesis was to evaluate the potential contribution of horticultural crops in stabilizing export earnings of Ethiopia. Results in chapter three show that Ethiopia should diversify its export portfolio in the non-traditional agricultural commodities like hides and skins, chat, pulses, cereals, cotton, and horticultural products (fruits, vegetables and flowers). These commodities contributed positively to the overall stability in the total export earnings in recent years. Furthermore, the analysis indicates that fluctuations in supply have more effect on earnings instability than export prices. In general, it can be concluded that there are various export products (traditional and non-traditional) that lead to a more balanced export portfolio, either because of negative volume or price correlation. The main lesson to be learned is that a more balanced export portfolio is possible leading to stable export earnings and horticultural products can contribute to that. One should note, however, that price and volume fluctuations are subject to change in the future and further updated analysis is required to make up-to-date recommendations.

In chapter four, farm household behavior in land and labour allocation decisions to cash and food crop production is examined. Reduced form equations derived from a non-separable farm household model are used in estimating the effect of different economic variables on land and labour allocation decisions for households in different market participation regime. Empirical results show that farm households that own much farm

capital and have exogenous income sources allocate more land and labour to cash crop production. More farm capital employed on a given farm increases the productivity of land and labour and as a result encourages households to rent in (hire) more land (labour) as the marginal benefits from renting (hiring) factors from local markets are higher than the marginal costs of these resources. Since cash crops are mostly produced using irrigation, motor pumps play a central role to get adequate quantities of water for irrigation and use a farmland multiple times a year including the dry off-season. Thus, access to motor pump service for irrigation increases both land and labour allocation to cash crop production. The purchase of a motor pump might be expensive for small-scale farmers unless there are institutional arrangements providing motor pumps on a short-term credit basis or renting the motor pump services out. Promotion of savings from the vegetable sale could also contribute in enhancing farm household investment on farm capital.

In addition, higher cash crop prices promote more labour use in cash crop production and reduce the respective labour demand in food crop production, as expected. Unlike in food crop production, there is no strong evidence that transaction costs affect household market participation and the level of resource use for cash crop production. This finding could be due to the fact that distance to local market is the only variable used as a proxy to measure the effect of transaction costs in the estimations whereas most cash crops are marketed at farm-gates. There are also regional differences both in land and labour market participation for cash crop production. Households from the two research sites (*Haro-Maya* and *Ziway*) significantly differ in their land and labour market participation decisions. This implies that policies that work at one region may not necessarily work at the other. Therefore, market development policies should consider region specific differences.

The interaction between household decisions on what crops to grow and at which market outlet to sell is not well addressed in the literature. Chapter five examines the interaction between crop and market outlet choices at a household level. A simultaneous equation model is developed for crop and market outlet choice interactions and used to test for simultaneity between the two decisions for seven vegetable crops. From the test results it can be learned that for onion and kale crops produced around Ziway there is simultaneity in size of farmland allocated to these two crops and the share of these crops marketed at the farm-gate. This shows that household preference to trade at a particular market outlet influences farm household land allocation decisions to a particular crop. In other words, institutional arrangements and their accessibility to farm households play a role in commercializing small-scale agriculture.

Chapter six examines the bargaining power of vegetable producing farm households at farm-gate price negotiations under asymmetric price information. Estimation equations for factors influencing the bargaining position of sellers at farm-gate and the spread between the initial ask and offer prices in negotiation are developed. The general conclusion to be drawn from the estimation results is that transmitting the daily vegetable wholesale price information to the potential vegetable producing areas via radio, internet or mobile phones could help tomato producers in reducing their valuation uncertainties and claim reasonable farm-gate prices. In this regard, establishing and supporting farmers' vegetable marketing co-operatives could help to bridge the price information gap, facilitate the price information transmission process, and when there is a shortage of buyers at farm-gate, assist farmers in assembling and transporting their vegetable products to the central market. Basic infrastructural developments like improving local road networks connecting vegetable farms with the main roads contribute towards increasing farmer's bargaining power over farm-gate prices.

7.3 Discussion

This section discusses two issues of this thesis. The first issue is how the individual chapters in the thesis are linked to each other and what they contribute to the body of literature on agricultural commercialization. The second issue discusses the major lessons that could be learned from the conclusions drawn in this thesis in line with the objectives of the RESPONSE programme[1], particularly focusing on the development of less-favored areas through commercializing small-scale agriculture.

Linkages among the chapters in the thesis

Chapter three of the thesis starts at a macro level with examining the role of non-traditional agricultural commodities in stabilizing export earnings of Ethiopia. Special attention is paid to horticultural crops with the intention that horticulture could be the possible way out for agricultural commercialization of small-scale farmers with relatively better agricultural resource potentials. If small-scale farm households have to move towards the production of horticultural crops for agricultural commercialization, factors influencing household decision behavior in resource use should be studied, which is the core objective of chapter

[1] RESPONSE is an abbreviation for **Re**gional Food **S**ecurity **Po**licy for **N**atural Resource Management and **S**ustainable **E**conomies. Detailed explanation of the RESPONSE programme is given in Ruben et al. (2006)

four and brings the study to a micro level. Though crops can generally be classified into food and cash crops in explaining agricultural commercialization, there are diversities in each category. For instance, different cash crops demand different types and quantities of inputs and different institutional/market arrangements to obtain these inputs. Farm households also differ in their resource potentials to get access to different markets to obtain inputs and trade their cash crop harvests at different market outlets. Given the household potential to participate in output markets, the availability and accessibility of market outlets could influence household decisions in crop choice. With this assumption, crop and market outlet choice interaction is dealt with in chapter five. Regardless of the possible market outlets where transactions could occur, farmers' bargaining power in market price negotiations matters a lot in getting reasonable prices for their crop harvests supplied to a market. Market prices that usually appear as an outcome of price negotiations influence the next season production plan and the incentives to shift resources from subsistence to more commercial agriculture as well. With this motive, chapter six discusses the bargaining position of farm households in cash crop markets and what socio-economic factors influence farmers' bargaining power. This chapter brings the study to a detailed analysis of one market outlet and one product with respect to price formation.

Lessons for the RESPONSE programme

Within the broad goal of the RESPONSE programme, i.e., *identifying alternatives for addressing poverty, food security and natural resource management in less-favoured areas*, there are some specific lessons that could be learned from this thesis. First, the findings in this thesis confirm that regions and farm households within the same region are far from homogeneous in their resource endowments and access to markets and market related institutions (Ruben and Pender, 2004). Such diversity in the socio-economic set up calls for different development strategies/pathways and rules out the *'one-size-fits-all'* principle.

Second, missing or imperfect markets limit the opportunities to rural farm households in choosing activities that could lead to higher household welfare. Creating the missing institutional arrangements and introducing supportive mechanisms to strengthen the already available but less-functional ones could help small-scale farmers in widening up their production and marketing choices that could potentially enable them to attain a better living standard. This goes along with earlier findings like Dercon and Krishnan (1996) on entry barriers in activity choice in rural Ethiopia and Tanzania.

Third, as shown in chapter six of this thesis, provision of basic infrastructure like rural road networks and information communication facilities improves farm household welfare through enhancing their bargaining position. Moreover, it creates a conducive environment that promotes the participation of rural households into factor and product markets and the integration of local and regional markets (Fan and Chan-Kang, 2004; Oskam et al., 2004). Well integrated local and regional markets could also encourage farm household market participation and, as a result, speed up the move from subsistence towards more market oriented household resource use and production decisions. This effect is much stronger particularly for areas with good agricultural potential but poor/shallow rural markets (Ruben and Pender, 2004).

To realize economic development in rural areas in general and in less-favoured areas in particular, policies that improve the well functioning of rural markets and market related institutions need to be focused on. Well functioning markets and market related institutions enable farm households to attain the possible maximum net benefit from the agricultural resources at their disposal. It is only under such circumstances that the '*invisible hand'* contributes towards poverty reduction and better living standards for the rural population and particularly for those living in less-favoured areas.

7.4 Future research

Based on the results and conclusions obtained in this thesis, some suggestions for future research can be made. First, the portfolio approach used in analyzing the export earnings stability at macro level can also be applied to investigate the portfolio of different crops grown at household (micro) level (Fafchamps, 1992). Missing/imperfect markets, credit constraints, and risky production and marketing circumstances influence farm household preferences towards risk and risk management strategies. For different households with different preferences towards risk, optimal portfolios that balance the trade-off between risk and higher household income of different cash and food crops could be investigated. Analyzing the synergies and trade-offs among different food and cash crops produced by small-scale farm households (Govereh and Jayne, 2003) helps to understand where policy makers should focus in attaining the desired food security and higher household income for better household welfare through markets.

Second, vegetable production during the dry off-season requires irrigation by pumping up water from the two fresh lakes (Lake Haro-Maya and Lake Ziway). However, using lake water free of charge for irrigation purpose may put the sustainability of these

lakes under pressure. Though not addressed in this thesis, unsustainable water use could also limit the shift of land and labour use from subsistence to cash crop production. Future research along this line is important and urgent as commercial flower farms recently started to boom around Lake Ziway and also use the lake for irrigation.

Third, in addition to the household specific analysis considered in this thesis, one can also investigate the interactions between the subsistence and semi-subsistence or relatively more commercial oriented farm households in land and labour markets at a village level (Dyer et al., 2006). Such analysis helps to understand how rural land and labour markets contribute to income distribution and risk sharing arrangements among the rural households with different resource endowments. It is also interesting to incorporate landless and subsistence households in the analysis and try to investigate how possibly these households could be linked to markets for better welfare. Moreover, such a village level analysis helps to bridge the gap between the macro and micro level analyses performed in this thesis.

Fourth, in this thesis, farm household land and labour allocation decisions to cash and food crop production are analyzed using cross-section data. Results from cross-section data, however, have their own limitations in giving a general picture of the move towards commercializing agriculture. In this regard, the household specific moves and the general trend in this move in a dynamic environment should be investigated using panel data. The use of panel data could also give the opportunity to incorporate production and marketing risk components in household land and labour allocation decisions.

Finally, trade inefficiencies could be modelled in the farm-gate price negotiations. In this thesis, only farm-gate price negotiations that led to exchange (trade) were considered in the analysis. However, farm-gate price negotiations may fail due to lack of equal information on central market prices by both trading agents. It could be the case that a failed negotiation would have been beneficial for both trading agents if both parties would have had equal market price information. Sometimes negotiations fail deliberately due to sellers holding on higher ask prices in order to get information on the possible maximum valuations of the buyers. This mechanism has a benefit in revealing information but also a cost if the next negotiation ends at a lower price than what the earlier buyer offered. Given the fluctuating daily wholesale prices at the central vegetable market and the perishable nature of vegetables, it is interesting to analyze the cost-benefit of using negotiation failure as information revealing strategy and the loss in product quality by holding on to high ask prices.

REFERENCES

Alwang, J. and P.B. Siegel (1994). Portfolio Models and Planning for Export Diversification: Malawi, Tanzania and Zimbabwe, *Journal of Development Studies,* 30(2): 405-422.

Amemiya, T. (1974). Multivariate Regression and Simultaneous Equation Model when the Dependent Variables are Truncated Normal. *Econometrica*, 42(6): 999-1012.

Arndt, S. W. (1999). Globalization and Economic Development. *The Journal of International Trade and Economic Development* 8(3): 309-318.

Befekadu, D., Berhanu, N. and Getahun, T. (2001). Annual Report on the Ethiopian Economy 2000/2001, The Ethiopian Economic Association; Addis Ababa, 2: 26-31

Berhanu, N., Kibre, M. and Worku, G. (2002). Sources and Uses of Export Support Services in Ethiopia, *Ethiopian Economic Policy Research Institute (EEPRI),* Working Paper No 2/2002.

Bigman, D. (2002) Diversifying Agricultural Production and Exports in Africa: The role of Agricultural Research and Development. In Bigman, D. (ed.), *Globalization and the Developing Countries: Emerging Strategies for Rural Development and Poverty Alleviation.* CABI publishing, 237-257.

Binswanger, H. and M. Rosenzweig (1986). Behavioral and material determinants of production relations in agriculture. *Journal of Development Studies,* 22: 503-539.

Brook, D. (1999). Ethiopia's Export sector: Performance and prospects. Economic Focus 2 (2)

Chatterjee, K., and W. Samuelson (1983). Bargaining under Incomplete Information. *Operations Research* 31:835-851.

Coe, D. T. and E. Helpman (1995). International R&D Spillovers. *European Economic Review* 39: 859-887

Cramton, P.C. (1984). Bargaining with Incomplete Information: An Infinite-Horizon Model with Two Sided Uncertainty. *Review of Economic Studies*, 51: 579-93.

Crawford, V.P. (1982). The Theory of Disagreement in Bargaining. *Econometrica,* 50(3):607-637.

CSA (2002) Annual Land Use Report: The Federal Democratic Republic of Ethiopia: Central Statistics Authority, Addis Ababa. .

De Janvry, A., M. Fafchamps, and E. Sadoulet (1991). Peasant Household Behavior with Missing Markets: Some Paradoxes Explained. *Economic Journal,* 101:1400-17.

Dercon, S. and P. Krishnan (1996). Income Portfolios in Rural Ethiopia and Tanzania: Choices and Constraints. *Journal of Development Studies,* 32(6):850-875.

Desalegn, Y. (2002). Horticultural export performance of Ethiopia and other Sub Sahara African Countries, KINIJIT, Ethiopian Export Promotion Agency (EEPA), Addis Ababa, 1(1): 6-7. (*In Amharic).*

Dolan, C. and J. Humphrey (2000) Governance and Trade in Fresh Vegetables: The Impact of UK Supermarkets on the African Horticultural Industry. *Journal of Development Studies* 37 (2): 147-176.

Dutilly-Diane, C., E. Sadoulet, and A. de Janvry (2003). Household Behavior under Market Failures: How Natural Resource Management in Agriculture Promotes Livestock Production in Sahel. University of California, Barkley, Working Paper 979,

Dyer, G. A., S. Boucher and J. E. Taylor (2006). Subsistence Response to Market Shocks. *American Journal of Agricultural Economics*, 88(2):279-291.

Eswaran, M. and A. Kotwal (1986). Access to Capital and Agrarian Production. *The Economic Journal*, 96(382):482-498.

Fafchamps, M. (1992). Cash Crop Production, Food Price Volatility and Rural Market Integration in the Third World. *American Journal of Agricultural economics*, 74(1):90-99.

Fafchamps, M. and R.V. Hill (2005). Selling at the farm-gate or traveling to market. *American Journal of Agricultural Economics*, 87(3):717-734.

Fan, S. and C. Chan-Kang (2004). Returns to investment in less favoured areas in developing countries: a synthesis of evidence and implications for Africa. *Food Policy*, 29(4):431-444.

Gibbons, R. (1992). *A Primer in Game Theory*. Harvester Wheatsheaf, New York.

Govereh, J. and T.S. Jayne (2003). Cash cropping and food crop productivity: synergies or trade-offs? *Agricultural Economics*, 28:39-50.

Hassan, R.M. (1996). Planting Strategies of Maize Farmers in Kenya: a simultaneous equation analysis in the presence of discrete dependent variables. *Agricultural Economics,* 15:137-149.

Heckman, J.J. (1979). Sample Selection Bias as a Specification Error. *Econometrica*, 47(1) 153-61.

Higgins, J. (1986). Input Demand and Output Supply on Irish Farms: A Micro-economic Approach. *European Review of Agricultural Economics*, 13: 477-493.

Key, N., E. Sadoulet, and A. de Janvry (2000).Transactions Costs and Agricultural Household Supply Responsiveness. *American Journal of Agricultural Economics*, 82: 245-259

Keyzer, M., Merbis, M., and Overbosch, G. (2000). WTO, Agriculture and Developing Countries: The case of Ethiopia, FAO, Rome.

Kreps, D.M. (1990). *A Course in Microeconomic Theory*. Financial Times Prentice Hall, London.

Kuyvenhoven, A., J. Pender and R. Ruben (2004). Development strategies for less-favoured areas. *Food Policy*, 29:295-302.

Love, J. (1979). A Model of Trade Diversification Based on the Markowitz Model of Portfolio Analysis, *Journal of Development Studies*, 15(2): 233-241.

Maddala, G.S. (1983). *Limited Dependent and Qualitative Variables in Econometrics*. Econometric society Monographs, No.3., Cambridge University press.

Markowitz, H. M. (1959). *Portfolio Selection*. New York: Wiley Press.

MasCollel, A., M. D. Whinston, and J. R. Green (1995). *Microeconomic Theory*. Oxford University press, Oxford.

Omamo, S.W. (1998). Transport costs and Small holder cropping choices: An application to Siaya District, Kenya. *American Journal of Agricultural Economics* 80: 116-123.

Onafowora, O. A., and O. Owoye (1998). Can trade liberalization Stimulate Economic growth in Africa? *World Development,* 26(3): 497-506

Oskam, A., M.H.C. Komen, P. Wobst and A. Yalew (2004). Trade Policies and the Development of Less-favoured Areas: Evidence from literature. *Food Policy*, 29: 445-466.

Pender, J. (2004). Development pathways for hillsides and highlands: some lessons from Central America and East Africa. *Food Policy*, 29:339-367.

Perry, M. (1986). An Example of Price Formation in Bilateral Situations: A Bargaining Model with Incomplete Information. *Econometrica,* 54(2):313-321

Pingali, P. (1997). From Subsistence to Commercial Production Systems: The Transformation of Asian Agriculture. *American Journal of Agricultural Economics,* 79:628-634.

Rahmato, D. (1999) Water Resource Development in Ethiopia: Issues of Sustainability and Participation, Forum for Social Studies, Addis Ababa.

Ruben, R. and J. Pender (2004). Rural Diversity and Heterogeneity in Less-favoured Areas: The quest for policy targeting. *Food Policy*, 29:303-320

Ruben, R., M.H. Kuiper and J. Pender (2006). Searching development strategies for less-favoured areas. *Netherlands Journal of Agricultural Sciences*, 53(3/4):319-342

Sadoulet E. and A. de Janvry (1995). *Quantitative Development Policy Analysis*. The Johns Hopkins University Press, Baltimore.

Samuelson, W. (1984). Bargaining under Asymmetric Information, *Econometrica* 52(4):995-1006.

Sexton, R.J., and M. Zhang (1996). A Model of Price Determination for Fresh Produce with Application to California Iceberg Lettuce, *American Journal of Agricultural Economics*. 78: 924-934.

Sexton, R.J., M. Zhang, and J.A. Chalfant (2005). Grocery Retailer Behavior in Perishable Fresh Produce Procurement. *Journal of Agricultural & Food Industrial Organization*, 3(1): article 6 http://www.bepress.com/jafio/vol3/iss1/art6

Singh, B. (2002). *Nontraditional Crop Production in Africa for Export.* In: J. Janick and A.Whipkey (eds). Trends in New Crops and New Uses. ASHS Press, Alexandria, VA.

Singh, I., L. Squire and J. Strauss (1986). The basic model: Theory, Empirical results, and policy conclusions. In Agricultural *Household Models: Extensions, Applications, and Policy*. ed. in Singh, L. Squire and J. Strauss, pp.17-47. The Johns Hopkins University Press, Baltimore, USA.

Skoufias, E. (1994). Using Shadow Wages to Estimate Labour Supply of Agricultural Households. *American Journal of Agricultural Economics*, 76 (2): 215-227

Sobel, J., and I. Takahashi (1983). A Multistage Model of Bargaining. *Review of Economic Studies,* 50 (2): 411-426.

Srivastava, J., D. Chakravarti, and A. Rapoport (2000). Price and Margin Negotiations in Marketing Channels: An Experimental Study of Sequential Bargaining Under One-sided Uncertainty and Opportunity Cost of Delay. *Marketing Science,* 19(2):163-184.

Stanley, D. L. (1999). Export diversification as a strategy: The Central American case revisited. *The Journal of Developing Areas* 33: 531-548.

Taylor, J.E., and I. Adelman (2002). Agricultural Household Models: Genesis, Evolution, and Extensions. *Review of Economics of the Household*, 1: 33-58.

Varian, H.R. (1992). *Microeconomic Analysis.* Third edition. W.W. Norton & Company, New York.

Winters, L.A. (2004). Trade Liberalization and Economic Performance: An overview. *The Economic Journal,* 114:F4-F21

Woldehanna, T. (2000). Economic Analysis and Policy Implications of Farm and Off-Farm Employment: A Case Study in the Tigray Region of Northern Ethiopia, PhD Dissertation, Wageningen University, The Netherlands.

World Bank (2004). Opportunities and Challenges of High-Value Agricultural Exports in Ethiopia (Draft/unpublished document).
http://siteresources.worldbank.org/INTETHIOPIA/Resources/PREM/OppandChallengesHighValueExports.pdf

Yilankaya, O. (1999). A Note on the Seller's Optimal Mechanism in Bilateral Trade with Two-sided Incomplete Information. *Journal of Economic Theory*, 87:267-27

SUMMARY

Sub-Saharan African countries are mainly exporting agricultural commodities that face fluctuations in world market prices resulting in export income instability. The instability is high for countries like Ethiopia that obtain more than 50% of their export income from a single agricultural export commodity, i.e. coffee. In order to attain stability in export earnings, diversifying the export base towards non-traditional agricultural commodities, like horticulture, seems important. Linking small-scale farm household horticultural production with export could help both in reducing export earnings instability and enhancing farm household income. In addition, the production of high value and labour intensive horticultural products contributes to poverty reduction and rural development through generating higher income and better employment opportunities for landless farm households. For areas with good agricultural potential, like central and eastern parts of the Oromia regional state of Ethiopia, development strategies that stimulate households to shift their land and labour allocation from subsistence farming towards production of high value and marketable commodities like horticultural products is crucial.

In attaining the shift in household resource use from subsistence towards commercial agriculture, the role of well functioning markets is substantial. Particularly under the absence of cooling and storage facilities, markets for horticultural products need special attention due to the perishable nature of these products. The level of transmission and accessibility of market price information could affect the bargaining position of vegetable producing farmers on vegetable prices. Besides the bargaining position, the availability of alternative market outlets can also influence farmers' production plans. This is due to the fact that different vegetable crops demand different handling and transporting procedures, which may not all be feasible for some individual households. Some vegetable crops may also lose their quality unless immediately supplied to the consumers. Thus, at which market outlet a farm household would like to sell a given vegetable product may influence the size of land allocated to the particular crop, and vice versa.

The general objective of this thesis is to examine the development of less favoured areas through commercializing small-scale agriculture that produces crops with export potential. Although the main focus is on the behavior of family farms in the shift from subsistence to commercial farming, the research also tries to investigate the role of non-traditional agricultural export commodities, like fruits, vegetables, and flowers in stabilizing Ethiopia's export income. From the general objective, four specific objectives are defined and analyzed in separate chapters.

Different data sets are used in working on the specific objectives. Chapter 2 describes the research sites and data collected from different sources that deal with different levels of the economy. The national agricultural commodity export data used in the portfolio analysis was obtained from the Ethiopian Export Promotion Agency. Survey data was collected in 2003 from a sample of 154 farm households in eastern and central Oromia regional state of Ethiopia. From June to September 2004, additional data was recorded on a total of 66 farm-gate transactions while buyers and sellers were bargaining on tomato prices. To support the analysis in the bargaining process, the daily tomato wholesale prices at the central vegetable market in Addis Ababa were recorded for the same period.

In chapter three a portfolio approach is used to analyze the role of non-traditional agricultural commodity exports in stabilizing export earnings of Ethiopia. A group of eleven agricultural export commodities from the year 1998/99 to 2001/02 is used for the analysis. The main findings of this chapter are that traditional commodities like horticulture, chat, spices, hide and skin help to stabilize the export earnings of Ethiopia and that the main instability of export income arises from fluctuating price and quantity of coffee. The quantity of coffee exports varies less than its world market price. For other agricultural commodities, however, the variation in export quantities exceeds the price fluctuations.

In chapter four, an endogenously switching regression analysis is used to estimate the effect of different explanatory variables on land and labour allocation decisions to cash and food crops production at a household level. Land and labour allocation decisions differ for households depending on their participation status in land and labour markets. The major findings in this chapter are that households participate in land market as a buyer for the purpose of cash crop production if they use motor pumps for irrigation and if they have much farm capital. Availability of a motor pump and large farm capital positively affects the land and labour allocation decisions towards cash crop production.

The decision between crop specific area allocation and market outlet choice can be made recursively or jointly at the same time before or during the planting period. To test these alternative ways of decision making, a simultaneous equation model is specified in chapter five. Test results show that the simultaneity assumption is valid for two vegetable crops, namely onion and kale produced around Ziway. This shows that the availability and accessibility of a specific market outlet could influence household crop choice and the size of farmland allocated to each crop.

Using a bargaining model, chapter six analyzes the price setting mechanism between buyers and sellers under asymmetric information. The basic assumption is that merchants

buying vegetables and farmers selling them at the farm-gate are not equally informed on the central market prices of vegetable products. Thus, difference in market price information results into valuation differences between the buyers and the sellers on the same vegetable product under transaction. Such a difference in valuation is settled through price negotiations which results into a final transaction price that favors either the buyer or the seller depending on their bargaining power in the price negotiations. From the analysis, it is learned that sellers' bargaining positions increases when they have central market tomato wholesale price information and when this wholesale price is higher. However, the seller's bargaining position is lower when the distance to the tomato farm is farther from the main road, when the buyer speaks the bargaining price first, and when there is a large difference in quality assessment between the buyers and the sellers. The difference between the initial ask and offer prices is wider when the sellers and the buyers differ in their tomato quality assessment and when a large volume of tomatoes is transacted.

Chapter seven summarizes the major findings from each chapter dealt with the specific research objectives. It also discusses the linkage among the specific chapters in this thesis and the major lessons learned from this thesis in line with the research objectives of the RESPONSE programme. The chapter finally suggests some further research topics related to small-scale agricultural commercialization that are not well addressed in this thesis.

SAMENVATTING (SUMMARY IN DUTCH)

Afrikaanse landen ten zuiden van de Sahara exporteren voornamelijk agrarische producten waarvan de wereldmarkt prijzen fluctueren wat leidt tot instabiele export inkomsten. Voor een land als Ethiopië dat meer dan 50% van de totale export inkomsten haalt uit één agrarisch export product, namelijk koffie, is deze instabiliteit in inkomsten hoog. Om export inkomsten te stabiliseren is het van belang om het export aanbod te verbreden richting niet traditionele landbouw producten zoals tuinbouw producten. Door kleinschalige tuinbouw productie op gezinsbedrijven te koppelen aan export kan de instabiliteit van export inkomsten verminderen en tevens de inkomenspositie van gezinsbedrijven verbeteren. Bovendien draagt de productie van kwalitatieve en arbeidsintensieve tuinbouwproducten bij aan armoede vermindering en rurale ontwikkeling door het genereren van hogere inkomens en betere werkgelegenheid voor landloze huishoudens. Voor gebieden met goede agrarische mogelijkheden, zoals centrale en oostelijke delen van het Oromia district in Ethiopië, zijn ontwikkelingsstrategieën die gezinsbedrijven stimuleren hun land- en arbeidsinzet te verschuiven van zelfvoorzieningslandbouw naar productie van vermarktbare tuinbouwproducten cruciaal.

Om de verschuiving van productiemiddelen van zelfvoorzieningslandbouw richting commerciële tuinbouw te bereiken zijn goed functionerende markten belangrijk. Vanwege het ontbreken van koeling en opslag mogelijkheden verdienen markten voor tuinbouwproducten bijzondere aandacht gezien de beperkte houdbaarheid van deze producten. De mate waarin tuinbouw producenten beschikken over marktprijs informatie kan de onderhandelingspositie van tuinbouwers in prijsonderhandelingen beïnvloeden. Naast de onderhandelingspositie kan ook de beschikbaarheid van verschillende afzetmogelijkheden het teeltplan van een tuinbouwer beïnvloeden. Leveringseisen en transport verschillen per tuinbouwgewas en huishoudens kunnen hierin beperkt zijn. Sommige tuinbouwproducten verliezen hun kwaliteit wanneer ze niet direct na oogst verhandeld en geleverd worden. Hoe en waar een gezinsbedrijf bepaalde tuinbouwproducten kan afzetten kan daarom van invloed zijn op het areaal van bepaalde producten en vice versa.

De algemene doelstelling van dit proefschrift is te onderzoeken hoe commercialisering van landbouw richting marktbare tuinbouwproducten met export potentie kan bijdragen aan de ontwikkeling van minder ontwikkelde gebieden. Hoewel de nadruk ligt op het gedrag van gezinsbedrijven in de omschakeling van zelfvoorzieningslandbouw richting commerciële tuinbouw wordt in dit onderzoek ook onderzocht wat de rol van niet traditionele landbouw export producten als groenten, fruit en bloemen is in stabilisatie van de

exportinkomsten van Ethiopië. Vanuit de algemene doelstelling zijn vier specifieke doelen afgeleid die in aparte hoofdstukken uitgewerkt worden.

Verschillende datasets zijn gebruikt in de uitwerking van de specifieke doelstellingen. Hoofdstuk twee beschrijft de onderzoeksgebieden en de gegevens die verzameld zijn op verschillende niveaus van de economie. Nationale exportgegevens van agrarische producten die gebruikt worden in de portfolio analyse van hoofdstuk 3 zijn afkomstig van het Ethiopische Bureau voor Export Promotie. In 2003 is een enquête gehouden onder 154 gezinsbedrijven in centraal en oostelijk Oromia, Ethiopië. Van juni tot september 2004 zijn aanvullende gegevens verzameld. Op 66 gezinsbedrijven is het prijsonderhandelingsproces tussen koper en verkoper waargenomen terwijl er onderhandeld werd over de prijs van tomaten. Voor het onderzoek naar het onderhandelingsproces zijn in dezelfde periode ook dagelijks de groothandelsprijzen op de centrale markt voor tomaten in Addis Ababa vastgelegd.

In hoofdstuk drie wordt een portfolio model gebruikt om de rol van niet traditionele agrarische export producten in de stabilisatie van export inkomsten te onderzoeken. Elf agrarische export producten zijn opgenomen in de analyse over de periode 1998/99-2001/02. De belangrijkste resultaten van dit hoofdstuk zijn dat tuinbouwproducten, chat, kruiden en huiden bijdragen in het stabiliseren van export inkomsten en dat koffie de voornaamste bron van instabiele exportinkomsten is. De hoeveelheid geëxporteerde koffie varieert minder dan de wereldmarktprijs van koffie. Voor andere agrarische exportproducten zijn fluctuaties in hoeveelheden groter dan de prijsfluctuaties.

In hoofdstuk vier wordt een endogeen switching regression model gebruikt om het effect van verschillende verklarende variabelen op land- en arbeidsallocatie met betrekking tot commerciële en voedsel productie op gezinsbedrijfsniveau te schatten. Land- en arbeidsallocatie beslissingen verschillen voor huishoudens en zijn afhankelijk van het feit of deze huishoudens wel of niet participeren in grond- en arbeidsmarkten. De belangrijkste resultaten in dit hoofdstuk zijn dat huishoudens participeren als vrager op de grondmarkt voor commerciële productie wanneer ze de beschikking hebben over een waterpomp en wanneer er een redelijke hoeveelheid kapitaal aanwezig is. Beschikbaarheid van een waterpomp en kapitaal zijn ook van belang in de hoeveelheid arbeid en land die gevraagd wordt voor commerciële gewasteelt.

Keuzes met betrekking tot gewasarealen en afzetmarkten kunnen opeenvolgend of gelijktijdig genomen worden voorafgaand aan het groeiseizoen. Om dit te testen is in hoofdstuk vijf een simultaan stelsel van vergelijkingen gespecificeerd. Test resultaten laten

zien dat voor twee tuinbouwproducten, namelijk uien en kool, deze beslissingen inderdaad gelijktijdig worden genomen. Dit laat zien dat beschikbaarheid en bereikbaarheid van een specifieke afzet markt teeltbeslissingen en areaal grootte kunnen beïnvloeden.

Op basis van een model voor onderhandelingen wordt in hoofdstuk zes het prijsvormingsproces tussen kopers en verkopers met asymmetrische informatie bestudeerd. Een belangrijke aanname is dat handelaren die groenten kopen en boeren die deze groenten op het bedrijf verkopen ongelijk geïnformeerd zijn over de marktprijzen op de centrale markt in Addis Ababa. Verschillen in prijsinformatie leidden tot verschillen in waardering van de partij groenten die verhandeld wordt. Een dergelijk verschil in waardering wordt overbrugd in prijsonderhandelingen die leidden tot een transactieprijs welke dichter bij de waardering van de verkoper dan wel bij de waardering van de koper ligt. Dit hangt af van de onderhandelingspositie van beide partijen. Uit de analyse volgt dat de onderhandelingspositie van een verkoper beter is als deze beschikt over informatie over prijzen van de centrale markt en wanneer deze centrale prijzen hoog zijn. De onderhandelingspositie van de verkoper wordt slechter naarmate het bedrijf verder van de hoofdweg af ligt, wanneer de koper de onderhandelingen start door als eerste en biedprijs uit te spreken en wanneer er een groot verschil is in kwaliteitsbeoordeling tussen koper en verkoper. Het verschil tussen initiële bied- en vraagprijzen is groter wanneer verkopers en kopers verschillen in kwaliteitsbeoordeling en wanneer grote partijen tomaten worden verhandeld.

Hoofdstuk zeven vat de belangrijkste conclusies uit de verschillende hoofdstukken van dit proefschrift samen. Het bespreekt tevens de relatie tussen de verschillende hoofdstukken en de belangrijkste lessen uit dit onderzoek in relatie tot de doelstelling van het RESPONSE project waar dit promotieproject een onderdeel van is. In het hoofdstuk worden tot slot suggesties gedaan voor toekomstige onderzoeksonderwerpen op het gebied van commercialisering van kleine gezinsbedrijven die in dit proefschrift niet aan bod zijn gekomen.

APPENDICES

Appendix A3[1]. Equation (3.5) in the text is derived as

$$\frac{\partial w_i}{\partial X_i} = \frac{\partial\left(\frac{X_i P_i}{\sum X_i P_i}\right)}{\partial X_i} = \frac{\partial\left[X_i P_i\left(\sum X_i P_i\right)^{-1}\right]}{\partial X_i}$$

$$= P_i\left(\sum X_i P_i\right)^{-1} + (-1)\left(\sum X_i P_i\right)^{-2}(P_i)(X_i P_i)$$

$$= \frac{P_i}{\sum X_i P_i} - \frac{X_i P_i (P_i)}{\left(\sum X_i P_i\right)^2}$$

$$= P_i\left(\frac{1}{\sum X_i P_i} - \frac{X_i P_i}{\sum X_i P_i}\left(\frac{1}{\sum X_i P_i}\right)\right)$$

$$= P_i(1 - w_i)\frac{1}{\sum X_i P_i}$$

$$= (1 - w_i)\frac{P_i}{\sum X_i P_i}$$

Appendix A6. Derivation of the initial ask/offer price

Based on the work of Sobel and Takahashi (1983) and Gibbons (1992: 219-224), the following simple optimization problem shows that the initial ask/offer prices are not equal to the final transaction price when there is a cost of delay and agents are not committed to their initial ask/offer prices in the bargaining process.

To simplify the bargaining process, we assume bargaining process of only two rounds. In the first round the seller proposes an initial ask price and this price is either accepted or rejected by a buyer. If rejected, the seller makes the final ask price in the second round. If the buyer does not accept, the game is over and they both get zero benefit. To simplify the equilibrium analysis, it is also assumed that $\underline{v}_s = \underline{v}_b = 0$.

The objective function to be maximized, equation (6.8), is reduced to:

[1] Appendix starts with A3 to match with the number of chapters

$$\underset{p_1, p_2}{Max} \quad (p_1 - V_s)[G(\bar{v}_b) - G(\hat{v}_{b,1})] + \delta_s (p_2 | p_1 - V_s)[(G(\hat{v}_{b,1}) - G(\hat{v}_{b,2})] \tag{A1}$$

The seller's maximization problem is subject to the sequential rationality assumption that states that a buyer accepts the ask-price at period n if:

$$V_b - p_1 \geq \delta_b (V_b - p_2), \qquad \text{i.e.,} \qquad V_b \geq \frac{p_1 - \delta_b p_2}{1 - \delta_b} \tag{A2}$$

By solving the above maximization problem subject to the sequential rationality constraint, we get the equilibrium initial ask price as:

$$p_1^* = \frac{(2 - \delta_s)^2}{2(4 - 3\delta_s)} \bar{v}_b \tag{A3}$$

The buyer accepts if $V_b \geq p_1^*$. If not accepted, the Perfect Bayesian Equilibrium price the seller should ask in the second period is:

$$p_2^* = \frac{2 - \delta_s}{2(4 - 3\delta_s)} \bar{v}_b < p_1^* \quad ; \quad for\ \delta_s < 1 \tag{A4}$$

When there is no cost of delay, $\delta_s = 1$, a seller should be committed to his initial ask price , i.e., $p_1^* = p_2^* = \frac{1}{2}\bar{v}_b$. But, when the cost of delay is very high, i.e., δ_s is close to 0, the optimal ask price converges from the initial ask price $p_1^* = \frac{1}{2}\bar{v}_b$ to $p_2^* = \frac{1}{4}\bar{v}_b$ in case the buyer did not accept the initial ask price p_1^*.

COMPLETED TRAINING AND SUPERVISION PLAN

Table **A1**. List of courses attended and credits obtained

Name of the course	Department/Institute	Year	Credits
I. General part			
Techniques for Writing and Presenting a Scientific Paper	MGS*	2002	**1**
Research Methodology	MGS	2002	**2**
II. Mansholt-specific part			
Mansholt Introduction course	MGS	2002	**1**
Bio-economic Farm Household Models	MGS & RESPONSE**	2002	**1**
Mansholt Multidisciplinary Seminar	MGS	2005	**1**
Presentations:			
Presentation of final PhD Thesis Proposal	MGS & RESPONSE	2002	**1**
Presentation at international conferences			**2**
1. 10th EAAE Congress, Zaragoza, Spain	EAAE	2002	
2. 86th EAAE seminar Florence, Italy	EAAE	2004	
3. 2nd EAAE PhD Workshop, Wageningen, The Netherlands	EAAE	2005	
III. Discipline-specific part			
Agricultural Models	MGS	2001	**5**
Advanced Econometrics II	MGS	2001	**4**
Economic Organisation Theory	NAKE***	2002	**2**
Empirics of Economic Growth	NAKE	2002	**2**
Market Micro-Structure	NAKE	2002	**2**
Social Choice Theory	NAKE	2002	**2**
Macroeconomics	CentER	2002	**4**
3 NAKE Workshops + reports	NAKE	2002-05	**6**
*(Minimum requirement = 20 Credit hours****)*	Total Credits		**36**

Note: * *MGS = Mansholt Graduate School*
** *RESPONSE = Regional Food Security Policies for Natural Resource Management and Sustainable Economics*
*** *NAKE = Netherlands Network of Economics*
**** *One credit hour is equivalent to 40hours work.*
EAAE=European Association of Agricultural Economists

CURRICULUM VITAE

The author was born on March 16, 1972 in Horro district, East Wollega Zone, Oromia Regional State, Ethiopia. He attended his primary and junior secondary education at Abuna and Sekela schools, respectively. He completed his high school education at Shambu senior secondary school and joined Nekemte Teachers Training Institute for one year training as a primary school teacher. He worked for four years as a primary school teacher and joined Alemaya University of Agriculture in September 1994 to pursue his BSc. In 1998, he obtained his BSc degree in Agricultural Economics with great distinction. After graduation, he was employed at Awassa College of Agriculture as a graduate assistant. In August 2000, Moti has got a NUFFIC scholarship from the Dutch Government to study his MSc at Wageningen University. He graduated his MSc study in Agricultural Economics and Management in January 2002. Immediately, he has got the opportunity to continue his PhD study in RESPONSE (Regional Food Security Policies for Natural Resource Management and Sustainable Economies) project funded by International Food Policy Research Institute and Wageningen University and supervised by Agricultural Economics and Rural Policy Group of Wageningen University. Moti is married to Shibire Adam and he is a father of three kids (Jalane, Roba and Robera).

December 2006
Wageningen

Regional Food **S**ecurity
Policy for **N**atural
Resource Management
and **S**ustainable
Economies

==========

The research presented in this thesis was carried out in the framework of the RESPONSE *(Regional Food Security Policies for Natural Resource Management and Sustainable Economies)* programme, a joint initiative of Mansholt Graduate School for Social Sciences, C.T de Wit-Graduate School for Production Ecology and Resource Conservation of Wageningen University and Research center (WUR) in co-operation with the International Food Policy Research Institute (IFPRI) in Washington D.C. The programme aims at supporting policy makers in identifying alternatives for addressing poverty, food security and natural resource management in less-favoured areas.

RESPONSE is one of the six multi-annual research programmes of the Interdisciplinary Research and Education Fund (INREF) of WUR, launched in 2000. INREF enables the co-operation of Wageningen University researchers with international and national research institutions in the South. The RESPONSE programme includes 10 sandwich PhD students from East Africa (Ethiopia, Kenya and Uganda) and Southeast Asia (China, Bangladesh and the Philippines). Fieldwork activities have been co-funded by the Dutch Ministry of Foreign Affairs (Directorate General for International Co-operations/DGIS), the European Union and the Neys-van Hoogstraten Foundation.

Publisher: Ponsen & Looijen bv, Wageningen

Cover design and picture: by the author.

- Front page: vegetables production and marketing around Lake Ziway, Ethiopia.
- Back page: vegetables and cereals production around Lake Haro-Maya, Ethiopia.

This study was financed by RESPONSE and Agricultural Economics and Rural Policy Group, Wageningen University.