This is to certify that the
dissertation entitled

AN ANALYSIS OF INCOME POVERTY EFFECTS IN CASH CROPPING ECONOMIES IN RURAL MOZAMBIQUE : BLENDING ECONOMETRIC AND ECONOMY-WIDE MODELS

presented by

RUI M. S. BENFICA

has been accepted towards fulfillment
of the requirements for the

Doctoral degree in Agricultural Economics

Major Professor's Signature

9/22/2006

Date

AN ANALYSIS OF INCOME POVERTY EFFECTS IN CASH CROPPING ECONOMIES IN RURAL MOZAMBIQUE: BLENDING ECONOMETRIC AND ECONOMY-WIDE MODELS

By

Rui M.S. Benfica

A DISSERTATION

Submitted to
Michigan State University
In partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

2006

ABSTRACT

AN ANALYSIS OF INCOME POVERTY EFFECTS IN CASH CROPPING ECONOMIES IN RURAL MOZAMBIQUE: BLENDING ECONOMETRIC AND ECONOMY-WIDE MODELS

By

Rui M.S. Benfica

Contract farming is a pervasive institutional arrangement in cash cropping economies in Mozambique. Empirical evidence on its nature and, especially, the extent to which policies can generate broad based income growth and poverty reduction is lacking. This study investigates the rationale for persistence, the determinants of farmer participation and performance in cotton and tobacco schemes (Essay One), and the economy-wide effects of expansion and shocks in cotton and tobacco sectors on poverty reduction in *concession areas* of the Zambezi valley of Mozambique (Essay Two).

In the first essay, we find that in both sectors contract farming is an institutional response to widespread failure in input, credit and output markets and the absence of a functional public and market based service provision network. Two stage econometric procedures (testing for the existence of threshold effects in land holdings and educational attainment) indicate that in both areas participation in the schemes is driven by factor endowments, asset ownership and alternative income opportunities, and very little by demographic factors. Also, there are no returns to education in either sector; this result is consistent with previous research in Mozambique but surprising in an agronomically demanding crop like tobacco. Farm level profitability in cotton is significantly lower than in tobacco. Land holdings have a significant effect on profits for both crops at the highest threshold level, but effects on total crop income and total household income are found

only in tobacco growing areas, where tobacco farmers appear not be giving up profitable off-farm opportunities. In those areas, we find that results may be driven by the relatively more efficient use of hired labor; labor supply in those areas is predominantly provided by non-growers that end up sharing the benefits of contract farming. Lower profitability in cotton areas is a result of low producer prices, high input costs, and lack of effective coordination which results in low productivity and poor quality of farm output.

In the second essay, we find that poverty reduction effects of scheme expansion and shocks are sizable in both areas, more so in tobacco growing areas where economic linkages are stronger. While in tobacco areas expansion with higher export prices yields higher benefits, in cotton areas, where levels of productivity are extremely low, expansion with productivity gains has a more broad-based effect; even when impacts are limited among growers, any expansion in cotton production results in some benefits to non-growers. The damages of increased input prices are more severe in tobacco growing areas, where the input package is substantially more expensive. The effects of an export tax are more severe in tobacco growing areas where it significantly limits the effects of otherwise successful expansion efforts. In both areas, better maize prices have very positive implications for poverty reduction.

The study recommends that government not embark in restrictive trade policies (export taxes and maize export restrictions). Instead, it should promote an environment conducive for private sector investment and improved sector coordination. Increased contribution of cotton to rural livelihoods will require increased productivity through an improved input package, extension, and prices to farmers. For long term sustainability in tobacco, adverse environmental impacts deserve more attention.

DEDICATION

I dedicate this work to my wife, Marcia, and my son Ruy Allan, my sources of joy and inspiration; and my parents for their love and dedication!

ACKNOWLEDGEMENTS

I would like to acknowledge several people and institutions that, in many different ways, made possible the completion of my Ph.D. Program. I ought a very special thanks to Dr. David L. Tschirley, my major professor and Dissertation Supervisor, who encouraged me to pursue this dream, and always gave wise advice in multiple aspects of this journey. Dr. Tschirley was instrumental in the research and Dissertation design and completion; without his unconditional commitment this journey would not be completed. Many thanks are also due to Dr. Duncan H. Boughton, who served in the committee, and was instrumental for the design and implementation of the field work in Mozambique; Dr. Boughton's willingness to share views, find common ground, and overcome sometimes difficult circumstances is appreciated. I thank Dr. Channing Arndt, from Purdue University, for accepting to participate in the committee and for his outstanding mentoring role and support provided while I was in Mozambique and throughout the process particularly with respect to the application and understanding of economy-wide modeling techniques. I also thank Dr. Charles Ballard, from the Economics Department at MSU, for participating in the committee and for his practical and pragmatic contributions.

Through Dr. Arndt's networking, I interacted with economy-wide modeling practitioners around the world with whom I learned a great deal. In addition to Dr. Arndt, I recognize the important contributions of the instructors in the CGE Training Courses at the University of Cape Town (UCT, South Africa): Sherman Robison (University of Sussex and IDS, UK); Lawrence Edwards (UCT), Dirk van Seventer (TIPS); James Thurow (University of Natal and IFPRI); Rob Davis; Scott McDonald (University of

Sheffield, UK); and Joe Francois (Erasmus University, The Netherlands). A Special appreciation goes to Professor Sherman Robinson for the three weeks he was willing to spend with me at the University of Sussex, UK, where I designed the regional CGE models used in this study.

The collaboration with the Agriculture Promotion Centre (CEPAGRI) and the Department of Policy Analysis, Economics Directorate of the Ministry of Agriculture of Mozambique and its Provincial branches of Tete and Sofala was also very important for the completion of this work. I thank all the staff at the central and provincial levels, field supervisors, enumerators and support staff, whose contribution made this ambitious effort possible. Particular recognition goes to my field supervisors Arlindo Miguel, Julieta Zandamela and Natércia de Sousa. I thank the cotton companies, C.N.A. and DUNAVANT Mozambique, and the tobacco companies, MLT and DIMON Mozambique, for the help provided in the organization and implementation of the field work at the district level, and by providing information crucial for the design and implementation of this work.

This work is inevitably associated with the success of the Food Security III Project, funded by USAID, that covered my Assistantship in the Department of Agricultural Economics and a great deal of the field work in Mozambique. In spite of not being formally part of the committee, Dr. Michael Weber, the Project Co-Director, has always been a great source of wise advice throughout my Ph.D. Program. Additional financial support was obtained through a project funded by the AERC (African Economic Research Consortium) that supported my staying at the University of Copenhagen, Denmark, and University of Sussex, UK. In addition to funds from the Food Security

Project, the second part of the field work was generously funded by the Italian Cooperation in Mozambique, through a funding facility obtained via CEPAGRI. Additional funding on the initial phase was provided by the Ministry of Agriculture.

In the Department of Agricultural Economics, I would like to thank Dr. Eric Crawford, the Graduate Program Advisor, for his advice throughout the program. A special recognition also goes to Dr. John Staatz, whose class 'Professional Practice in Agricultural Economics', a.k.a. 'Boot Camp for Agricultural Economists', was crucial in increasing awareness and in improving my understanding of the practical challenges of our profession and how to best go about them under different environments and audiences; a *golden key* that I am pleased to keep!

The environment among graduate students at MSU was excellent. Without all the friendship and fruitful interaction with my fellow graduate students, staff and professors, it would have been hard to complete this journey successfully. My warm thanks to all!

I would also like to thank the Mozambican community of Graduate Students across the U.S., particularly those at Purdue University, Louisiana State University, Fresno State University, and especially Anabela Mabota at Ohio State University. Together, we managed to make our stay enjoyable through the many visiting trips we made to each other across the different States. I also thank our good friend Julia Nhampule (who visited us in a critical moment during the program) for all the support.

Last but not least, I thank my wife Marcia and my son Ruy Allan for their love and patience throughout the process. To my parents, Afonso and Maria Luisa, my brothers and sisters, and my maternal grandmother who taught me the ABC, a big Thanks!

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

LIST OF ACRONYMS

CDF	Cumulative Distribution Function
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CF	Contract Farming
CGE	Computable General Equilibrium
CNA	Companhia Nacional Algodoeira
CPI	Consumer Price Index
DAD	Distributive Analysis/Analyse Distributive Software
DINA	Direcção Nacional de Agricultura
FMC	Factor Market Closures
FACTFE	Factor is Activity Specific and Fully Employed
FMOBFE	Factor is Mobile and Fully Employed
FMOBUE	Factor is Mobile and Unemployed
GAMS	General Algebraic Modeling System Software
GDP	Gross Domestic Product
GOM	Government of Mozambique
GTAP	Global Trade Analysis Project
IAF	Inquérito aos Agregados Familiares/Household Expenditure Survey
IFPRI	International Food policy Research Institute
IMR	Inverse Mills Ratio
INE	Instituto Nacional de Estatística
JFS	João Ferreira dos Santos
LEO	Leontief Technology
LES	Linear Expenditure System
MA	Ministério da Agricultura/Ministry of Agriculture
MLT	Mozambique Leaf Tobacco
MPF	Ministry of Planning and Finance
MSU	Michigan State University
PRSP	Poverty Reduction Strategy Paper
PU	Purdue University
RH	Representative Household Approach
RoW	Rest of the World
SAM	Social Accounting Matrix
S-I	Savings-Investment
TIA	Trabalho de Inquérito Agrícola/National Agricultural Survey
ZVR-CGE	Zambezi Valley Region Computable General Equilibrium Model
ZVR-SAM	Zambezi Valley Region Social Accounting Matrix

CHAPTER 1

INTRODUCTION

1.1. Background

In spite of a significant drop in recent years, more than half of Mozambique's population still lives under the poverty line. Absolute poverty is more prevalent in rural areas where the great majority of the country's population lives and works. Poverty in those areas, using a consumption metrics, reaches about 55% of the population. Urban poverty levels are also alarming; about 52% using the same metrics (MPF/IFPRI/PU, 2004).[1] An analysis of changes in the poverty head count measure for the Zambezi Valley region, the focus area of this study, indicates that the proportion of poor people fell more rapidly there than it did in the country as a whole between 1996/7 and 2002/3; averaging a 28% drop across the provinces whose districts are included in the study region. This contrasts with a 15% drop nationwide. A great deal of this recovery can possibly be attributed to the expansion of cash cropping in the region in recent years, through direct effects and indirectly from increased employment and consumption of farm and non-farm goods and services, some of which are produced locally.

Research throughout the developing world has shown a potentially strong relationship between agro-industrial investments, growth in smallholder agriculture, and poverty reduction (Jaffee and Morton, 1995; Dorward *et al.* 1998; Delgado, 1999). If properly structured to relate to smallholder producers, those investments can play a very important role in rural poverty reduction strategies in Mozambique (Tschirley, 2002). To

[1] Using the poverty headcount measure (Flexible Bundle Approach), national poverty incidence decreased from 69% in 1996/7 to 54% in 2002/3. In rural areas, by the same measure, poverty reduced in 16 percentage points, against only 11 percentage points in urban areas nation-wide.

have a positive effect on rural poverty reduction in a sustainable manner, a necessary (but not sufficient) condition for any arrangement is that it must be profitable for both the firm involved and also for rural residents. Also, the issue of whom, within the income distribution scale, grows specific crops and how profitable they are, and who gets access to employment opportunities, is essential to assess the direct impact on income differentiation of the arrangements or technological options. Growth in rural incomes as a result of indirect effects depends on the patterns of demand and the structure and flexibility of response of the farm and non-farm economy to changes in effective demand.[2]

In Mozambique, cotton and tobacco are important cash crops grown by the smallholder sector and demanded by a large-scale processing/trading sector with important links to external markets. These are both very demanding crops in input and factor use, particularly chemical inputs and labor; this is particularly important in tobacco, which uses a wider range of productivity enhancing inputs and is more demanding in its field practice requirements. Given the current stage of development of rural agricultural input and credit markets in the country, farmers have little access to improved seed and chemical inputs in rural areas. These market failures result in a heavy reliance on contract farming as the dominant mode of sub-sector organization.

Most schemes take the form of *forward resource/management contracts*.[3] The

---

[2] For a discussion on supply chain institutional arrangements and poverty reduction in rural Mozambique see Benfica *et al*, 2002.

[3] These differ from the simple sale/purchase contracts because they include stipulations regarding the transfer and use of specific resources and/or managerial functions (Jaffee and Morton, 1995). Forward resource management contracts partially internalize product and factor transactions, and are sometimes referred to as interlinked contracts or interlocked markets (Minot, 1986; Glover and Kusterer, 1990; Dorward *et al.* 1998).

standard contract consists in the firms supplying seeds, other inputs (including chemicals), and technical assistance to farmers on credit for use on specific crops. Farmers agree to utilize the inputs as instructed, and to sell all their production to the firms at harvest at agreed-upon prices. The costs initially supported by the firms, together with any interest charge, are deducted at the time of the harvest. In the Zambezi Valley of Mozambique, government has granted the cotton and tobacco companies monopsony rights, i.e., farmers are not permitted to sell outside the contracting scheme they are assigned to. These schemes are normally implemented on land for which individual farmers or farming communities have use rights, but there are cases in other parts of the country where the firms use designated areas or blocks within their own land concessions for that purpose (Strasberg, 1997).

Results from recent studies in the Zambezi Valley (Walker *et al.*, 2004; Benfica *et al.*, 2005) indicate that growers of cash crops, particularly cotton and tobacco, tend to have crop and total incomes somewhat higher than those of non-growers.[4] Those studies have also indicated that a number of farmers engaged in the contracting schemes have losses in their operations. On the other hand, the extent of indirect effects through labor markets and other linkages, which can potentially foster broader income distribution and impact poverty reduction across different household groups, have not been fully documented.

This study is motivated by three researchable hypotheses. First, resource and technology endowments are important for access to and performance in contract farming in cotton and tobacco areas. Second, due to farmer heterogeneity, the effects of

[4] Differences in total incomes are much less accentuated due to relatively higher non-agricultural incomes earned by non-cash crop growers (Tschirley and Weber, 1994; Benfica *et al.*, 2005). This may imply more equitable effects of cash crops on a broader scale.

participation in contract farming for specific types of households can differ substantially from the average effect across all households; understanding *what type* of farmer benefits from participation is crucial for designing effective policy for the sectors, and can also be useful in advising companies on effective expansion paths. Finally, the emerging trends in non-crop incomes and the incidence of labor market interactions and farm/non-farm linkages, associated with a dynamic cross-border economy, seem to indicate that contract farming can be inequality reducing, i.e., non-growers of those crops, in some areas, may be indirectly affected by that growth and the policies and exogenous shocks in cotton and tobacco sectors in the Zambezi Valley.

1.2. Research Objectives and Questions

The general objective of this study is to help guide government and donors in allocating development resources aimed at inducing private sector investments to take place in ways expected to yield a high profit potential while generating significant income growth and poverty reduction effects in rural areas of the Zambezi Valley of Mozambique.

The study has three specific objectives and associated research questions:

1. To understand the rationale for persistence and the determinants of farmer participation and performance in cotton and tobacco contract farming schemes in the Zambezi Valley of Mozambique. The associated research questions are:

    a. Why is contract farming the dominant and persistent institutional arrangement in the Zambezi Valley cash cropping economies?
    b. What are the determinants of farmer participation in contract farming schemes in cotton and tobacco sectors?
    c. What determines participant farmer profitability in those schemes?

2. To assess the effects of participation in contract farming on agricultural and total household incomes, accounting for threshold effects of education and land holdings, and controlling for selectivity bias. We aim at answering the questions:

    a. To what extent does participation in contract farming explain differences in farmer crop and total household incomes?
    b. What types of farmers benefit from contract farming?

3. To understand the mechanisms and assess the economy-wide income and poverty effects of expansion, policies and shocks to cash cropping sectors on household groups. Specific questions include:

    a. What kinds of policies have the greatest impact on poverty reduction?
    b. What is the best combination of policies to counteract negative shocks?

1.3. Organization of the Dissertation

This dissertation is organized in five chapters, including this introduction. Chapter Two details the methodology used in the data collection process, and discusses the construction and balancing of the Social Accounting Matrix used in the economy-wide analysis.

In Chapter Three, we present the first Dissertation Essay that addresses the first two research objectives. In the first part of the Essay, we present an overview of the cotton and tobacco sectors, followed by an analysis of the organization of production and trade, to review the rationale for the dominance and persistence of contract farming in those sectors. Then, two-stage econometric procedures (a sample selection and a treatment effects model with land and educational attainment thresholds) are used to assess the determinants of farmer participation and performance in contract farming, and

the effects of participation on crop and total household incomes of farming households in cash cropping areas. Finally, the chapter addresses specific policy implications for each area.

Chapter Four introduces the second Dissertation Essay that addresses the third research objective of the study. First, it presents the detailed structure of the regional SAM and the CGE model, commodity balances, factor market and macro system closures, as well as considerations on model calibration. Second, it uses the regional SAM to derive a set of representative characteristics of the economy. Finally, the economy-wide framework is used to assess the income and poverty effects of expansion and alternative policies and shocks in the cash cropping sectors on growers and non-growers in those economies, using cumulative distribution functions of household income *per capita.*

Chapter Five presents a summary of conclusions, economic policy implications and associated recommendations for further research.

CHAPTER 2

FIELD RESEARCH METHODOLOGY

2.1. Introduction

This chapter presents the methodology used for data collection in this study. To get sufficiently reliable data for the analysis, a multi-visit survey was undertaken in the study region. Two visits, six months apart, allowed for more precision in the data collected on the levels of input use and the variation in factor use, particularly the seasonality in labor demand and household decisions with respect to the use of family or wage labor and its allocation across competing activities. The schedule for the field data collection was driven by the crop calendar of the two cash crops of interest. The data collected were used for both the econometric analysis in Chapter Three and for the construction of the Social Accounting Matrix (SAM) used as the database in the economy-wide analysis in Chapter Four. The following are details on the sampling strategy and coverage, the contents of the survey instrument, and considerations regarding the construction and balancing of the SAM.

2.2. Survey Sampling Approach

The survey followed a stratified random sampling procedure. It covered concession areas for four firms operating contract farming schemes in the Zambezi Valley of Mozambique. Two of the firms, Mozambique Leaf Tobacco (MLT) and DIMON Mozambique, operate tobacco growing schemes in Tete Province. The other two are cotton companies, Dunavant Mozambique operating in Tete Province and C.N.A. operating in Northern Sofala Province.

The survey targeted a total of 300 smallholder farmers interviewed in two rounds, each round recalling six months of the 2003/2004 agricultural season. In tobacco areas, the sample targeted 180 farmers among growers (130) and non-growers (50). One hundred of those farmers were drawn from the Mozambique Leaf Tobacco Area (70 growers and 30 non-growers), and 80 were from the DIMON Mozambique area (60 growers and 20 non-growers). In cotton areas 120 farmers were targeted, 90 growers and 30 non-growers. Sixty of those farmers were drawn from the Dunavant Mozambique Area (42 growers and 18 non-growers), and the other 60 were from the C.N.A. area (48 growers and 12 non-growers).

Table 2.1. Zambezi Valley Study: Survey Sample and Sample Attrition Rates

Growing Areas And Firms	First Round of Survey — Number of Farmers —			Second Round of Survey — Number of Farmers —			Sample Attrition Rate
	Growers	Non-Growers	Total	Growers	Non-Growers	Total	(%)
Tobacco Areas							
MLT	70	30	100	64	26	90	10.0
DIMON	60	20	80	53	16	69	13.8
All Area	130	50	180	117	42	159	11.7
Cotton Areas							
Dunavant	42	18	60	41	18	59	1.7
C.N.A.	48	12	60	46	12	58	3.3
All Area	90	30	120	87	30	117	2.5
All Sample	220	80	300	204	72	276	8.0

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

The households were first interviewed in March 2004 to collect data on field and economic activities for the period September 2003 – February 2004, which covers pre-harvesting activities for most crops. The second round was implemented in September

2004 to collect data for the remainder of the period that included harvesting and post-harvesting activities. Because tobacco harvesting started around February/March and continued for several months, information on sales and data on labor use for harvesting and marketing activities for this crop were collected in the second round.

Table 2.1 shows a sample attrition rate of 8.0%, which reduced our sample to 276 observations.[5] To ensure appropriate statistical treatment of the data collected when generating the results, we developed sampling weights derived from the sample selection probabilities resulting from the sampling strategy and available population data. Those weights are used in the generation of all results in the statistical and econometric analysis and for generating representative aggregates at the regional level when constructing the SAMs.

2.3. Contents of the Survey Instruments

The objective of the survey was to get household level data on the use of intermediary inputs and factors, and production, sales and earnings information for the major agricultural and non-agricultural activities undertaken in the selected region. These include the relevant cash crops, cotton and tobacco, other agricultural production sectors and selected non-farm activities as well as details on other sources of income, asset ownership and investments. Multi-level survey questionnaire design techniques were applied to allow for appropriate treatment of the data collected in the various parts of the survey. Excepting for minor differences, the survey instruments used in both

[5] In panel data collection, where the same households are visited multiple times, the sample attrition rate refers to the proportion of households that are not re-interviewed for a variety of reasons.

rounds were very similar, but in each case applied for a specific recall period. The following is a list of topics included in the survey instrument:

- Smallholder household demographics;
- Land use and cropping patterns;
- Use and sources of farm non-labor inputs;
- Labor allocation on farm and non-farm activities;
- Production and marketing of crops;
- Ownership of production and marketing assets;
- Ownership and marketing of livestock;
- Income diversification: Micro and small enterprises and wage labor;
- Remittances from (and to) rural smallholder households;
- Pensions and other transfers;
- Uses of cash revenues: Assets and business startups;
- Smoking habits in rural smallholder households.

Electronic copies of the questionnaires and data sets are available on the Michigan State University Food Security Group website.[6]

2.4. Construction and Balancing of the Regional SAM

The Regional SAM is the database used in the economy-wide analysis. Assembling a SAM is a complex process that requires a great deal of perseverance and a strong dose of ingenuity (Dervis *et al.*, 1982; Thorbecke, 1998; Sadoulet and de Janvry, 1995; Taylor and Adelman, 1996). The process of building the Zambezi Valley Regional SAM (ZVR-SAM) included several steps. First, we designed a specific SAM framework, that consisted in the identification of the relevant accounts, and the appropriate level of dis-aggregation reflecting the structure of the local economy and the

[6] http://www.aec.msu.edu/fs2/mozambique/survey/index.htm

objectives and issues identified for the research. Second, based on the anatomy defined for the various accounts, we explored in detail the existing sources of data, identified the gaps, and the needs for additional data collection.

Given the specific nature of the research and the limited availability of data at the sub-national level, a great deal of the data used to construct the ZVR-SAM, particularly on the production and income sides, had to be collected through the sample survey, as described in the previous section. Expansion procedures using population census data (INE, 2000) were necessary to make the data representative of the study area.

On the consumption side, we derived household expenditure shares using the National Expenditure Survey (IAF 2002-03) for the enumeration areas corresponding to our study region. The data were used to estimate household home consumption and expenditures across commodities in the SAM for the different household groups. To accommodate those data in the SAM, a matching procedure was adopted. It consisted in ranking the four household groups in the SAM by total income, then attributing to each the average expenditure pattern of the relevant quartile group from the IAF data for the Zambezi Valley: the poorest group in the SAM received the expenditure pattern of the bottom quartile from IAF, through to the richest group in the SAM, which received the expenditure pattern of the top quartile in IAF. The analysis of production, marketing, and domestic consumption data allowed for the derivation of variables such as crop exports and household transfers to the rest of the world.

The end result of this work was a consolidated SAM representative of the Zambezi Valley Region. Additionally, for analytical purposes, we disaggregated the master SAM into two Sector/Concession specific SAMs.

Despite the careful data collection, processing and cleaning, and a very interactive process in assembling the SAMs, inconsistencies remained, arising from measurement errors, incompatible data sources, and lack of data. To impose consistency, we used the Cross-Entropy Method (Robinson, *et al.*, 1998). This method is based in information theory and incorporates errors in variables, inequality constraints and prior knowledge about any part of the SAM including, but not restricted to, rows and column sums. All the necessary adjustments resulting from the procedure were within the generally acceptable bounds of less than 5%.

CHAPTER 3

DISSERTATION ESSAY ONE

Interlinked Transactions in Cash Cropping Economies: Rationale for Persistence, and the Determinants of Farmer Participation and Performance in the Zambezi Valley of Mozambique

3.1. Introduction

Contract farming is the most pervasive form of market organization in cash crop production in Mozambique. All cotton and tobacco production by smallholder growers in the Zambezi Valley region originates from contract farming arrangements promoted by agro-industrial firms. In total, there are two out-grower tobacco companies and three firms devoted to the management of cotton contract farming schemes. Those firms are assigned specific geographical "concession" areas, where they provide inputs and extension assistance to small farmers on credit, and are granted monopsony rights that entitle them to purchase all the output at predetermined prices.

Contract coordination, through contract farming interlinked transactions, present several potential advantages. First, it helps to cope with market failure by reducing uncertainty for farmers regarding access to inputs, services and output markets (Glover, 1984; Goldsmith, 1985; Minot, 1986) and by assuring access to sufficient raw material of acceptable quality for processors. Second, it may significantly raise income of growers and enhance rural development by serving as a source of information for new production technologies. Finally, it may trigger multiplier effects through employment linkages, and infra-structure and marketing development in the local economy (Warning and Key, 2002).

There are also potential limitations and negative impacts of contract farming. First, given its monopsonic nature, these arrangements may result in asymmetric bargaining where one buyer largely determines the prevailing price and contract conditions. After farmers have invested in specific assets, or altered their cropping patterns and become more dependent on their contract crops, they may lose bargaining power and be more likely to accept less favorable or exploitative contract terms (Little and Watts, 1994). Second, the cost of enforcing contract provisions can be very high for both parties due to opportunistic behavior by participants and weaknesses in the legal system in rural areas. Finally, contract farming may result in barriers to entry for farmers when processors limit suppliers to those capable of meeting volume and quality standard requirements, typically the already better off farmers (Benfica, Tschirley and Sambo, 2002).[7]

In addition to the quality and intensity of the assistance and the prevailing prices and overall world market conditions, the performance of contract farming schemes and their broader impacts on rural development depends on the types of growers that get contracted. It is clear that if firms contract primarily with wealthier growers, the poorer members of the community will fail to benefit directly from the contract arrangements (Warning and Key, 2002). Nevertheless, the extent to which such approaches will exacerbate existing patterns of economic stratification, as argued by Key and Runsten (1999), cannot be conclusive without further investigation. The net effect depends upon the extent of economic linkages. In the Zambezi Valley case, at least three effects are

[7] In addition to those limitations, widespread contractual coordination may raise price volatility in the remaining spot market transactions, due to the thinness of those markets and the lack of transparency across many contracts within the same sub-sector. This will reduce or distort the information supplied by those spot market prices.

especially important: (i) spillover effects on food crop yields through increased fertilizer use, and input market development; (ii) the effects of increased labor demand and re-spending of wage earnings; and (iii) multiplier effects from re-spending of cash crop earnings. The presence of these important spillovers from growers to non-growers makes the assessment an empirical question.

The objective of this paper is as follows. First, we develop a conceptual framework following Williamson (1991) and link it to an institutional analysis to identify the factors determining the dominance of contract farming in cotton and tobacco value chains in the Zambezi Valley region. Second, taking into account the selective nature of participation in those schemes and the stratified random nature of our sample, we develop two versions of sample selection models (Heckman, 1979; Greene, 2003) to address the following issues: (i) the determinants of farmer selection into the contract farming schemes; (ii) once selected into the schemes, the determinants of participants' performance; and (iii) assess whether overall agricultural and total household income of participants is statistically higher than that of non-participants after controlling for demographic, factor and asset endowments, structural factors, and sample selection bias. A key contribution of this paper is its investigation of threshold effects of education and land holdings; rather than focusing on the average effect of participation, we ask *what type* of farmer benefits from participation; an answer to this question is crucial for policy design and to shed light on the identification of effective expansion paths to companies.

While sample selection and treatment effects models are common in many areas, applications to the performance and impact of contract farming in developing countries are rare. Warning and Key (2002) used a treatment effects model to analyze the impact

of the *Arachide de Bouche* Confectionary Peanut Program in Senegal. They found that program participants and non-participants were indistinguishable by wealth measures and that participating farmers increased their gross agricultural income substantially. One limitation of their study was the extremely small sample size; only 26 observations. Our study is an empirical contribution to the literature in three ways. First, it uses a much larger sample size and controls for a larger set of variables than previous studies. Second, we use interaction terms to assess how participation effects vary across thresholds of land holdings and education. Finally, we extend the analysis to include a standard sample selection model and evaluate the determinants of farmer selection and performance within the contract farming scheme itself.

This essay is organized as follows. Section 3.2 gives an overview of the tobacco and cotton sub-sectors in Mozambique, including some measures of its recent performance, and puts the study region into perspective. Section 3.3 develops a conceptual framework for the analysis of the organization of production and trade in the value chains, and identifies the nature of contract farming and the factors leading to its dominance in the Zambezi Valley region. Section 3.4 reviews the study area sampling coverage and undertakes a comparison of means between scheme participants and non-participants for selected household level variables. Then, it outlines the sample selection problem and correction, and the specification of the cash crop income determinants model and the treatment effects model with sample selection correction and land holdings and education threshold effects. Finally, it presents the estimation and the discussion of results for both models. Section 3.5 closes with the discussion of policy implications.

3.2. An Overview of the Cotton and Tobacco Sub-sectors

This section presents an overview of the tobacco and cotton sectors in Mozambique. It starts by looking at national production trends over the past decade. Then, it characterizes the 2003/2004 agricultural season by province and by firm, and puts the study region into perspective.

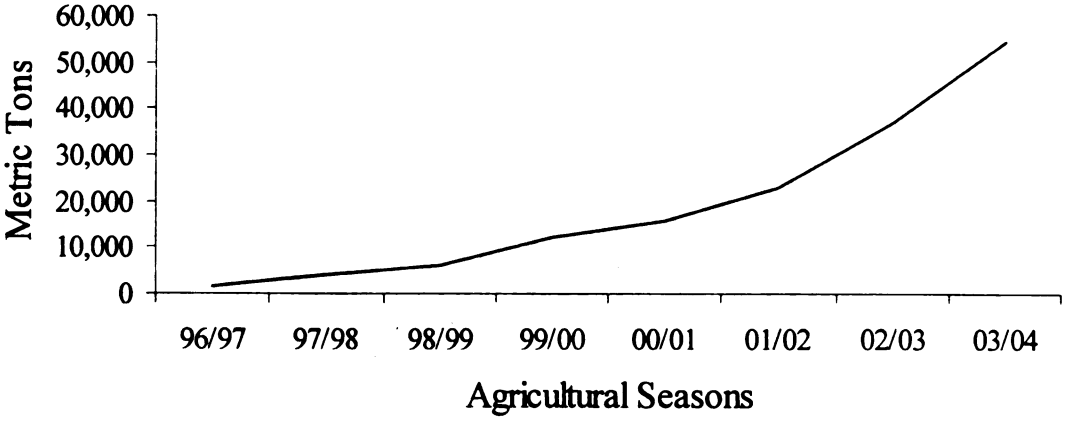
3.2.1. The Tobacco Sector

Tobacco production in Mozambique has grown very rapidly over the past decade. From 1,500 tons in the 1996/7 agricultural season, national production of raw tobacco has increased every year to reach over 54,000 tons in 2003/4; see Figure 3.1. Over the same period the estimated number of tobacco growing households has increased from 6,000 to more than 100,000.

Figure 3.1

Raw Tobacco Production in Mozambique

1996/97-2003/04



Source: DINA-MA

There are currently five major Firms/Partnerships operating in the country promoting both smallholder contract farming schemes and larger scale commercial operations.[8] The positive impact of this rapid expansion in the tobacco sector on rural smallholder household incomes and welfare has been dramatic (Walker *et. al*, 2004; Donovan, 2004; Boughton *et al.*, 2004; Benfica *et al.*, 2004, 2005). Table 3.1 presents key tobacco sector statistics for the agricultural season 2003/2004.

Table 3.1. Key Statistics of the Tobacco Sector in Mozambique, 2003-2004

Province/Firms	Area Planted		Production		Yield (tons/ha)
	Area (ha)	%	Volume (tons)	%	
All Mozambique	62,315	100.0	54,408	100.0	0.87
Total by Province					
Niassa	8,977	14.4	7,692	14.1	0.86
Cabo Delgado	82	0.1	82	0.2	1.00
Nampula	5,985	9.6	3,625	6.7	0.61
Zambézia	3,991	6.4	2,391	4.4	0.60
Tete	32,381	52.0	27,032	49.7	0.84
MLT	23,849	38.3	20,000	36.8	0.84
DIMON	8,532	13.7	7,032	12.9	0.82
Manica	10,359	16.6	13,214	24.3	1.28
Sofala	510	0.8	360	0.7	0.71
Gaza	30	0.0	12	0.0	0.40
Total by Firm					
JFS	13,127	21.1	9,341	17.2	0.71
MLT	25,288	40.6	22,920	42.1	0.91
DIMON	12,594	20.2	10,950	20.1	0.87
STANCOM	11,306	18.1	11,197	20.6	0.99

Notes: The total number of growers in the country is estimated at over 100,000. From those, 44,783 work in Tete Province alone (MLT: 34,038 and DIMON-Mozambique: 10,745). Due to the absence of precise data for most of the firms, data on the number of producers is not detailed in the Table.
Source: DINA-MA, and Individual Firms.

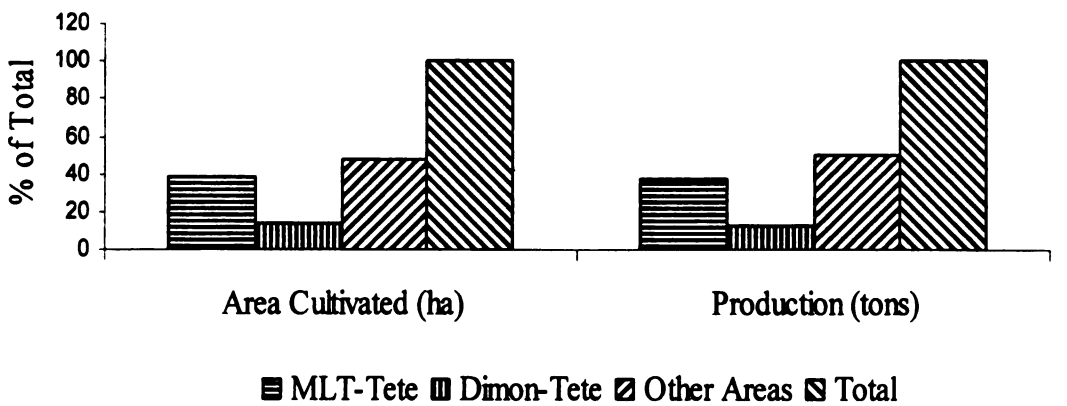
[8] The Firms/Partnerships operating in the country are as follows: MLT – Mozambique Leaf Tobacco (Tete and Manica); JFS – João Ferreira dos Santos (Manica, Nampula, Cabo Delgado, Niassa, and Gaza); DIMON (Tete, Manica, and Sofala); Stancom/Mosagrius (Niassa); and Stancom/Sonil (Nampula).

Overall, there were 62,315 hectares of land planted with tobacco in eight Provinces. That area includes commercial farming by large growers and smallholder growers involved in contract farming schemes. Total production in that season reached over 54,000 tons of raw tobacco, of which about three quarters are of the burley type. The total number of growers is estimated at over 100,000.

About 52% of the total area planted nationally and 50% of the total production was by smallholder growers in our study region (Tete Province). Those farmers were engaged in contract farming schemes with Mozambique Leaf Tobacco (37% of the national production by 34,038 farmers), and Dimon Mozambique (13% of the national production by 10,745 farmers).[9] See percentage distributions of land area and production in Figure 3.2.

Figure 3.2

MLT-Tete and Dimon-Tete in Total Area and Production
2003/2004 Season



Source: DINA-MA and tobacco companies

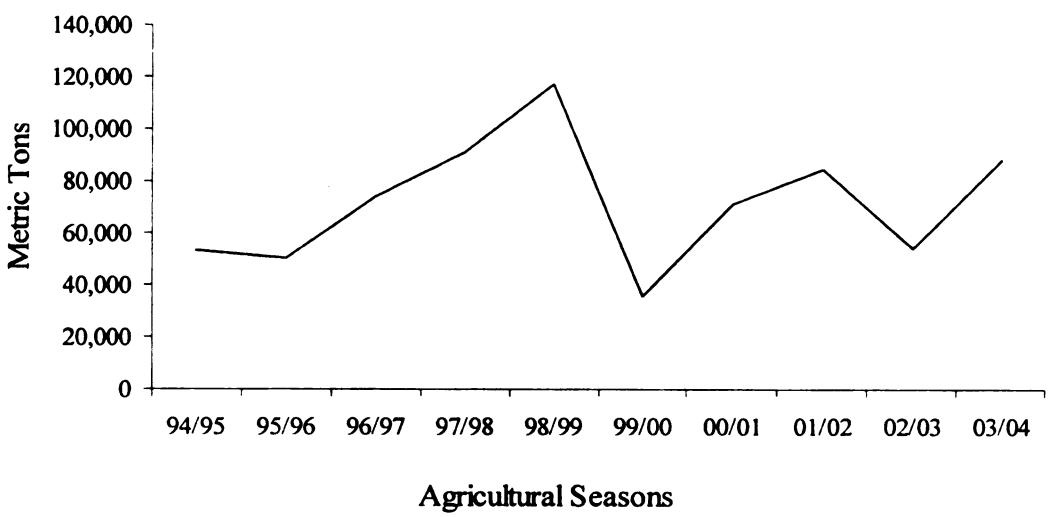
[9] Note that if we account for the production those two firms get from their global operations in the country, their national production share is much higher: MLT (42%) and DIMON-Mozambique (20%).

3.2.2. The Cotton Sector

Cotton production in Mozambique has varied widely over the years. Current production is dramatically higher than from the early- to mid-1980s, but is only about 60% of the historical high, achieved more than 30 years ago. Key factors explaining the decline are persistently low producer prices, the lowest in the region, and issues related to the organization and performance of the contract farming arrangements between ginning/exporting firms and smallholder farmers. The production of 88,000 tons achieved in 2003/2004 still falls short of the ten-year high achieved in 1998/99 (Figure 3.3).

Figure 3.3

Seed Cotton Production in Mozambique
1994/95 – 2003/04



Source: IAM – Instituto do Algodão de Moçambique

Historically, cotton production in Mozambique has been concentrated in the northern part of the country, particularly in Nampula Province, but that pattern is currently changing. Between 1990 and 2000, Nampula production accounted, on average,

for 52% of national production, against only 12% for all central provinces (Tete, Zambézia, Sofala, and Manica). By 2003/04 the figures were 39% and 29%, respectively. This shifting balance has been driven by continuing problems in Nampula, and by the entrance of two new firms in the Center committed to increasing yields and overall development of the supply chain (Tschirley *et al.*, 2005).

Table 3.2. Key Statistics of the Cotton Sector in Mozambique, 2003-2004

Province/Firms	Growers	Area Planted		Production		Yield (tons/ha)
	Growers	Area (ha)	%	Volume (tons)	%	
All Mozambique	107,845	174,157	100.0	88,173	100.0	0.51
Provinces						
Niassa	-	14,863	8.53	7,817	8.87	0.53
Cabo Delgado	41,671	38,958	22.37	20,819	23.61	0.53
Nampula	24,759	75,606	43.41	34,144	38.72	0.45
Zambézia	9,918	13,957	8.01	3,940	4.47	0.28
Tete	7,430	7,361	4.23	4,256	4.83	0.58
DUNAVANT	4,022	2,257	1.30	1,037	1.18	0.46
AGRIMO	3,408	2,627	1.51	1,839	2.09	0.70
COTTCO	-	2,477	1.42	1,380	1.57	0.56
Manica	1,685	7,531	4.29	4,067	4.61	0.54
Sofala (C.N.A.)	22,382	15,937	9.15	13,130	14.89	0.82
Total by Firm						
SAN/JFS	-	18,923	10.87	11,208	12.71	0.59
PLEXUS	32,691	31,312	17.98	17,485	19.83	0.56
SODAN	32,987	25,430	14.60	10,544	11.96	0.41
MOCOTEX	215	2,739	1.57	427	0.48	0.16
SANAM	-	31,047	17.83	11,137	12.63	0.36
CANAM	-	20,460	11.75	10,774	12.22	0.53
IAM/MEMBA	470	400	0.23	48	0.05	0.12
AGRIMO	13,326	8,434	4.84	4,770	5.41	0.57
SAAM	-	5,500	3.16	607	0.69	0.11
DUNAVANT	4,022	2,257	1.30	1,037	1.18	0.46
COTTCO	-	8,758	5.03	4,562	5.17	0.52
C.N.A.	24,067	17,131	9.84	14,015	15.89	0.82
Autonomous	67	1,766	1.01	1,559	1.77	0.88

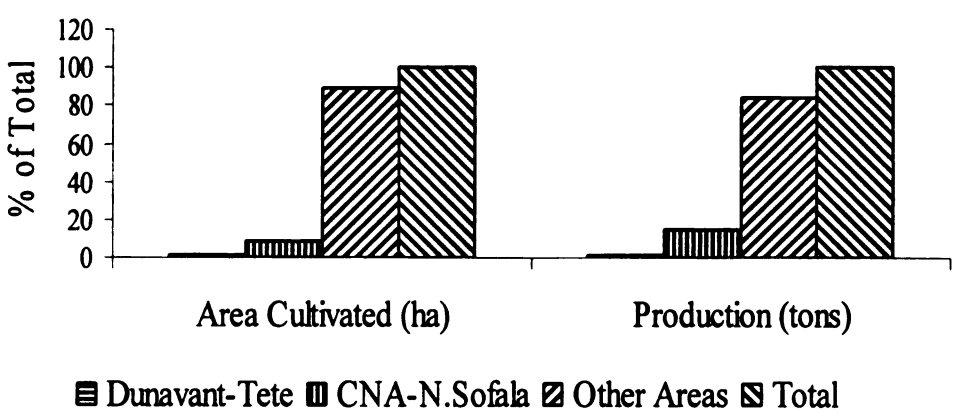
Notes: DUNAVANT and AGRIMO merged recently.
Source: IAM and Individual Firms.

In terms of individual firms, in 2003/04 (Table 3.2), Plexus (in Cabo Delgado province, north of Nampula) accounts for 18% of the area cultivated and 20% of total production. CNA in the Center is second with about 16% of national production, in spite of cultivating only 10% of national cotton area.[10]

Unlike tobacco, cotton production in our study area does not represent the dominant share of national production. While C.N.A. began operations over a decade ago, the other two companies in the area (Dunavant Mozambique and COTTCO/Algodão do Zambeze) started only within the past three years. All together, the firms included in the survey sample (Dunavant/Tete and C.N.A./Northern Sofala) account for about 18,000 hectares, or 11% of the national cotton area, and 14,000 tons, approximately 17% of the national production in 2003/2004 (Figure 3.4). In the 2003/4 season C.N.A. worked with approximately 22,000 growers, while DUNAVANT operated with about 4,000.

Figure 3.4

Dunavant-Tete and C.N.A.-Northern Sofala
in Total Area and Production
2003/2004 Season



Source: DINA-MA and cotton companies

[10] Yields by CNA farmers (0.82 tons/ha) are well above the national average of 0.51 tons/ha in 2003/04.

Overall, the performance of the cotton sub-sector in Mozambique has been far from satisfactory (The World Bank, 2005; Tschirley et al., 2006). Farmer profits remain well below potential due to very poor yields and low producer prices. In fact, Mozambique pays the lowest prices in the region; the 1998-2002 average producer prices were $0.16 per kilogram, compared to $0.22 in Zambia and Tanzania and $0.25 in Zimbabwe (Poulton *et al.*, 2004). Yields in 2003/04 were 0.51 tonnes per hectare, compared to 0.9 tonnes in Zimbabwe and over 1.0 ton in West Africa (Lemaitre *et al.*, 2001). While C.N.A. presents the best yield record in the country (over 0.8 tonnes/ha), it pays farmers statutory minimum prices, well below those in other countries. The other player in the sample, Dunavant Mozambique, has only recently started operations; its yields are still relatively low, but it makes an effort to retain farmers by paying prices well above the national average. Given its successful track record in Zambia, it is expected to play a key role in the development of the Mozambican cotton sector.

Further down the value chain, a large proportion of installed ginning capacity remains unutilized, and ginning outturns and lint quality are very low. Since the late 1990s, ginning outturns averages 35% in the country, compared to 38% in Zambia 40% in Zimbabwe and 42% in West Africa (Lemaitre *et al.*, 2001; Ofiço and Tschirley, 2003; Horus, 2004; and World Bank, 2005).[11] As a result of its low quality, the price paid to Mozambique cotton in the world market is significantly discounted relatively to the Index A price. Therefore, improvements in ginning quality and yields can have positive effects on the competitiveness of the sector by reducing lint production costs and improving export prices (World Bank, 2005), increasing the prospects for better prices to farmers.

[11] More recently ginning outturns reached around 37%, with C.N.A. achieving as high as 41.5% in the 2001/02 season.

3.3. The Organization of Production and Trade in Cotton and Tobacco Sectors

3.3.1. Conceptual Framework

The approach used to analyze the organization of production and trade in this section follows Williamson in the sense that institutions are explicitly endogenized, particularly the process of institutional change and the choice and design of institutional arrangements (Williamson, 1991). Institutions are central to economic development because they affect production and transaction costs (North, 1990). In the presence of transaction costs and information constraints, institutions influence the efficiency and distribution of resources (Cook and Chaddad, 2000). This approach is particularly relevant in developing countries, where high transaction costs, missing markets and market failures[12] are the rule rather than the exception (Bardhan, 1989).

The likely effect of agro-industrial investment on smallholder welfare is to some extent related to the nature of the institutional relationship (contractual form) between farmers and agro-industrial firms. Williamson (1991) identifies three broad types of contractual forms: neo-classical spot markets, bilateral contracts, where autonomous parties enter into contracts that extend beyond single transactions, and vertical integration within a firm.

Transactions underlie each of these institutional arrangements. In this context, transactions refer to the activities that allow or constrain transformation activities. A transaction occurs when two or more parties enter into an arrangement in which rights and obligations are exchanged (Staatz, 1988). All transactions come bundled with a mix

[12] Missing markets refer to a situation where there is no market to govern the allocation of resources or goods and services. Market failure is a situation in which markets exist but do not allocate resources efficiently. Market failure may be due to market power, externalities, public good nature of the goods or services, or the existence of incomplete or asymmetric information, and uncertainty.

of characteristics - the degree of *asset specificity*, the degree and type of *uncertainty* to which the parties are subject to, and the *complexity* and *frequency* with which the transactions occur (Williamson, 1991). For example, transactions which occur under isolated spot markets for low value commodities involve relatively low levels of all these characteristics. Transactions underlying a contract farming scheme have higher levels of these characteristics.

The mix of transaction characteristics is influenced by a number of factors related to production, marketing and processing characteristics, and to factors related to the economic and political environment (Jaffee and Morton, 1995; Delgado, 1999; and Benfica, Tschirley and Sambo, 2002). Competitive forces tend to promote the emergence of forms of economic organization that minimize total costs of production and exchange in the economic system (Staatz, 1988).

The analytical model used in this research is a simplified version, although following the same logic, of models used in much of the applied work in transaction costs economics (Klein, 1995; and Dorward, 2001). The efficient form of organization for a given economic relationship, i.e., the likelihood of observing a particular organizational form, is a function of certain properties of the underlying transactions. Formally: $\boldsymbol{Y} = \Phi [\boldsymbol{X}]$, where, $\boldsymbol{Y}$ is a vector of alternative arrangements/organizational forms, more specifically: *Spot marketing, contract farming alternatives, and plantation agriculture*; and $\boldsymbol{X}$ is a vector of transaction characteristics that affect transaction costs, more specifically: condition and degree of *asset specificity,* degree and type of *uncertainty* that parties to the transaction are subject to, and *complexity and frequency* with which they occur.

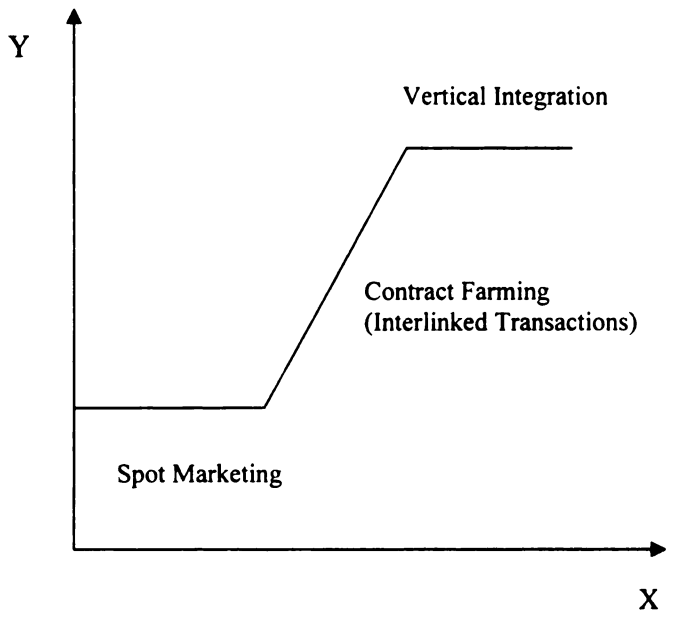
The probability of observing a more integrated organizational form depends positively on the amount or value of the specific assets involved in the relevant transactions, on the degree of uncertainty, the complexity of the transaction and its frequency (Klein, 1995). In general, therefore, the greater the degree of asset specificity, the less likely it is that spot markets will be relied upon. In that case, contractors will seek to negotiate contracts that protect their investment in the face of external change. Figure 3.5 illustrates that low degrees of uncertainty, complexity and frequency may favor spot markets and reduce the need for vertical coordination. The opposite, however, may lead to the recognized need of building contractual relationships that acknowledge mutual interest in contracting, facilitate information flows and allow for a flexible joint response to changes in external circumstances; this includes a wide range of contractual arrangements.[13] But such relationships require trust. Where trust cannot be established, vertical integration may be chosen instead (Dorward, Kydd and Poulton, 1998).

The level of the elements in $\boldsymbol{X}$ is influenced by a number of factors related to production characteristics, marketing/processing characteristics and the economic and political environment. Formally: $\boldsymbol{X} = \Omega(\boldsymbol{Z})$. Specific $\boldsymbol{Z}$ factors are introduced and explained in Table 3.3, and inference is made about favored arrangements in the presence of each factor. The framework is then used in the next section to show the degree to which these factors affect the choice of organizational form in the cotton and tobacco sectors in the Zambezi Valley of Mozambique.

[13] As show in Figure 3.5, spot marketing and full vertical integration are two extreme forms of organization; contract farming can be seen as a continuum, tending to either of the extremes depending on the terms agreed and the overall environment where it operates.

Figure 3.5

Organization of Production and Trade
A Conceptual Framework



Y – Alternative Institutional Arrangements/Forms of Organization
X – Transaction characteristics: asset specificity, uncertainty, complexity and frequency.

Table 3.3 summarizes how each factor affects transaction costs and its implications for the type of institutional arrangement likely to result. In the next section we apply the same framework to the cotton and tobacco sub-sectors in the Zambezi Valley of Mozambique.

Table 3.3. Transaction Cost Factors and Institutional Arrangements

Factor	Effect on Transactions Costs	Type of Organizational Forms Most Favored		
		Spot Markets	Contract Farming	Vertical Integration
Production characteristics				
High labor intensity	Increases supervision costs and requires capital saving/labor using technologies.	X	X	
Economies of scale	Requires high initial investment and high cash flow to be sustainable; generally not feasible for smallholders.			X
High returns to inputs, complex management	Requires effective research and extension, as well as timely availability of inputs.		X	X
Marketing/processing characteristics				
High economies of scale in processing	Leads to the need for scale complementarity that creates strong incentives for stable supply of raw materials through more coordinated arrangements.		X	X
High quality standards	Increases returns to close vertical coordination.		X	X
High perishability	Increases the costs of not having a stable market. Increases returns to close vertical coordination.		X	X
High value to weight/volume	Increases risk of large loss in farm to market transaction.		X	X
Low value to weight/volume	Increases unit transport costs.			X
Principal market is export	Tends to reduce number of buyers and risk of default in CF; quality standards usually higher; greater economies of scale.		X	X
Many potential buyers	Increases cost and risk of default in CF.	X		X
Requires processing before final sale	Tends to reduce number of buyers and risk of default in CF.		X	X
Exogenous economic & political factors				
Land scarcity/high population density	Increases land cost, political difficulties obtaining large tracts.	X	X	
Agriculture has a large share in the labor force	Increases land cost, political difficulties obtaining large tracts.	X	X	
Endogenous economic & political factors				
Poorly integrated output markets	Increases procurement costs and marketing costs in general. Increases returns to coordination.		X	X
Missing input/factor markets	Non availability of necessary production inputs limits reliance on spot markets and increases the returns to vertical coordination.		X	X
Poor communications	Raises cost of active vertical coordination, especially contract negotiation and enforcement.	X		X
Low literacy/educational levels among farmers	Raises cost of ensuring adoption of new production technologies/ management practices; raises cost of collective action.	X		X
Weak property rights enforcement	Increases uncertainty with regard to reliance in contracts and the use of collateral. Increases the risk of default in CF.	X		
Weak local government	May make coordination more difficult; may be easier to accumulate large tracts of land.	X		X

Source: Author's Conceptualization and Benfica, Tschirley, and Sambo (2002).

3.3.2. Contract Faming: Nature and Determining Factors

This section uses the analytical framework developed in the previous section to look at the major factors determining the current form of organization of production and trade in cotton and tobacco sectors in the Zambezi Valley of Mozambique. Note that contract farming is the sole form of organization observed for both sub-sectors in the region. Therefore, we will start by defining that particular form of organization and characterize it for the case of the cotton and tobacco sub-sectors in the study region.

3.3.2.1. The Nature of Contract Farming Operations in Mozambique

In contract farming, farmers agree with processors/traders/exporters, through formal or informal contracts, to limit their production and marketing behavior in return for some level of service provision and purchase guarantee. These arrangements are best viewed in the Zambezi Valley of Mozambique, and in many parts of the developing world, as a response to missing institutions and widespread failure of input and credit markets and to poor or absent service provision. In addition to processors' need to ensure sufficient volume of purchases to reduce unit marketing and processing costs, concerns about product quality often significantly affect the structure of these relationships.

Both cotton and tobacco schemes take the form of *forward resource management contracts.* These contracts differ from the simple sale/purchase contracts because they include stipulations regarding the transfer and use of specific resources and/or managerial functions (Jaffee and Morton, 1995). Forward resource management contracts partially internalize product and factor transactions, and are sometimes referred to as interlinked contracts or interlinked markets (Minot, 1986; Glover and Kusterer, 1990; Dorward *et al*,

1998). Given the current stage of development of rural agricultural input and credit markets in the country, farmers have little access to those resources. The contracts, designed to fill that gap, consist in the firms supplying seeds and chemical inputs on credit, along with technical assistance on specific areas of land. Farmers agree to utilize the inputs as instructed, and to sell all their production to the firms at harvest at pre-determined prices. Input costs are deducted at the time of the harvest/marketing. Given the lack of alternative contract enforcement mechanisms, the Mozambican Government has granted the agro-industrial firms legal monopsony power over specific geographic areas, referred to as *concessions*. Farmers in these areas are not permitted to sell to any but the concession holder. In the Zambezi Valley, production in these schemes takes place entirely on land "owned" by the individual farmers.[14]

3.3.2.2. Factors Leading to Interlinked Transactions

Many of the factors identified in Table 3.3 operate exactly the same way for both sub-sectors. Indeed, they are both dependent on quality raw materials for processing. High quality requires the use of on-farm chemical inputs and specific production techniques. In a country that has a high degree of failure in output, input and credit markets, and a poorly educated populace, reliance on spot markets for such crops is not feasible, and some degree of non-market vertical coordination is called upon to support and sustain these value chains. We now turn to an evaluation factor by factor. See Table 3.4 for the incidence of individual factors in each sector.

Production characteristics. Current crop production technology in these sectors is

[14] In some other parts of the country, however, firms can also use designated areas or blocks within their own land concessions for that purpose (Strasberg, 1997). Note that in Mozambique land is officially state owned, therefore non-tradable.

characterized by high labor intensity, no economies of scale and potentially high returns to inputs. In principle, particularly in a plantation setting, *high labor intensity* leads to high supervision costs in a principal agent setting. In addition, under a plantation arrangement, firms would have to pay the legal minimum wage for agricultural workers, generally set at a level higher than the informal wages paid to hired labor by smallholder growers and, for some cases, even above the implicit wage earned by cash crop growers. With contract farming labor, supervision is transferred to the household. Given the relatively simple production technologies, the relatively high level of use of family labor and low level of hiring in cotton, household level supervision costs are relatively low in contract farming for that crop. Tobacco uses more complex production techniques and more wage labor, but that wage labor tends to be relatively well trained, which reduces supervision costs.[15] *Economies of scale*, to be achieved and sustained, normally require high investment and cash flow which favors vertical integration.[16] *High returns to inputs* demand a great deal of detail in input use that requires some degree of coordination. In the current stage of development of the Zambezi Valley of Mozambique, *capital constraints* associated with a *poorly developed marketing system for inputs, outputs and credit*, makes contract farming the most feasible alternative to deal with the factors associated with crop production in these sub-sectors and the reduction in the resulting levels of uncertainty. The realization of this potential depends on the technological knowledge of farmers and on the level of coordination and organization of the out-grower firm extension systems.

[15] Costs associated with labor supervision are more accentuated in a plantation setting relative to household level management, as principal agent (manager-worker) problems, especially derived from adverse selection and moral hazard are far more intense when all workers have to be hired and work for a wage.
[16] Overtime, in the accumulation process, if returns are promising, contract farmers may have the incentive to invest in technologies that allow for the achievement of those economies of scale.

Table 3.4. Incidence of Selected Factors in Cotton and Tobacco Sectors

Factor	Is the Factor Present? (Degree of incidence: +++, ++, +, -)	
	Cotton Sector	Tobacco Sector
Production characteristics		
High labor intensity	+	+ + +
Economies of scale	+	+
High returns to inputs, complex management	+ +	+ + +
Marketing/processing characteristics		
High economies of scale in processing	+ + +	+
High quality standards	+ +	+ + +
High perishability	-	-
High value to weight/volume	+ +	+ + +
Principal market is export	+ + +	+ + +
Many potential buyers	-	-
Requires processing before final sale	+ + +	+ +
Exogenous economic & political factors		
Land scarcity/high population density	-	-
Agriculture has a large share in the labor force	+ + +	+ + +
Endogenous economic & political factors		
Poorly integrated output markets	+ + +	+ + +
Missing input/factor markets	+ + +	+ + +
Poor communications	+ +	+ +
Low literacy/educational levels among farmers	+ +	+ +
Weak property rights enforcement	+ + +	+ + +
Weak local government	+ +	+ +

Legend: + + + Strong presence; + + Moderate presence; + Weak presence; - Absent.
Source: Author conceptualization.

Processing and marketing characteristics. There are a number of factors related to processing and marketing/export characteristics that strongly favor the inter-linkage of transactions in both sub-sectors. First, the two cotton firms in the region have a considerable amount of unused processing capacity and therefore need more raw product to exploit *economies of scale in processing.* In the tobacco sector all production is currently exported raw, but getting volume is as well important to achieve economies of scale in export. In both cases there is no competitive small scale processing option, so a system that can ensure volume is needed. Second, in both sectors, more so in tobacco at this point, the marketing system stresses *quality standards* and pays a premium for it. In

principle, returns to firms and farmers can be increased with further quality differentiation. Since quality is strongly affected by how well and consistently production is managed, coordination mechanisms through contract farming are necessary. Third, the *high value to weight/volume* of these crops makes transport costs relatively cheap, especially for tobacco. If the products were *perishable*, this would increase the risk of high loss in farm-to-market transactions under an independent production system and favor a more coordinated approach. But both products are not perishable, so the high value to weight ratio, although important, has little influence over the organizational form governing transactions. Fourth, both crops are exported, which implies high returns to product quality that means potentially high returns to more effective coordination. Fifth, the presence of relatively few potential buyers and the need to process before final sale reduces the risk of default in contract farming. Without effective contract enforcement mechanisms in place, however, contract farming can be jeopardized. In theory, these two factors favor some form of non-market vertical coordination.

The bottom line is that dependence on quality output for processing that is highly dependent on proper use of chemical inputs in an environment where input markets are missing and human capital is relatively weak, makes reliance on spot markets infeasible. Full vertical integration (plantation arrangements) could be considered but the labor intensive nature of the production process makes labor supervision costs high. The statutory agricultural minimum wage that firms would have to pay to workers can also be a serious burden. This combination of factors renders some form of contract coordination the most feasible alternative in both sectors.

While contract farming allows these systems to function, asymmetric information

and unbalanced bargaining power over issues such as prices and grading have emerged as barriers to its development. Furthermore, especially in cotton, low world prices, low ginning outturns, and low productivity at the farm level have constituted major constraints. These are, in part, consequences of a wide range of market and coordination failures and weaknesses in the concession system, many of which are beyond the scope of this study.

3.4. Farmer Selection/Performance and Effects of Participation

The previous section identified the factors leading to the dominance of contract farming in the cotton and tobacco sectors in the Zambezi Valley. Contract farming can be seen as a principal-agent game where a firm (the principal) works with a grower (the agent) to produce a crop. In this process, the firm chooses the farmers with whom it would like to contract and sets the contract terms. The firm's objective is to produce a given quantity of output while minimizing direct and indirect (transaction) costs. Farmers, in turn, will choose whether to participate. The combination of these choices describes the selection process for the contract farming scheme (Warning and Hoo, 2000). The benefits participants accrue will depend on the terms of the contract and their own characteristics and endowments.

In this section, we assess the determinants of three related processes for each crop study area: farmer participation in the production of the cash crop, participants' performance with the crop, and whether farmer participation, independently or associated to levels of land ownership and education attainment, has a significant impact on crop and total household income. We first present the study sampling coverage and descriptive statistics on scheme participants and non-participants in each concession area. Second,

we formally present the rationale for sample selection bias and the Heckman two-stage sample selection bias correction model. Finally, we present the Farmer Scheme Performance Sample Selection Model, and the Treatment Effects Model specification, estimation and results.

3.4.1. Study Area Sample and Comparison of Means

3.4.1.1. Survey Sample Coverage

The survey covered concession areas for four firms operating contract farming schemes in the Zambezi Valley of Mozambique: both tobacco firms operating in Tete Province - Mozambique Leaf Tobacco (MLT), and DIMON-Mozambique - and two cotton companies, one operating in Tete Province (DUNAVANT-Mozambique) and the other operating in Northern Sofala Province (C.N.A.). The survey targeted a total of 300 smallholder farmers, 180 in tobacco growing areas and 120 in cotton growing areas. Due to sample attrition, the final sample size for analysis was reduced to 276 observations; 159 smallholders for tobacco concession areas and 117 smallholders for cotton concession areas. In both areas the sample comprised both grower and non-grower smallholder households. More details on survey sampling are presented in Chapter 2.

3.4.1.2. Comparison of Means

We present two sets of descriptive statistics. A comparison of means for three types of household level variables: demographic characteristics; farm assets and use of hired labor; and levels of crop and household income (total and *per capita*) along with prevalence and levels of selected income components. We also analyze how the outcome variables – cash crop profits, crop and total household incomes - vary across types of

growers, by land holdings and education attainment levels.

Results for the tobacco sector in Table 3.5 indicate that participants and non-participants are not statistically different in terms of demographic characteristics such as household size, labor endowments, education, and age of the head. Household headship is almost statistically significant with the likelihood for female headship relatively higher among non-growers. Also, differences are not statistically significant for the use of animal traction, and the rate of diversification into livestock and self-employment non-farm activities. Statistically significant differences exist for a number of variables. First, total area owned, and total and *per capita* crop incomes, with growers having areas and agricultural incomes significantly larger, especially due to the cash crop. Note that net profits from tobacco average $730.74, i.e., 46.5% of total net agricultural income for that group. About 30% of tobacco farmers lost money during the survey year.[17] Second, as expected, tobacco growers own greater values of agricultural and marketing equipment (hand tools and other equipment, including bicycles). Third, tobacco growers are twice as likely to hire permanent labor.

Finally, non-growers have wage labor and non-farm self-employment incomes that are much higher in magnitude than those for tobacco growers, but those differences are not statistically significant. These differences partially compensate for the large difference in crop incomes and make the differences in total household income less accentuated, but still significantly different in a statistical sense. It is consistently observed in Table 3.7 that tobacco profits among participating farmers increase with land holdings. The same pattern is observed for the relationship between net total crop and

[17] Results by firm indicate that the proportion was higher in MLT areas, about 36%, against 23% in DIMON-Mozambique areas.

household incomes across land holding quartiles for growers and non-growers in tobacco areas. Results with respect to education attainment are not so robust (Table 3.8). While it appears that cash crop profits are positively related to education, those differences vanish as one considers total crop and household income in tobacco areas.

Table 3.5. Comparison of Mean Values for Selected Variables: Tobacco Growers and Non-Growers

Selected Variables	Type of Farmers (mean values)		Statistical Significance of the Difference		
	Tobacco Contract Growers	Non-Tobacco Growers	t-Stat	P > | t |	LS of the Difference [1/]
Demographic Characteristics					
Female Headed Households (%)	5.13	11.90	- 1.49	0.14	.
Education of the HH Head (years)	3.22	2.76	1.00	0.32	
Age of the Household Head (years)	38.50	40.52	- 0.95	0.34	
Labor Adult Equivalents	3.45	3.68	- 0.88	0.38	
Farm Assets					
Total Area – hectares	6.94	4.36	2.84	0.01	**
Value of Manual Tools ($US)	28.63	15.59	2.16	0.03	*
Value of Equipment ($US)	66.60	36.63	2.58	0.01	**
Use of Animal Traction (%)	7.69	4.76	0.64	0.52	
Use of Hired Labor					
Permanent Labor (% using)	71.79	30.95	4.98	0.00	**
Income Diversification (%)					
Livestock	93.98	96.15	- 0.44	0.66	
Self-employment	60.15	53.85	0.56	0.55	
Wage Labor Employment	24.81	53.84	- 3.03	0.00	**
Household Income ($US)					
Net Household Income	1,815.28	1,022.48	2.35	0.02	*
Net Household Income *per capita*	318.06	174.70	2.36	0.02	*
Net Agricultural Income [2/]	1,572.70	595.47	3.11	0.00	**
Net Agricultural Income *per capita*	274.23	98.26	3.18	0.00	**
Wage Labor Income	80.76	122.35	- 0.92	0.36	
Self-employment (non-agricultural)	90.24	185.90	- 1.14	0.26	
Livestock Income	90.11	79.50	0.35	0.73	
Number of observations	117	42			

[1/] Levels of Significance (LS): + at the 10-percent level, * at the 5-percent level, ** at the 1-percent level.

[2/] Net revenues from tobacco sales averages $730.74 among growers, i.e., 46.5% of net agricultural income.

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

The comparison of means for the cotton sector is presented in Table 3.6. Results indicate that among demographic variables only that for educational attainment of the household head is statistically different between the two groups.[18] Results suggest that non-grower smallholder households have higher formal educational attainment. Regarding farm asset variables, total area is the only variable that shows a statistical difference between growers and non-growers. However, due to the lower return to cotton and the fact that non-growers plant more maize and other crops, the difference does not translate into statistically significant differences in total and *per capita* crop incomes between the two groups. Net profits from cotton average $93.60, i.e., only 18% of net agricultural income for that group. These average profits represent only 13% of those obtained by tobacco growers. However, contrasted to tobacco areas, where close to one third of the growers lost money, only about 20% of cotton farmers lost money during the survey year.[19] Growers have on average more physical and livestock assets than non-growers, but the differences are not statistically significant.

The use of permanent labor is generally limited in cotton growing areas, but, as expected, grower households are more likely to use that type of workers. However, differences between those two groups are not statistically significant. Estimated total and *per capita* income is higher for growers, but again, the difference is not statistically significant at 10% or lower levels. Likewise, non-growers appear to have off-farm incomes (both wage labor and self-employment) higher than growers.

[18] The household age variable is close to significant, indicating that grower household heads tend to be older than those in non-growing households.
[19] Results by firm indicate that the proportions were 19% among C.N.A. farmers, and about 21% among Dunavant Mozambique farmers.

Table 3.6. Comparison of Mean Values for Selected Variables: Cotton Growers and Non-Growers

Selected Variables	Type of Farmers (mean values)		Statistical Significance of the Difference		
	Cotton Contract Growers	Non-Cotton Growers	t-Stat	P > | t |	LS of the Difference [1/]
Demographic Characteristics					
Female Headed Households (%)	5.74	6.67	- 0.18	0.86	
Education of the HH Head (years)	2.60	3.40	- 1.88	0.06	+
Age of the Household Head (years)	44.33	40.40	1.46	0.15	.
Labor Adult Equivalents	3.51	3.25	0.86	0.39	
Farm Assets					
Total Area (hectares)	3.97	2.81	2.58	0.01	**
Value of Manual Tools ($US)	12.94	11.81	0.61	0.54	
Value of Equipment ($US)	46.75	33.44	0.97	0.33	
Use of Animal Traction (%)	5.75	6.67	- 0.18	0.86	
Use of Hired Labor					
Permanent Labor (% using)	9.20	3.33	1.03	0.30	
Income Diversification - Percent					
Livestock	90.11	88.46	0.24	0.81	
Self-employment	62.64	84.62	- 2.13	0.04	*
Wage Labor Employment	34.07	38.46	- 0.41	0.68	
Household Income - $US					
Net Household Income	732.40	574.64	1.21	0.22	
Net Household Income *per capita*	124.89	108.57	0.76	0.45	
Net Agricultural Income [2/]	518.24	364.50	1.50	0.14	.
Net Agricultural Income *per capita*	86.69	65.85	1.13	0.26	
Wage Labor Income	42.18	80.57	- 1.24	0.22	
Self-employment (non-agricultural)	32.15	56.02	- 0.60	0.55	
Livestock Income	85.37	72.29	0.61	0.54	
Number of observations	87	30			

[1/] Levels of Significance (LS): + at the 10-percent level, * at the 5-percent level, ** at the 1-percent level. [2/] Net revenues from cotton sales averages $93.60 among growers, i.e., 18.1% of net agricultural income.

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

These higher off-farm incomes for non-cotton growers and the resulting lack of significant difference in total incomes are consistent with previous studies in Mozambique (Tschirley and Weber, 1994; Tschirley and Benfica, 2001; and Walker *et al.*, 2004). In addition, mean values for wage labor and self employment income in Table

3.6 indicate that non-growers tend to have higher incomes from these sources but the difference is not statistically significant. One may argue that these results suggest a relative degree of stagnation in these economies; the cotton incomes are not yet capable of pulling the rest of the economy into a dynamic mode.

Results in Table 3.7 indicate a positive but weak association between land holdings and profits from cotton sales. The relationship is more accentuated when it comes to overall crop and household incomes, especially among non-cash crop growers. On average, returns to education (Table 3.8) appear much less important for cotton profits than for tobacco. The econometric analysis will shed some more light on the significance of these indicative relationships.

Table 3.7. Mean Profits, Net Crop and Total Income by Land Area Quartiles

Quartiles of Land Area	Mean Land Area (ha)	Cash Crop Profits ($US)	Total Net Crop Income ($US)			Total Net Household Income ($US)		
			Growers	Non-Growers	All Farmers	Growers	Non-Growers	All Farmers
Tobacco Areas								
Quartile 1	2.28	184.7	562.0	175.6	417.1	726.7	533.5	654.2
Quartile 2	3.92	411.8	749.7	507.5	689.2	947.7	649.1	873.0
Quartile 3	6.12	462.1	1,499.0	846.8	1,298.3	1,684.1	1,227.1	1,543.5
Quartile 4	12.71	1,601.4	3,056.9	990.8	2,798.6	3,437.7	1,246.3	3,163.8
Total	6.26	730.7	1,572.7	543.5	1,300.8	1,815.3	844.0	1,558.7
Cotton Areas								
Quartile 1	1.72	76.6	302.5	231.3	271.7	458.4	381.8	425.2
Quartile 2	2.88	52.1	477.4	321.2	439.7	687.1	565.8	657.8
Quartile 3	3.70	81.4	486.3	418.1	474.5	747.0	720.8	742.5
Quartile 4	6.45	156.0	740.4	1,283.2	834.0	953.5	1,460.4	1,040.9
Total	3.67	93.6	518.2	458.7	503.0	732.4	661.0	714.1

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

Table 3.8. Mean Profits, Net Crop and Total Income by Education Attainment Level

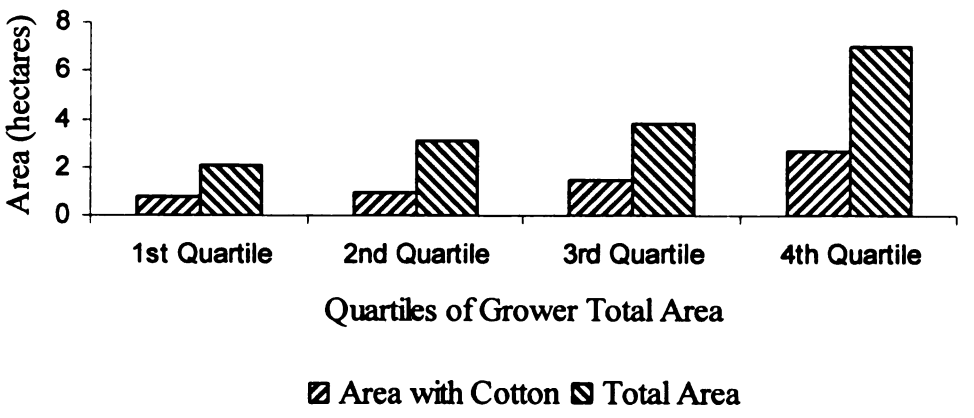
Years of Education of HH Head	Cash Crop Profits ($US)	Total Net Crop Income ($US)			Total Net Household Income ($US)		
		Growers	Non-Growers	All Farmers	Growers	Non-Growers	All Farmers
Tobacco Areas							
No schooling	554.9	1,472.4	377.0	1,126.5	1,594.4	659.29	1,299.1
1 – 3 years	731.5	1,695.0	669.4	1,446.9	1,931.2	887.35	1,678.7
4 + years	833.9	1,501.3	550.7	1,259.6	1,821.9	948.50	1,599.9
Total	730.7	1,572.7	543.5	1,300.8	1,815.3	844.03	1,558.7
Cotton Areas							
No schooling	65.9	652.5	211.0	564.2	1,005.6	483.3	901.1
1 – 3 years	90.4	426.6	342.5	408.8	519.3	508.0	516.7
4 + years	119.9	559.6	638.5	587.2	858.4	844.7	853.6
Total	93.6	518.2	458.7	503.0	732.4	661.0	714.1

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

In Figures 3.6 and 3.7, we explore how area planted with cash crops relates to total area owned, by plotting both variables by total land area quartiles among cotton and tobacco growers.

Figure 3.6

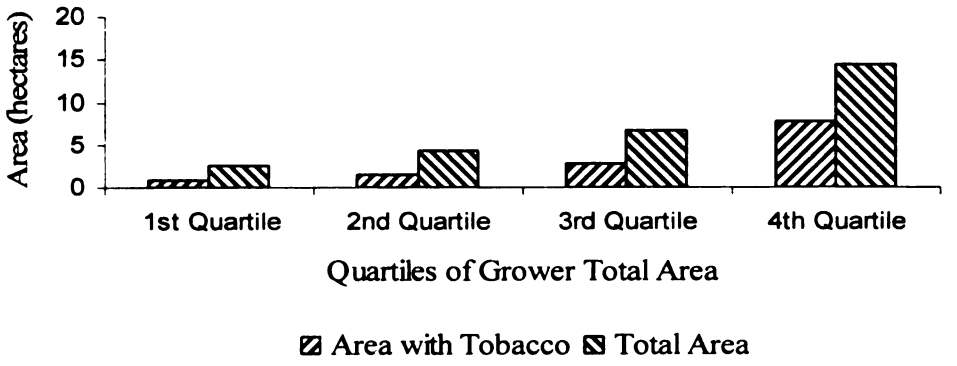
Cotton Area Cultivated and Total Area Owned by Quartiles of Grower Total Area



Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

Figure 3.7

Tobacco Area Cultivated and Total Area Owned by Quartiles of Grower Total Area



Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

In both cases, it is clear that area planted with the cash crop increases with total area owned. Correlation between the two variables is 0.76 among cotton growers and 0.92 among tobacco growers. It is worth noting that among cotton growers, the share of area planted with cotton in total area (across quartiles) is relatively flat; 38% (Quartile 1), 31% (Quartile 2), 37% (Quartile 3), and 39% (Quartile 4). Among tobacco growers those shares increase significantly between the lowest and the highest total area quartiles; 37% (Quartile 1), 37% (Quartile 2), 42% (Quartile 3), and 54% (Quartile 4).

3.4.2. Conceptual Framework

In this section we wish to explain what determines the levels of cash crop income (profits or losses) of participants and whether participation in contract farming schemes affects differences in total crop and household income between growers and non-growers in tobacco and cotton growing areas of the Zambezi Valley, controlling for land endowments and education attainment threshold effects, as well as demographics,

technology and location fixed effects. Because cash crop income is only observed for a sub-set of the population, we run into a sample selection problem usually referred to as incidental truncation, i.e., the observation of cash crop income depends on another variable, in this case, the participation in contract farming schemes.

To accurately estimate the determinants of cash crop income, and the effects of participation on total agricultural and household income, we have to account for the fact that there may be unobservable factors that affect both the likelihood of participation in the schemes and the performance of participating farmers (Greene, 2003; Warning and Key, 2002). To control and correct for this possible sample selection bias, we use a standard sample selection model to access participation and within scheme performance, and a selection adjusted treatment effects model to assess if and how participation affects total crop and household income levels.

3.4.2.1. Determinants of Cash Crop Income

(a) Sample Selection Bias and Correction

We now present a standard sample selection model that explains and addresses the sample selection problem. Let the equation that determines sample selection be

$$c_i = \gamma z_i + e_i \ , \qquad E(e \mid z) = 0 \tag{3.1}$$

and the equation of primary interest be

$$y_i = \beta x_i + u_i \ , \qquad E(u \mid x) = 0 \tag{3.2}$$

where c_i is a dummy for participation, z_i is a vector of variables thought to affect the participation decision, y_i indicates the level of outcome of participants, x_i is a vector of variables assumed to affect the outcome, and e_i and u_i are disturbance terms. The model

assumes $u_i \sim N(0, \sigma)$, $e_i \sim N(0, 1)$, and corr$(u_i, e_i)=\rho$.

Several assumptions are made. First, we assume that the elements in x and z are always observed. Second, we assume that (in addition to x) z is exogenous in (3.2), i.e., $E(u|x,z)=0$. Third, we require that x be a strict subset of z, with some elements of z not included in x (exclusion restrictions). Fourth, since the error term in the sample equation, e_i, is assumed to be independent of z, and x is a subset of z, then e_i is also independent of x. Finally, we assume that e_i has a standard normal distribution (Wooldridge, 1999 and 2000).

Where does the bias come from? Correlation between the error terms u_i and e_i causes the sample selection bias. To see how, let us assume that (u_i, e_i) are independent of z. By taking the conditional expectation of (3.2) on z and e_i and considering that x is a subset of z, we have

$$E(y_i \mid z_i, e_i) = \beta x_i + E(u_i \mid z_i, e_i) = \beta x_i + E(u_i \mid e_i) \tag{3.3}$$

Note that $E(y_i \mid z_i, e_i) = E(u_i \mid e_i)$ because (u_i, e_i) is independent of z. It follows that if u_i and e_i are jointly distributed with zero mean, then E($u_i \mid e_i$)=ρ e_i for some parameter ρ, and replacing this in (3.3) we have

$$E(y_i \mid z_i, e_i) = \beta x_i + \rho e_i \tag{3.4}$$

Although we do not observe e_i, we can use this to compute $E(y_i \mid z_i, c_i)$, for c_i=1, and get

$$E(y_i \mid z_i, c_i) = \beta x_i + \rho E(e_i \mid z_i, c_i) \tag{3.5}$$

Taking into account the relation between c_i and e_i from Equation (3.1) and the

fact that e_i has a standard normal distribution, it can be shown that $E(e_i \mid z_i, c_i)$ is simply the non-selection hazard, what Heckman (1979) referred to as the Inverse Mills' Ratio (IMR), $\lambda(\gamma z_i)$, when c_i=1.

Thus:

$$E(y_i \mid z_i, c_i = 1) = \beta x_i + \rho\lambda(\gamma z_i) \tag{3.6}$$

Equation (3.6) indicates that the expected value of the outcome (y_i), given the set of characteristics z_i, and the observance of y_i when c_i=1 (i.e., the household engages in contract farming) is equal to βx_i plus the IMR evaluated at γz_i. The equation indicates that we can estimate the parameters of interest, β's, using only the selected sample, and that we should include $\lambda(\gamma z_i)$ as an additional regressor.

The parameter ρ defines the selection bias. If ρ=0, OLS of y on x using the selected sample gives consistent estimates of β. Otherwise, if ρ≠0, we have omitted a variable that is correlated with x_i. That is why Heckman (1979) points out that the presence of the selection bias can be viewed as an omitted variable problem in the selected sample. The parameter ρ will be equal to zero when u_i and e_i are uncorrelated.

(b) Specification with Sample Selection Correction and Threshold Effects

Since γ is unknown, we cannot evaluate $\lambda(\gamma z_i)$ for each observation. The following is a summary of the procedure used in this paper, also known as the *Heckit Method*, named after the work of James Heckman[20].

[20] James J. Heckman received the Nobel Price in Economics in 2000 for his development of theory and methods for analyzing selective samples. http://nobelprize.org/economics/laureates/2000/index.html.

The first step uses all the observations in the sample to estimate the Probit Model of c_i on z_i,

$$\Pr(c_i = 1 \mid z_i) = \Phi(\gamma z_i) \tag{3.7}$$

Equation (3.7) returns the estimates of γ, i.e., the determinants of participation in contract farming. The inverse mills ratio, IMR (λ), is obtained from these estimates for each observation i, as $\lambda_i = \phi(\gamma z_i)/\Phi(\gamma z_i)$, where $\phi(\gamma z_i)$ and $\Phi(\gamma z_i)$ are the normal density and distribution functions, respectively.

The second step consists in running an Ordinary Least Squares (OLS) Regression. The Net Cash Crop Income Determinants Model uses the selected sample, i.e., observations for which c_i=1, to run

$$y_i = \sum_{j=2}^{4} \alpha_j^0 A_{ji} + \sum_{k=2}^{3} \delta_k^0 E_{ki} + \beta x_i + \rho\lambda(\gamma z_i) + u_i \tag{3.8}$$

where, y_i is the net cash crop income, A_{ji} are owned land area quartiles, E_{ki} are education attainment dummies, and x_i (other demographic, assets, technology and locational factors) is a subset of z_i from the first stage.[21] Equation 3.8 returns estimates of the determinants of net cash crop income, α_j^0, δ_k^0, and β's, and the sample selection bias coefficient ρ.

[21] Elements excluded from z_i are known as exclusion restrictions.

3.4.2.2. Effects of Contract Farming on Crop and Household Income

(a) The Treatment Effects Model

The treatment effects model is an extension of the selectivity model presented in the previous section. It estimates the effect of an endogenous binary treatment on a continuous fully observed variable, conditional on the independent variables. In our case, it is the effects on total crop or household income (y_i) of participation in contract farming operations (c_i). The primary regression of interest is

$$y_i = \beta x_i + \varphi c_i + e_i \tag{3.9}$$

where, c_i is a binary decision variable, that stems from an unobservable latent variable that is assumed to be a linear function of the exogenous covariates and w_i and a random component u_i. Specifically,

$$c_i^* = \gamma w_i + u_i \tag{3.10}$$

The decision to obtain the treatment (participate in contract farming) is made according to the rule

$c_i = 1$ if $c_i^* > 0$

$c_i = 0$, otherwise

where e_i and u_i are bivariate normal with mean zero and covariate matrix

$$Cov(e_i, u_i) = \begin{bmatrix} \sigma & \rho \\ \rho & 1 \end{bmatrix}$$

This model has many versions and has been applied in a variety of contexts (Barnow *et al.*, 1981; Maddala, 1983; Angrist, 2001; and Greene, 2003). The model is

estimated either by maximum likelihood (MLE) or through a two-step procedure. The MLE estimation can be time consuming with large datasets and the two-step estimation with consistent covariance estimates provides a good alternative (StataCorp, 2003).

In the fist stage of the two-step option (Maddala, 1983), one obtains the probit estimates of the treatment equation

$$\Pr(c_i = 1 \mid w_i) = \Phi(\gamma w_i) \tag{3.11}$$

From these estimates, the hazard, h_i, for each observation i is computed as

$$h_i = \phi(\gamma w_i)/\Phi(\gamma w_i) \qquad \text{if } c_i = 1, \text{ and}$$

$$h_i = \phi(\gamma w_i)/[1 - \Phi(\gamma w_i)] \qquad \text{if } c_i = 0$$

where $h_i = \phi(\gamma w_i)$ and $\Phi(\gamma w_i)$ are respectively the density and distribution functions of the standard normal evaluated at w.

By taking the difference in the expected outcome between participants and non-participants in this model,

$E[y_i \mid c_i = 1, x_i, w_i] - E[y_i \mid c_i = 0, x_i, w_i] = \varphi + \rho[\phi(\gamma w_i)/\Phi(\gamma w_i)(1 - \Phi(\gamma w_i))]$, it becomes clear that if the selectivity correction is omitted from the second step equation, the OLS will overestimate the effect of the treatment (Greene, 2003).

(b) Specification with Treatment and Threshold Effects

The Threshold Treatment Effects Model of Contract Farming on Crop and Household Income uses the full sample to run

$$y_i = \beta x_i + \varphi c_i + \sum_{j=2}^{4} \alpha_j^0 A_{ji} + \sum_{j=2}^{4} \alpha_j c_i A_{ji} + \sum_{k=2}^{3} \delta_k^0 E_{ki} + \sum_{k=2}^{3} \delta_k^0 c_i E_{ki} + \rho h_i(\gamma w_i) + u_i \tag{3.12}$$

where, y_i is total crop or total household income, c_i is the participation dummy, A_{ji}

refers to land holdings quartiles, E_{ki} are education attainment dummies, and h_i is the sample selection hazard variable. Both the land holdings and the schooling variables (A_{ji} and E_{ki}) are interacted with the participation dummy (c_i) to assess the effects of participation associated with land and education thresholds. The model generates OLS estimates of the average and threshold treatment-effects coefficients φ, α's and δ's, the β's (effects of other variables), and the sample selection bias coefficient ρ.

From the results of regressions (3.8) and (3.12), we can test for sample selection bias using the t-statistic on λ and h_i, respectively, as a test of H_0: ρ=0. Under the null hypothesis there is no sample selection bias.

3.4.3. Model Estimation and Discussion of Results

3.4.3.1. Farmer Participation and Performance in Contract Farming

The *Farmer Selection/Participation Equation* (Equation 3.7) is estimated using the entire sample. The dependent variable is a dummy equal to 1 if the farmer participates in the scheme and 0 otherwise. It is assumed that farmer likelihood of participation is affected by four sets of factors: demographics, asset and factor endowments and technology, income diversification, and location. The variables associated with each factor are as follows.

- *Demographic Characteristics*. The demographic variables include gender and age of the household head, number of labor adult equivalents in the household, and dummy variables for the level of formal education attained by the household head. Education dummies include "no schooling" (excluded dummy), "1-3 years of schooling", and "more than 3 years of

schooling".

- *Household production assets and technology.* These include quartile dummies of total area owned[22], a dummy for the use of animal traction, the value of hand tools, and the value of other agricultural/marketing equipment, including bicycles.
- *Income diversification variables.* It is hypothesized that households that have significant involvement in non-cash cropping activities will, given the constraints in labor and other endowments, be less likely to enter into cash crop contracts. To account and test for that, we include dummy variables for livestock, self-employment and wage labor activities.
- *Spatial/Location variables.* These variables are district-Firm level fixed effects and are included to account for the differences across locations in the level of development, including natural resource endowments, physical and communications infra-structure development, and other factors. In tobacco areas we dropped the district of Angónia (MLT Area) and in cotton areas the district of Gorongosa (C.N.A. Area).

The *Farmer Performance Equation* (Equation 3.8) uses only those farmers that participate in the contract farming schemes in each area. The dependent variable is the net value of cash crop income, i.e., after deducting the value of inputs provided on credit by the out-grower firm and wage labor costs.

The explanatory variables include all demographic variables, household production assets and technology, all location variables as previously defined, and

[22] Average land area for each quartile – across all households - is presented in Table 3.7.

Lambda, $\lambda(\gamma z_i)$. If statistically significant, Lambda indicates and corrects for the presence of sample selection bias. All income diversification dummies were treated as exclusion restrictions, variables contained in the selection equation but assumed not to affect scheme performance.[23] Model results are presented in Tables 3.9 and 3.10 for tobacco and cotton areas, respectively. We discuss the results for each area separately in (a) and (b) below.

(a) Results for Tobacco Farmers

Probit results for tobacco contract farming areas in Table 3.9 indicate that household participation in tobacco contract farming schemes is more associated with endowments, technology, and income diversification opportunities than with household demographic characteristics. While point estimates indicate that female headed households are less likely to engage in tobacco production, the statistical significance of that result is not strong. Unexpectedly, results indicate (although without statistical significance at any relevant level) that households with more adult equivalents are less likely to engage in the contracts. A similar result was found by Warning and Key (2002) in their assessment of the *Arachide de Bouche* confectionary peanut program in Senegal.

The use of animal traction and the value of manual tools are positively associated with the likelihood of farmer participation in tobacco contract farming schemes. The value of other equipment, including bicycles, has a small, positive, but statistically insignificant effect. Also surprising, in light of the means comparisons in Table 3.5, is that households with more land are not more likely than others to grow tobacco.

The probit results suggest that households that have access to alternative sources

[23] We tested the statistical significance of these variables and none were statistically significant in explaining the levels of cash crop income, but some were significant in explaining participation.

of income are less likely to directly participate in contract farming schemes in tobacco areas; households drawing income from livestock sales and wage labor are less likely to get engaged in tobacco production. This suggests that if these options are sufficiently profitable households will invest more family resources in those. These may help explaining the result on the negative relationship between available adult equivalents and the likelihood of participation. Effectively smaller households may rely on permanent wage labor and get engaged in tobacco while larger households may draw resources into these activities, including in selling labor to smaller households that choose to grow tobacco under contract. Education of the household head does not statistically increase the likelihood of participation. The Model Pseudo-R^2 is 0.25.

The analysis of the determinants of tobacco net cash income in the second step does not indicate the presence of sample selection bias, i.e., the coefficient of lambda is not statistically significant at 10% or less.

Once households choose to engage in tobacco, some effects are worth noting. First, female headed households have mean net tobacco profits $400 lower than their male counterparts. Second, regarding farm endowments and technology, land has no effect on net tobacco income until the fourth land area quartile, when it has a large and highly significant effect; while at lower levels of land holdings (Area_Q2 and Area Q3) the differences are not statistically significant, average profits of land rich households (Area_Q4) are $780 higher than that of their land poor counterparts (Area_Q1). The value of manual tools also has a positive partial effect on net tobacco income, although the effect of the variable is relatively small and only significant at the 10% level.

Table 3.9. Determinants of Profits from Tobacco Production

Explanatory Variables	Parameter Estimates							
	1st Stage: Participation [1/]				2nd Stage: Net Income/Tobacco			
	Coeff	Z	P > | z |	LS[2]	Coeff	t-stat	P > | t |	LS[2]
Demographics [3/]								
Female headed household	- 0.375	0.84	0.40		- 405.56	1.95	0.05	*
Age of household head	- 0.013	0.89	0.38		- 5.44	0.82	0.42	
Labor adult equivalents	- 0.154	1.29	0.20		106.51	1.26	0.21	
Education: 1-3 years	- 0.071	0.20	0.84		- 148.86	0.66	0.51	
Education >3 years	0.024	0.06	0.95		17.55	0.07	0.94	
Assets and Technology [4/]								
Area_Q2	0.333	0.92	0.36		247.07	1.36	0.18	
Area_Q3	0.027	0.06	0.95		- 78.32	0.34	0.74	
Area_Q4	0.500	0.96	0.34		780.34	2.30	0.02	*
Use of Animal traction	1.198	2.35	0.02	*	198.83	0.48	0.63	
Value of manual tools	0.023	1.70	0.09	+	8.47	1.79	0.08	+
Value of other equipment	0.004	1.22	0.22		3.86	1.51	0.13	
Diversification Activities								
Has livestock income	- 1.026	1.90	0.06	+				
Has Self-employment inc	0.257	0.89	0.37					
Has wage labor income	- 0.879	2.88	0.00	*				
Agro-Ecological Effects								
Mid-Altitude								
Macanga/MLT	- 0.831	2.15	0.03	*	30.78	0.10	0.92	
Mualádzi/DIMON	0.161	0.43	0.67		83.19	0.41	0.69	
Angónia/MLT(dropped)								
Lower Altitude								
Marávia/MLT	- 0.361	0.85	0.40		- 600.79	2.68	0.01	**
Luia/DIMON	- 0.543	1.17	0.24		- 787.16	3.72	0.00	**
Inverse Mills Ratio (λ)					229.53	1.03	0.31	
Constant	1.544	1.85	0.07	+	- 170.74	0.41	0.68	
Number of observations	159				117			
Wald chi2 (18)	45.25							
Prob > chi2	0.0004							
Pseudo R2	0.25							
Log pseudo-likelihood	- 81.62							
F (16, 100)					4.12			
Prob > F					0.0000			
R – Squared					0.46			
Root MSE					913.62			

[1/] Probit equation for participation, 1 if participates, 0 otherwise. [2/] Level of significance (LS): + 10%, * 5%, ** 1%. [3/]No schooling (Education=0) is excluded. [4/] Quartile 1 (Area_Q1) is excluded. Profits and value of assets are expressed in $US.

Source: Zambezi Valley Tobacco Concession Areas Study, 2004.

Third, there are no threshold effects of education on tobacco profits. This is a somewhat surprising result in a crop that is relatively intensive in management and

production specificity. We investigated: (a) if there were any statistically significant relationship between land area and education, and (b) if education determines the levels of self-employment and wage labor income. Results indicate that land and education of the household head have a weak correlation coefficient of 0.11, and that, when running the profits determinants regression without the land area variables, the education variable remains statistically insignificant. These results lend credence to our original finding that returns to education are low, even in this demanding crop. Furthermore, a two stage regression analysis on the determinants of off-farm income shows that education is an important determinant of both self-employment and wage labor income in tobacco growing areas, but only wage labor earnings (in the second stage) are statistically increased with increased educational attainment of the head. For detailed regression results, see Appendix B.

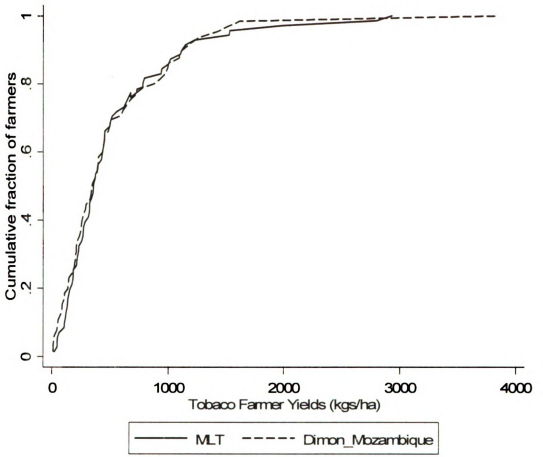
Fourth, agro-ecology matters. Results suggest that farmers operating in north high altitude areas in Macanga (MLT) and Mualadzi (Dimon) have profits pretty much in line with those in Angonia (MLT), the omitted dummy, while those in Luia (Dimon) and Maravia (MLT) in the lower and drier south have profits statistically lower. For a comparison of yields and profits across firms, see the cumulative distribution functions in Figures 3.8 and 3.9.[24]

Overall, the OLS model has a good explanatory power, R^2 =0.46, and the F-test and the probability value are also highly significant.

[24] Data on farmer experience (number of years farmers have grown tobacco) were collected for the Dimon area. In firm specific sample regressions, both the linear and the quadratic specifications did not show any significant effects.

Figure 3.8

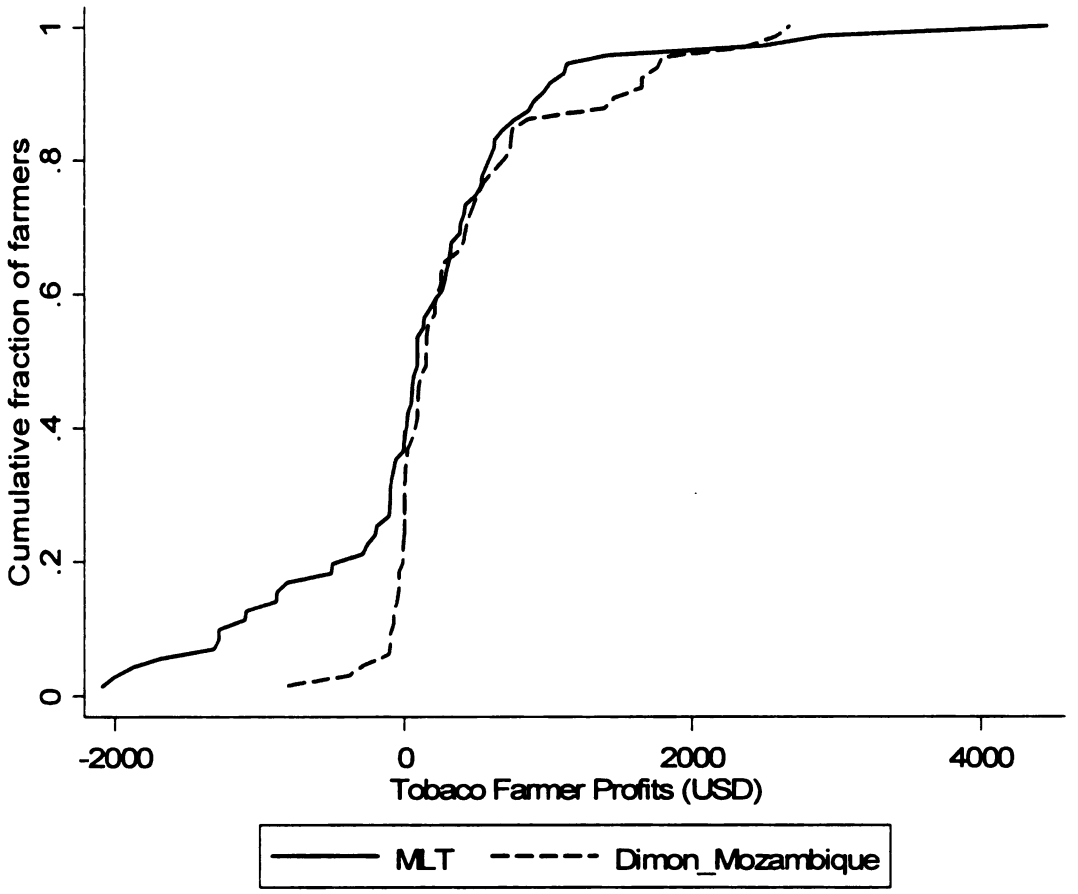
Cumulative Distributions of Tobacco Farmer Yields, by Firm
Zambezi Valley – Mozambique, 2003/2004



Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

Figure 3.9

Cumulative Distributions of Tobacco Farmer Profits, by Firm
Zambezi Valley – Mozambique, 2003/2004



Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

(b) Results for Cotton Farmers

Results for the sample selection model for cotton areas are presented in Table 3.10. The probit model in the first stage has a Pseudo – R^2 of 0.23. Model results indicate that choice of participation is inversely related to household head's education. This result is consistent with findings in other cotton growing areas of Mozambique where more educated farmers tend to choose off-farm work over cotton. In sharp contrast with results

in tobacco areas, households with larger land areas than the base group (land poor) are more likely to seek a contract in cotton; all the land holding threshold variables are positive and statistically significant.[25].The difference between the two sectors with this respect may be explained by the fact that, under current technological packages, in addition to land, participation in tobacco also requires the (unobserved) ability to manage production resources in a more complex set of field activities than what is required in cotton; in cotton land is the single most important resource.

Consistent with expectations, access to alternative sources of income reduces the demand for cotton production contracts. Livestock income opportunities and self-employment are negatively correlated with the likelihood of participation in contract farming; households do not appear to choose cotton if they have other good alternatives.[26] Expected low yields and cash returns in cotton production at this point contribute to this result. Note that even in C.N.A. areas where yields are considerably higher (see Table 3.2), cash returns are reduced by a more expensive input package and lower producer prices; the latter persistently set at the official minimum in recent years.

The regression results for farmer performance in the schemes show a p-value of 0.000 for the F-test of joint significance and an Adjusted R^2 of 0.64. The results indicate that the coefficient associated with the IMR is statistically significant at 5%, which indicates the presence of sample selection bias. Among the demographic variables, only the labor adult equivalents variable is statistically significant at 10%, indicating that once in the schemes, additional adults generate positive returns to cotton profitability; each

[25] The similarity in magnitude in the coefficients of land thresholds Q2 to Q4 suggests that the threshold for getting into cotton lies around the 25th percentile, i.e., the greater difference is between the smallest 25% and everyone else.

[26] Unlike in tobacco areas where labor demand is more pressing and labor markets are much more active, wage labor income does not compete with direct participation in contract farming in cotton areas.

additional adult adds on average $37 per year. Though not statistically significant, the coefficients on education achievement are positive. That is a rough indication that, although highly educated heads tend not to participate in cotton farming, the ones that do may be more likely to perform better than the less educated ones.[27]

Like in tobacco areas, no significant positive effects of total area owned on profits are observed until the fourth quartile; land rich cotton smallholders have profits that are about $150 higher than those of land poor cotton growers. This suggests that in order to benefit from the crop, smallholders need to be relatively large.

Furthermore, the value of production and marketing equipment is positively associated with returns to cotton growing. Finally, the analysis of district-firm fixed effects indicates that, controlling for other factors, average profits in all Dunavant areas are statistically lower than those in Gorongosa (C.N.A.). Only farmers in Maringue (C.N.A.) achieve higher profits than those in Gorongosa.[28] The cumulative distributions on Figure 3.10 indicate that yields for the C.N.A. farmers stochastically dominate those for the Dunavant farmers.

[27] We tested and found that education and land holdings are uncorrelated. Also, returns to education in cotton growing areas are more sizable, though also not statistically significant, in non-farm self-employment activities. See Appendix B for detailed regression results.

[28] Information on the number of years farmers have grown cotton (experience) was collected for the Dunavant area. Both the linear and the quadratic specifications did not reveal any significant effects. Note that, since Dunavant operations started only a few years ago, not much variation is observed in the sample.

Table 3.10. Determinants of Profits from Cotton Production

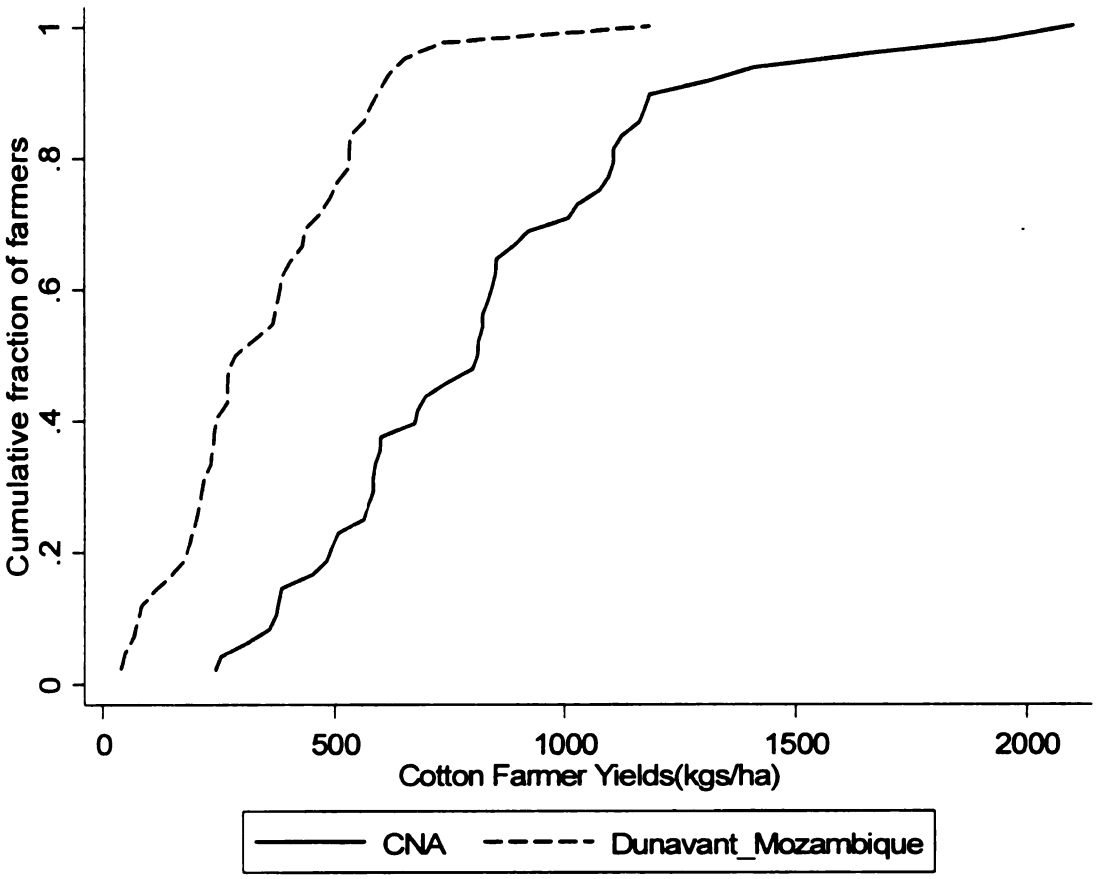
Explanatory Variables	Parameter Estimates							
	1st Stage: Participation [1/]				2nd Stage: Net Income from Cotton			
	Coeff	Z	P > | z |	LS[2]	Coeff	t-stat	P > | t |	LS[2]
Demographics [3/]								
Female headed household	- 0.594	0.95	0.34		13.140	0.15	0.88	
Age of household head	0.002	0.16	0.87		- 1.070	0.61	0.55	
Labor adult equivalents	- 0.193	1.55	0.12		37.033	1.75	0.09	+
Education: 1-3 years	- 0.141	0.37	0.71		41.620	0.77	0.44	
Education >3 years	- 1.079	2.54	0.01	**	85.253	1.36	0.18	
Assets and Technology [4/]								
Area_Q2	1.137	2.82	0.01	**	8.700	0.16	0.87	
Area_Q3	1.400	3.12	0.00	**	- 3.310	0.05	0.96	
Area_Q4	1.212	2.36	0.02	*	148.887	2.00	0.05	*
Use of Animal traction	0.507	0.62	0.53		97.614	0.65	0.52	
Value of manual tools	0.020	0.94	0.35		- 3.861	0.80	0.43	
Value of other equipment	0.002	0.52	0.61		1.279	3.59	0.00	*
Diversification Activities								
Has livestock income	- 0.887	1.75	0.08	+				
Has Self-employment inc.	- 1.104	3.11	0.00	**				
Has wage labor income	0.045	0.14	0.88					
District Fixed-Effects								
Chiúta/Dunavant	- 0.111	0.20	0.84		-566.612	7.22	0.00	**
Chifunde/Dunavant	- 1.085	1.98	0.05	*	-385.921	3.95	0.00	**
Moatize/Dunavant	0.101	0.22	0.83		-142.559	2.08	0.04	*
Caia/C.N.A.	0.229	0.48	0.63		-144.355	2.49	0.02	*
Maríngue/C.N.A.	- 0.104	0.20	0.84		18.698	0.26	0.79	
Gorongosa/C.N.A. (dropped)								
Inverse Mills Ratio (λ)					-154.986	2.09	0.04	*
Constant					205.148	1.39	0.17	
Number of observations	117				87			
Wald chi2 (19)	33.16							
Prob > chi2	0.02							
Pseudo R2	0.23							
Log pseudo-likelihood	- 62.57							
F (17, 69)					11.14			
Prob > F					0.00			
R – Squared					0.64			
Root MSE					193.90			

[1/] Probit equation for participation, 1 if participates, 0 otherwise. [2/] Level of significance (LS): + 10%, * 5%, ** 1%. [3/]No schooling (Education=0) is excluded. [4/] Quartile 1 (Area_Q1) is excluded. Profits and the value of assets are expressed in $US.

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

Figure 3.10

Cumulative Distributions of Cotton Farmer Yields, by Firm
Zambezi Valley – Mozambique, 2003/2004

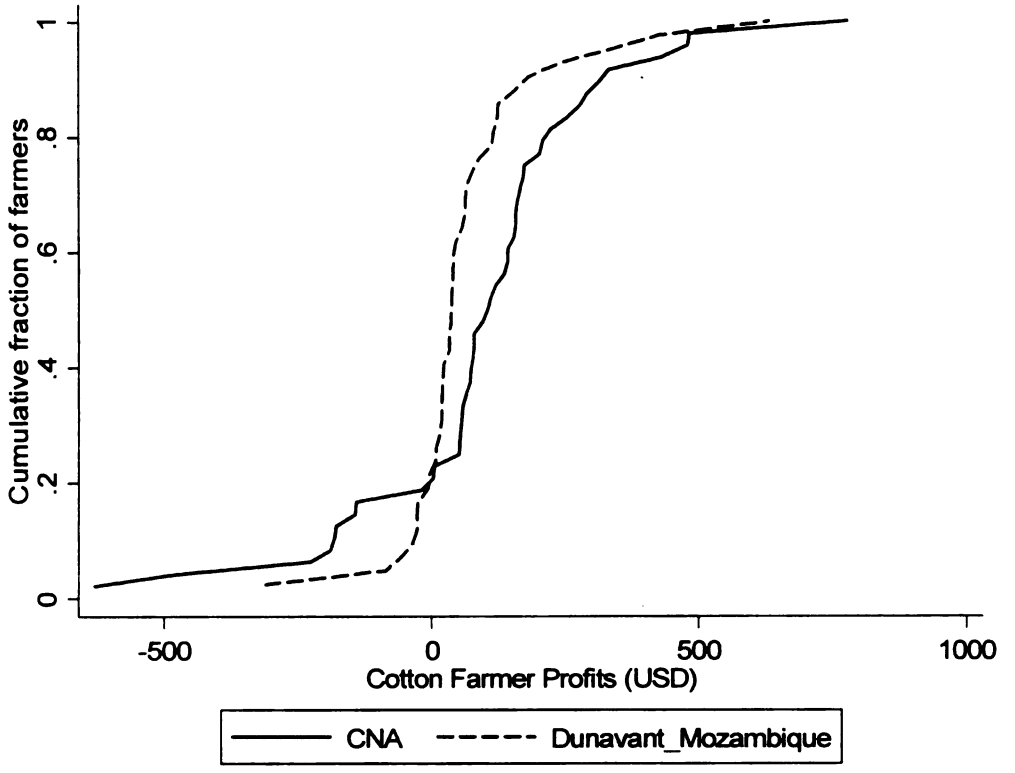


Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

Yet Figure 3.11 shows that, up to the 20th percentile of profits, C.N.A. farmers lose more money than Dunavant farmers; after the 20th percentile C.N.A profits are higher, but not by nearly as much as yields. This pattern is particularly due to the higher cost of the input package and the lower prices in the C.N.A. areas.

Figure 3.11

Cumulative Distributions of Cotton Farmer Profits, by Firm
Zambezi valley – Mozambique, 2003/2004



Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

3.4.3.2. The Effects of Contract Farming on Crop and Total Income

The objective of this model is to assess whether farmer participation in the contract farming schemes in cotton and tobacco concession areas of the Zambezi Valley of Mozambique significantly explains differences in the level of crop income and total income of rural households. As previously, we explore threshold effects of land holdings and education.

In spite of indications in section 3.4.1 that agricultural and household income of participants, more significantly in tobacco areas, are higher than those of non-participants, we cannot yet attribute that difference to their participation in the schemes; our analysis needs to take into account the possibility that the households that do participate in the schemes could have obtained higher incomes even if they had not chosen to participate, i.e., there may be factors that affect both their likelihood of participating in the schemes and their crop and household income levels. That said it is clear that assessing the impact of scheme participation by simply regressing crop income on the participation dummy variables using OLS could bias the estimate of the impact of participation. In this model we consider two different OLS regressions in the second stage: one for net crop income determinants and another for net total household income determinants. The explanatory variables are similar in both regressions and include:

- *Treatment dummy for scheme participation* that takes the value 1 if the farmer participates in the contract farming scheme, and 0, otherwise;
- *Threshold effects interaction terms* between land holding quartiles and participation, and educational attainment classes and participation;
- *Spatial/Location variables* - district dummies relevant for each area, and interactions between those and individual farmer participation status;
- *Selection hazard variable*: $h_i(\gamma w_i)$, generated from the first stage probit estimation, separately for participants and non-participants.

In addition to these variables, we also include variables to account for *demographic factors* and *household production/marketing assets and technology*, as defined in the profit determinants model.

(a) Results for Tobacco Areas

The results of the treatment effects model are analyzed through the OLS output related to the second stage of the procedure applied to both agricultural income and total household income.[29] In tobacco growing areas, average total crop income at the household level is approximately $1,315 ($1,573 among growers and $596 among non-growers), while total household incomes (crop plus income from farm and non-farm activities off the household farm) is $1,606 ($1,815 among growers and $1,023 among non-growers). The same set of independent variables, as previously described, are used in both regressions. As shown in Table 3.11, the models for tobacco areas fit reasonably well, with an Adjusted R^2 of 0.44 for the crop income regression and 0.43 for the total household income regression. Both regressions exhibit highly significant F-tests.

Several results stand out. First, the models find no returns to education in crop income, regardless of a household's participation status in the contract farming schemes. Education beyond three years does significantly increase total household income of non-growers, reflecting higher off-farm earnings, particularly from wage labor, of more educated non-grower households; participation in contract farming by such households almost entirely *offsets* this advantage, though this effect is not significant. These results are consistent with Walker et al's (2004) national analysis, and with Tschirley and Benfica (2002).

Second, two results stand out related to land holdings. First, participation in contract farming has no impact on crop and total household income until the fourth quartile, when its effect is very large; interaction effects of participation and land holding

[29] Since we used exactly the same selection equation applied in the previous section, we are not emphasizing the probit results here.

dummies are only statistically significant and sizable at the fourth quartile ($1,306 for crop income and $1,576 for total household income). This result suggests the presence of important returns to tobacco production (at least within the land area sizes seen in this sample), perhaps through more efficient use of hired labor. If true, the result suggests the possibility of substantial growth in coming years in the number of "emergent" or commercial smallholder households, driven by profit opportunities in tobacco. This class of farmers has been conspicuously lacking in Mozambique to date (Walker *et al*, 2004).

The ready availability of experienced labor in the area may be a key factor driving this result. Second, the relatively greater magnitude and significance of the coefficient on the fourth land quartile variable in the total income regression as compared to the crop income regression, suggests that even larger farmers appear to not be giving up on profitable off-farm income generating opportunities.

Third, female headed households earn lower crop incomes than their male-headed counterparts ($488 less), but differences in total household incomes are negligible in magnitude and not statistically significant; this suggests that diversification into off-farm activities by female headed households reduces gender differentiation in incomes in those areas. Ownership of equipment beyond hand tools appears to increase agricultural incomes: though the coefficient is not quite significant in the agricultural income regression, it is significant in the total income model and its magnitude is nearly identical.

Table 3.11. Effects of Tobacco Contract Farming (CF) on Net Crop and Net Total Household Income: Model with Land and Education Threshold Effects

Explanatory Variables [1/]	OLS Parameter Estimates – Tobacco Areas							
	Net Total Agricultural Income				Net Total Household Income			
	Coef.	Robust S.E.	P |Z|>z	LS[2]	Coef.	Robust S.E.	P |Z|>z	LS[2]
Participates in CF	407.70	555.62	0.46		85.87	568.47	0.88	
Demographics								
Female head househ.	- 488.01	239.68	0.04	*	0.66	282.52	0.99	
Age of househ. head	4.85	10.32	0.64		15.85	11.04	0.15	
Labor Adult equival.	25.44	98.06	0.80		- 3.99	105.43	0.97	
Education Threshold Effects [3]								
Education: 1-3 years	195.32	258.15	0.45		269.76	259.28	0.30	
Education >3 years	361.14	312.48	0.25		718.92	320.28	0.03	*
[Education : 1-3]*CF	- 482.02	572.20	0.40		- 452.16	581.29	0.44	
[Education >3]*CF	- 637.32	581.68	0.28		- 703.27	585.63	0.23	
Land Threshold Effects [4]								
Area_Q2	527.93	222.43	0.02	*	401.17	257.28	0.12	
Area_Q3	665.13	331.93	0.05	*	820.94	279.98	0.00	**
Area_Q4	723.32	396.06	0.07	+	691.65	359.09	0.06	+
Area_Q2*CF	- 129.33	349.50	0.71		4.26	377.02	0.99	
Area_Q3*CF	166.40	553.41	0.76		- 18.28	517.81	0.97	
Area_Q4*CF	1,305.86	631.67	0.04	*	1,575.96	652.95	0.02	*
Assets and Technology								
Use Animal traction	- 56.43	601.06	0.93		- 275.33	620.81	0.66	
Value of tools	8.59	9.14	0.35		5.72	8.82	0.52	
Value of equipment	4.31	2.81	0.13		4.38	2.39	0.07	+
Use fertilizer in maize	12.99	250.38	0.96		- 22.13	244.14	0.93	
Agro-Ecological Effects								
Mid-altitude								
Macanga/MLT	165.83	371.25	0.66		- 159.92	345.50	0.64	
Mualadzi/DIMON	774.05	459.01	0.09	+	423.32	419.30	0.32	
Angonia/MLT	224.71	341.65	0.51		- 91.76	283.13	0.75	
Macanga/MLT*CF	662.23	722.84	0.36		942.34	722.45	0.19	
Muala/DIMON*CF	182.69	602.86	0.76		357.91	586.89	0.54	
Angonia/MLT*CF	141.48	553.88	0.80		265.72	545.30	0.63	
Lower altitude								
Maravia/MLT	- 12.51	410.23	0.98		- 244.43	382.95	0.52	
Maravia/MLT*CF	90.38	772.74	0.91		36.57	760.10	0.96	
Luia/DIMON (excluded)								
Select. hazard ratio (h)	331.11	246.49	0.18		68.56	242.59	0.78	
Constant	- 1,101.09	793.64	0.17		- 679.39	773.48	0.38	
N	159				159			
F (27, 131)	4.11				4.92			
Prob > F	0.0000				0.000			
R – Squared	0.44				0.43			
Root MSE	1,207.00				1,258.10			

[1/]OLS regressors. [2/] Level of significance (LS): + 10%, * 5%, ** 1%. [3/]No schooling (Education=0) is excluded. [4/] Quartile 1 (Area_Q1) is excluded. Crop income, total HH income, and the value of assets, are expressed in $US. Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

Table 3.12. F-Tests of Joint Significance of CF and Education and Land Thresholds: Tobacco Areas

	Net Agricultural Income Regression				Net Total Household Income Regression			
	Combined Effect	F(2,131)	Prob>F	LS 1/	Combined Effect	F(2,131)	Prob>F	LS 1/
CF-Education Threshold Effects								
CF&[Education:1-3]*CF	(74)	0.40	0.67		(366)	0.40	0.67	
CF &[Education >3]*CF	(229)	0.61	0.54		(617)	0.92	0.40	
CF-Land Threshold Effects								
CF&Area_Q2*CF	279	0.33	0.72		90	0.01	0.99	
CF&Area_Q3*CF	574	0.28	0.76		68	0.01	0.99	
CF&Area_Q4*CF	1714	2.26	0.10	+	1662	2.91	0.05	*

1/ Level of significance (LS): + 10%, * 5%, ** 1%. The effects on net agricultural and net total household income are expressed in $US. Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

District level fixed effects are relatively weak. Results indicate that in terms of crop incomes among all households only in Mualadzi (Dimon) they are statistically (and in magnitude) higher than those in Luia (Dimon). There are no participation-location effects in crop incomes, which suggest relatively balanced outcomes across participants in different locations. The coefficient of the selection hazard ratio is not statistically significant in either regression, which indicates that correction for the selection bias in not important in this model.[30]

(b) Results for Cotton Areas

Results of the second stage OLS regressions for crop and household income for cotton areas are presented in Table 3.13. In cotton growing areas, average household total crop income is $479 ($518 for growers and $365 for non-growers), while total household incomes (crop plus income from farm and non-farm activities off the household farm) is $692 ($732 for growers and $574 for non-growers). F-tests of joint significance are

[30] In the analysis of the ARB Program, Warning and Key (2002) found a similar result regarding sample selection bias.

highly significant, with R^2s of 0.60 and 0.48.

The results indicate that none of the demographic variables are statistically significant in either regression. The coefficient on the participation dummy – which reflects returns to cotton farmers in the lowest land and education classes – is positive in both cases, but is not statistically significant. Likewise, none of the participation-land thresholds are statistically significant. This is somewhat consistent with earlier results indicating relatively low productivity levels in cotton and some kind of food first strategy being carried out by both cotton growers and non-grower, with maize production clearly competing for household labor and land resources; the end result is the prevalence of a situation where crop and total household incomes between cotton growers and non-growers, after controlling for demographic, factor and asset/technology endowments, and spatial factors, are not significantly different.

We also find that the value of farm and marketing equipment (excepting manual production tools) is positively associated with higher crop and total household incomes, but the magnitude of the effect is small. As expected, the value of manual tools is positively associated with crop income.

We know that cotton yields are substantially higher in C.N.A. areas than in Dunavant areas (Figure 3.8); on the other hand, Dunavant has been paying better prices than C.N.A. Therefore, there is still plenty of room for improvement in both productivity and pricing. There is no evidence of participation-district fixed effects.

Table 3.13. Effects of Cotton Contract Farming (CF) on Net Crop and Total Household Income: Model with Land and Education Threshold Effects

Explanatory Variables [1/]	OLS Parameter Estimates – Cotton Areas							
	Net Total Agricultural Income				Net Total Household Income			
	Coef.	Robust S.E.	P |Z|>z	LS[2]	Coef.	Robust S.E.	P |Z|>z	LS[2]
Participates in CF	60.39	223.12	0.79		200.72	280.63	0.48	
Demographics								
Female head household	- 61.67	110.41	0.58		- 55.45	169.74	0.75	
Age of household head	1.37	3.18	0.67		2.60	4.14	0.53	
Labor Adult equivalent	11.02	34.71	0.75		- 5.25	40.83	0.90	
Education Threshold Effects [3]								
Education: 1-3 years	99.30	157.58	0.53		107.91	187.02	0.57	
Education >3 years	51.55	172.07	0.77		210.47	200.74	0.30	
[Education : 1-3]*CF	- 303.33	226.18	0.18		- 252.81	280.34	0.06	+
[Education >3]*CF	- 257.31	280.30	0.36		- 436.22	399.59	0.28	
Land Threshold Effects [4]								
Area_Q2	116.97	137.16	0.40		296.49	174.84	0.09	+
Area_Q3	121.68	195.63	0.54		159.11	203.43	0.44	
Area_Q4	761.19	283.64	0.01	**	718.56	317.42	0.03	*
Area_Q2*CF	203.75	199.97	0.31		40.01	246.23	0.87	
Area_Q3*CF	152.56	257.67	0.56		322.72	271.95	0.24	
Area_Q4*CF	- 299.96	346.81	0.39		- 251.27	421.62	0.55	
Assets and Technology								
Use Animal traction	- 241.37	241.81	0.32		- 21.69	299.43	0.94	
Value of tools	16.62	8.61	0.06	+	9.46	8.20	0.25	
Value of equipment	2.05	0.621	0.00	**	1.81	0.96	0.06	+
District Fixed-Effects								
Chiúta/Dunavant	18.15	238.88	0.94		81.18	250.80	0.75	
Chiúta/Dunavant*CF	- 388.82	329.28	0.24		- 14.51	388.62	0.97	
Chifunde/Dunavant	- 467.27	250.65	0.07	+	- 336.54	255.26	0.19	
Chifunde/Dunava*CF	17.70	282.44	0.95		- 22.32	349.12	0.95	
Moatize (Dunavant)	- 319.40	153.28	0.04	*	- 386.35	190.54	0.05	*
Moatize/Dunava*CF	136.96	199.60	0.49		309.95	236.99	0.20	
Caia /C.N.A.	- 154.97	169.11	0.36		113.87	242.03	0.64	
Caia/C.N.A.) *CF	139.27	229.78	0.55		- 86.24	313.12	0.78	
Maríngue/C.N.A.	52.32	157.32	0.74		140.00	212.27	0.51	
Maríngue/C.N.A.*CF	28.79	222.47	0.90		30.20	283.82	0.92	
Gorongosa/C.N.A.(excluded)								
Select. hazard ratio (h)	106.59	150.70	0.48		160.53	202.70	0.43	
Constant	16.921	249.33	0.95		66.02	277.75	0.81	
N	117				117			
F (28, 88)	11.18				5.00			
Prob > F	0.00				0.00			
R – Squared	0.60				0.48			
Root MSE	389.03				500.91			

[1/]OLS regressors. [2/] Level of significance (LS): + 10%, * 5%, ** 1%. [3/]No schooling (Education=0) is excluded. [4/] Quartile 1 (Area_Q1) is excluded. Crop income, total HH income, and the value of assets, are expressed in $US. Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

The coefficient of the selection hazard variable is not statistically significant indicating the absence of sample selection bias in this model. Table 3.14 shows the F-tests of joint significance that assess the combined effects of participation per land and education thresholds. In all cases, the effects are not statistically significant.

Table 3.14. F-Tests of Joint Significance of CF and Education and Land Thresholds: Cotton Areas

	Net Agricultural Income Regression				Net Total Household Income Regression			
	Combined Effect	F(2, 88)	Prob>F	LS 1/	Combined Effect	F(2, 88)	Prob>F	LS 1/
CF-Education Threshold Effects								
CF&[Education:1-3]*CF	(242.94)	1.24	0.30		(52.09)	2.12	0.13	
CF&[Education >3]*CF	(196.91)	0.45	0.64		(235.50)	0.60	0.55	
CF-Land Threshold Effects								
CF and Area_Q2*CF	264.15	0.54	0.58		240.74	0.28	0.76	
CF and Area_Q3*CF	212.95	0.30	0.74		523.45	1.21	0.30	
CF and Area_Q4*CF	(239.56)	0.44	0.65		(50.54)	0.48	0.62	

1/ Level of significance (LS): + 10%, * 5%, ** 1%. The effects on net agricultural and net total household income are expressed in $US.

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

3.5. Summary of Policy Implications

Tobacco and cotton concessions in the Zambezi Valley of Mozambique have provided a secure source of cash income to the rural population in areas where alternative income generating activities are limited. In this section we look at some key issues in each sub-sector as they relate to the results of the analysis presented in this essay and elaborate on its policy implications.

Key results and implication from the econometric analysis in the ***tobacco sector*** relate to the impacts of education, land holdings, access to wage labor, issues related to labor migration, and the effects of environmental and technological spillovers. First, the

lack of returns to education in a crop as demanding as tobacco is surprising. Perhaps the best interpretation is that great scope remains for improving field practices, yields, and profitability; as companies strengthen their extension efforts and more farmers have more time to learn proper techniques, we expect more educated farmers to begin earning higher returns from tobacco.

Second, results on land holding size and access to wage labor may tell an interesting story. Tschirley and Benfica (2001) showed that those with wage labor income, especially those at the high end of this market, tend to maintain such income for long periods of time. Boughton *et al.* (2005) showed that most income growth throughout the country over the past six years has come from off-farm incomes, especially wage labor. The research in this essay shows that households with such income are less likely to grow tobacco; households *without* such income are the ones taking advantage of the tobacco opportunity. As a result, tobacco cultivation may reduce income inequality. However, many smaller farmers earn negative profits from tobacco, while larger farmers tend to earn large positive profits. Over time, this pattern could drive substantial expansion in the number of "emergent" smallholder farmers in the area. Those left behind will be the smaller farmers who also have little access to wage labor opportunities.

Third, recent expansion in tobacco production has been possible due in part to the readily available labor knowledgeable of tobacco cropping, especially in border areas. Survey data suggest that two-thirds of the 61% of farmers with permanent workers

employ at least one worker labelled as Malawian.[31] Many of these are former tobacco smallholders in Malawi that find the wage labor opportunities in Mozambique more profitable. The likelihood of a farmer employing this type of labor increases with area, and the profits and household income of farmers that hire Malawian labor tend to be above those that do not do such hiring. Approximately 25% of total payments to wage laborers in the area go to this group. In terms of our model, these patterns raise concerns about possible consumption leakages; yet, over 75% of the so called "Malawians" report spending 9-12 months working in Mozambique, which suggest that a great deal of their annual consumption takes place in Mozambique. In practice, then, our results suggest two things. First, income leakage is not likely to be a major problem. Second, availability of Malawian labor is important to the growth of the sector. One policy implication is that efforts to ensure that Malawi migrants gain some kind of permanent residency that leads them to spend more time and resources in Mozambican territory can be helpful both to feed expansion of the sector and to spread benefits in the local economy.

Finally, technological and environmental spillovers in tobacco growing areas need to be more closely examined. On the positive side, growers and non-growers both are far more likely to apply fertilizer on food crops than are farmers in other areas of the country; it is likely that the provision of fertilizer for tobacco has contributed to this pattern, through a combination of some diversion to food crops[32] and greater familiarity with the input leading to greater use. On the negative side, the rate of tree cutting by tobacco growers far surpasses the rate of planting (Benfica, *et al.*, 2005). Long-term

[31] Evidence suggests that this labor force is a mixture of returned refugees (established in Malawi during the Mozambique Civil War), family members of these returnees, and a genuinely new generation of Malawian migrant laborers.

[32] We do not know how common such diversion is.

consequences could be quite negative if these trends are not halted. Specific actions to contain or reverse the situation are, therefore, required.

In the cotton sector, results from our analysis are in line with several other studies in the cotton sector that have emphasized low prices and poor productivity at the farm level as factors leading to the stagnation of cotton farmer incomes in Mozambique (World Bank, 2005; Tschirley *et al.*, 2006); Mozambique pays the lowest prices in Africa, and farmer yields are also among the lowest. Our study clearly documents the low profitability of the crop relative to tobacco in the Zambezi Valley region. The concession model as applied in Mozambique, which precludes competition among companies and does not balance this with any effective performance monitoring system, must be considered an important contributor to the problem of low prices and also low productivity; resolving this problem through more sophisticated management of the concession system has to be a high priority for the government and other stakeholders over the next few years.

In this study we find, through our econometric analysis, that increased profits in cotton can be achieved with increased farm size and a higher level of production assets. However, there are no landholding threshold effects on income from all crops, nor on total household income. This seems to suggest some stagnation in these economies, where cotton activity is not yet capable of pulling the rest of the economy into a dynamic mode through strong economic linkages. Again, these results are quite different from those found for tobacco areas.

Improving the contribution of cotton to smallholder livelihoods in Mozambique

requires a host of improvements in the quality of the seed stock, systems for treating seed prior to distribution to farmers, improved input packages linked to effective extension with farmers, and improved pricing. The entrance of new companies into the sector such as Dunavant – with a good productivity and pricing record in Zambia – and CNA, with an impressive productivity record in Mozambique, holds the promise of improved results for smallholder farmers. These results, however, have so far not been delivered for most farmers. Reforms to the concession model currently in place would seem to be a requirement for significant future progress. Because many alternative approaches to reform are possible, informed research on reform paths, linked to some kind of participatory stakeholder process, should receive high priority among both public and private groups interested in the sector, and in smallholder welfare.

CHAPTER 4

DISSERTATION ESSAY TWO

Income Poverty Effects of Expansion and Policies in Cash Cropping Economies in Rural Mozambique: An Economy-wide Approach

4.1. Introduction

Econometric analysis in chapter three indicates that growth in cash cropping, especially of tobacco, can potentially affect income differentiation between growers and non-growers. Tobacco might reduce differentiation by providing high returns to households not engaged in remunerative off-farm activities, and by providing wage labor opportunities to more households; at the same time, it could contribute to differentiation by driving the growth of a group of relatively large, "emergent" tobacco farmers. The relative magnitude and direction of each of these effects depends to a great extent on the nature of second round effects that result from employment, production and consumption linkages in those economies. This is an issue we did not deal with in Chapter Three; it will be central to this chapter.

In this essay we use an economy-wide framework to analyze changes in the levels of income poverty of different household groups following certain exogenous shocks to the cotton and tobacco sectors; these shocks include expansion of contract farming through capital injections, technology improvements, changes in world market prices, and changes in Government trade policies. These issues are addressed using a regional agricultural CGE model in the tradition of Lofgren and Robinson (1999) and Taylor *et al.* (1999) which we developed and calibrated with a regional Social Accounting Matrix

(SAM). The model focuses on the Zambezi Valley area, which has received much of the new investment in these sectors over the past decade.

Macro Economy-wide models, normally designed to capture the second and higher feedback effects of investment and policy changes, have been used to analyze a wide range of issues in Mozambique, such as aid dependence, marketing and agricultural technology (Tarp *et al.*, 2002), the effects of HIV/AIDS, and the effects of multilateral trade agreements (Arndt, 2003; 2005). However, macro level economy-wide models, including national CGE models, typically abstract from local economies, and do not provide the detail needed to uncover the full impact of policy changes on rural economies; this is especially true when agricultural households are engaged in a portfolio of farm and non-farm activities (Taylor *et al.*, 1999), and when the analysis of issues and/or the impact of shocks that are specific to a relatively small region.

The essay is organized as follows. Section 4.2 explains the relevance of the study for pro-poor growth policy strategies. Section 4.3 presents the data and analytical methods that include the Regional SAM, the Regional CGE model, a discussion on interlinked transactions, and a conceptual framework for the Representative Household Approach to Poverty Analysis used in this study. Using SAM and household survey data, representative characteristics of the regional economy are presented in Section 4.4. Section 4.5 focuses on the definition and set up of the various policy and technology/investment options that form the basis for the analysis, and the presentation and discussion of results. Section 4.6 closes with conclusions and policy implications.

4.2. Relevance for Pro-Poor Growth Policy

Poverty reduction policy statements in Mozambique (GOM-PRSP 2001, 2005) recognize that agro-industrial investments and export oriented agriculture can play a role in reducing rural poverty. What these statements lack is specific knowledge that would help to sketch strategies to enhance the impact of these investments on rural poverty in a consistent and sustainable way. Current agro-industrial and agricultural export oriented investments in the country demonstrate various degrees of connectedness with rural households. The total impact of such investments or policies designed to promote them depend on the size of the direct and indirect/induced effects in a particular region (Hazell, 1984; Rogers, 1986; Haggblade *et al.* 1987; and Delgado *et al.* 1998). Alternative supply chain institutional arrangements, ranging from the reliance on independent producers in spot markets, to various forms of alliances and contracting, to full vertical integration, will generate various degrees of initial employment and income effects, depending on the crop and supply chain in question.

An important question for policy makers refers to the magnitude of the secondary effects from investments, i.e., the size of production, consumption, and employment linkages in the local economy. If those effects are expected to be strong, pro-poor economic growth strategies need not be directly or exclusively oriented to the poor. Furthermore, in an environment characterized by serious resource constraints, and bearing in mind that it is normally more expensive to reach the poor than the relatively more endowed, a growth strategy that emphasizes second round effects in rural poverty reduction may, if these effects are large, be preferred to one that focuses solely on the maximization of direct effects to the poor (Tschirley, 2002; Benfica *et al.*, 2002; Carrilho

et al., 2002).[33] The validity of this conclusion, that poverty reduction may be achieved at a lower cost when emphasis is given to second round effects, depends to a great extent on the structure of the economy where growth takes place that influences the relative costs and benefits associated with alternative investments and policy options. The preferred approach becomes, therefore, an empirical question. In this study we look at that question using data from the Zambezi Valley region of Mozambique where cash crops are grown under contract, and baseline data allows for stratification of farming households and the subsequent analysis of relative impacts of policy changes on income poverty levels.

4.3. Data and Analytical Methods

This section presents the data and analytical methods used in this study, including the Regional SAM for the Zambezi Valley (ZVR-SAM), the Regional CGE model (ZVR-CGE), including its standard structure, and a discussion on interlinked transactions in selected cash cropping activity sectors. Then, it presents a conceptual framework for the Representative Household Approach to Poverty/Inequality Analysis. Finally, it discusses issues related to the design and implementation of policy simulations with the CGE model.

[33] This is due to the greater difficulty in reaching the poor with messages on innovative technologies, but more importantly due to the lesser ability of the poorest households to make the adjustments and bear the risks needed to adopt new technologies. Indeed, rational policy makers attempting to reduce poverty in the face of a budget constraint will rely more on indirect effects than they would if costs to reach all groups were equivalent (Tschirley, 2002).

4.3.1. The Regional Social Accounting Matrix for the Zambezi Valley

4.3.1.1. Introduction

A SAM is both a data system and a conceptual framework useful for policy analysis (Thorbecke, 1998).[34] SAMs have been used to model diverse economies and institutional structures within various geographical scopes. Initial applications were mostly modeling macro level issues in a national accounting context; more recently the framework has been adapted to study micro (villages and towns) and sub-national (or regional) economies. The strengths of the SAM framework are in its flexibility and adaptability to model a variety of economic structures and institutional setups. As a data system, the SAM is *comprehensive* and disaggregated, as it includes transactions among sectors, factors and institutions; *consistent* in the sense that for every income there has to be an equivalent expenditure; and *complete* in that both the sender and the receiver of every transaction need to be identified. For a given year, the SAM provides a snapshot of the structure of the economy under investigation: the structure of production, inter-sectoral linkages, distribution of factor value added among socio-economic groups, and their expenditure patterns. The SAM framework consists of a square matrix of double-account, in which rows represent receipts (revenues) and columns represent expenditures (payments). As a *comprehensive*, *consistent*, and *complete* accounting method, it requires balancing of revenues and expenditures in all accounts.[35]

---

[34] The genesis of the SAM dates back to Sir Richard Stone's pioneering work on social accounts (1978), for which he received the Nobel Prize in Economics in 1984 (http://nobelprize.org/economics/laureates/1984/index.html). Subsequently, Pyatt and Round (1979) further formalized the SAM and showed how it could be used as a conceptual framework for policy and planning purposes.

[35] Issues regarding the process of constructing the regional SAM for the Zambezi Valley and the balancing procedure used to ensure the required accounting consistency are discussed Chapter Two.

4.3.1.2. The Structure of the Regional SAM

The Zambezi Valley Regional SAM (ZVR-SAM) keeps all the features of a standard SAM. Some important ones are: the inclusion of non-marketed home consumed commodities by farm households; the explicit treatment of marketing costs; and the separation between production activities and commodities that allows any activity to produce multiple commodities and any commodity to be produced by multiple activities. In addition, the SAM has two other distinctive characteristics. First, to account for the diversity of rural production activities, demand patterns, technologies, and market structures, the SAM is highly disaggregated. In total it includes 83 accounts. Second, agricultural activities (farm types) are mapped with household types. This allows for better integration and subsequent modeling in a CGE framework of production and consumption decisions in a non-separable fashion with the relevant differentiation across farm-household types and activities (Lofgren and Robinson, 1999; and Taylor *et al.*, 2005).

The 2003-2004 ZVR-SAM includes six major types of accounts: (i) activities; (ii) commodities; (iii) commodity marketing costs; (iv) factors of production: labor, land, and capital; (v) institutions: households, government, and rest of the world; and (vi) savings and investment. A schematic view of the SAM is presented in Table 4.1.

The *Production Activities* accounts describe the value of commodity inputs and the payments to factors used in the production process (columns) and domestic market sales and home consumption of goods and services (rows). The Zambezi Valley SAM includes 18 such accounts. There are six accounts for agricultural farms, four of which represent cash cropping farms: two tobacco farm types and two cotton farm types. The

remaining two represent non-growers of cash crops in the respective areas. Other activities include fishing, livestock, food processing, beverage processing, other processing or manufacturing activities, trading services, Government services, and other services. Finally, we include four marketing and exporting activities representing each of the four firms that operate contract farming schemes, supplying inputs on credit and buying back the output that is subsequently exported, after adding some value.

The *Commodities* accounts record the value of total supply, including the value of domestic production marketed and imports after taxes and marketing margins (columns) and total demand, including demand for intermediary inputs by activities, private and government consumption of goods and services, investment demand, and exports (rows). We have 45 commodity accounts. The major cash crops are represented by eight accounts, reflecting high level of disaggregation with firm-specific raw tobacco accounts, raw cotton accounts, and another similar set of accounts for packed/graded tobacco and cotton.[36] Other accounts represent agricultural raw and semi-processed food commodities ranging from maize grain and meal to fruits and vegetables (eight), animals and animal products (six), processed foods (six), agricultural inputs (four), non-food items (nine), and services, ranging from health and education to maintenance (four).

Marketing Costs (MC)/Marketing margin accounts quantify the wedges between production and market prices for domestically produced goods sold domestically, between import border prices and domestic market prices for imported commodities, and between domestic and export border prices for exported goods. In principle, they account for both transportation and the intangible costs of doing business, including procurement,

[36] Note that packed tobacco and packed cotton are entirely exported.

contract negotiations, etc. The SAM includes three relevant MC accounts: MC for domestic sales, MC for imports, and MC for exports. These accounts get payments from the tradable commodity accounts (rows) and make payments to a trading services commodity account (columns).

The *Factor* accounts describe the source of factor income, i.e., value added in each domestic activity and from the rest of the world (RoW) and how factor payments are distributed to the various institutions, including the different household groups and the rest of the world in proportions reflecting factor endowments (column). The Zambezi Valley SAM includes factor accounts for land (one), capital (five) and labor (four) resources. The labor accounts correspond to two labor types (family and hired labor) represented on a temporal dimension, i.e., each labor account is disaggregated to account for labor use and remunerations for the *pre-harvesting* and the *harvesting and post-harvesting* season, respectively. This allows for the analysis of seasonality in labor demand and payments to institutions. The capital account is divided in four activity specific accounts, each associated with a cash crop farm account, and one general capital account associated all other activities.

Table 4.1. Schematic Standard Regional Social Accounting Matrix

		EXPENDITURES								
		Activities (ACT)	**Commodities (COM)**	**Marketing Costs (MC)**	**Factors (F)**	**Representative Households (HH)**	**Local Government (GOV)**	**Savings/ Investment (S-I)**	**"Rest of the World" (ROW)**	**Total**
RECEIPTS	**Activities (ACT)**		Domestically marketed output			Home consumption				Gross output
	Commodities (COM)	Intermediate inputs purchased		Transaction costs		Consumption expenditures	Government consumption	Investment demand	Exports	Commodity demands
	Marketing Costs (MC)		Marketing costs							Marketing costs
	Factors (F)	Value added: Wages/rents					Wages/rents paid by GOV		Wages/rents from ROW	Total factor earnings
	Representative Households (HH)				Factor income to households	Intra-household transfers	GOV transfers to households		Remittances from ROW	Household income
	Local Government (GOV)	Producer taxes, value added taxes	Sales taxes, tariffs, export taxes		Factor taxes	Personal taxes			Transfers from ROW and Central GOV	Government receipts
	Savings/ Investment (S-I)					Household savings	Government savings			Total savings
	"Rest of the World" (ROW)		Imports		Factor income paid to ROW	Remittances to ROW				Payments to outside region
	Total	Total costs of production	Domestic supplies	Marketing costs	Factor expenditures	Household expenditures	Government expenditures	Total investment	Total receipts from outside	

Source: Zambezi Valley Regional SAM, adapted from Lofgren *et al.* (2002).

The *Institutions* accounts comprise all the income and expenditures of households, government, and the rest of the world. The *Household* accounts record income, i.e., the value of domestic factor incomes to households, inter-household transfers, subsidies or transfer payments from Government, and remittances from the rest of the world (row), and how households spend that income: household home consumed outputs from the activities they engage in, consumption expenditures of marketed goods and services, transfers to other households, payment of taxes, private savings and remittances to the rest of the world (column). The disaggregation of households in the Regional SAM is aimed at representing the dominant production structure implied by the classification of activities. With that in mind, we disaggregated the households in four major groups: (i) Tobacco growing households: farming households in tobacco areas that engage in tobacco production under contract with MLT or Dimon; (ii) Cotton growing households: farming households in cotton areas engaged in cotton production under contract with Dunavant or C.N.A.; (iii) Non-tobacco growing households in tobacco growing areas; (iv) Non-cotton growing households in cotton growing areas. Each of these groups of households engages in a portfolio of activities including food crop production and non-farm businesses, or some form of wage labor.

Typically, the *Government* accounts collect taxes on income from activities, commodities, factors, and transfers from the rest of the world (row), and pay for Government consumption of goods and services, transfers to households and to the rest of the world (column). The role of Government in this regional model is limited. In reality, the flows of the Government account in a sub-national SAM should reflect the actions of two actors – the local and the Central Government. The Central Government in this SAM

is located in the "Rest of the World". For simplicity, we consider a single Government account representing a regional Government. Income sources for the local Government include the collection of a flat lump-sum tax *per capita* in the region and a substantial inflow from the "Rest of the World" that includes the Central Government. In the base year that the SAM represents, there are no activity or commodity taxes on domestic or foreign trade. Local Government expenditures include transfers to households in the form of pensions, and expenses in health and education at the local level.

The *Rest of the World* (RoW) accounts record payments to the rest of the world for imports of goods and services, the use of foreign factors, and Government transfers (row), and receipts from exports, factor payments to domestic factors, remittances to households, transfers to Government and foreign savings (column). Like in the case of Government, the spatial definition of the SAM implies the existence of at least two RoW institutional accounts; the "Rest of the Country RoW" representing the rest of the national territory, and the "Foreign RoW" that represents agents outside Mozambique. The ZVR-SAM, however, includes only a single RoW account that covers all the areas outside the region, domestic and foreign. The base year that the SAM represents does not include any taxes or tariffs on trade between the region and the RoW.

The *Savings-Investment* account records the savings made by all the institutions (row) and how they are spent in investment goods (column). A detailed list of accounts and levels of disaggregation for the Zambezi Valley Regional SAM are presented in Tables 4.2 and 4.3. The SAM database is used to calibrate the ZVR-CGE model detailed later in this section.

Table 4.2. Regional SAM Accounts: Activities, Commodities and Marketing Costs

Accounts	Description of Individual Accounts	
Activities	Agriculture and Livestock/Fishing:	Marketing/Export of Cotton and Tobacco:
	Tobacco Growing Farms - MLT	MLT - Tobacco Marketing and Export
	Tobacco Growing Farms - DIMON	DIMON - Tobacco Marketing and Export
	Cotton Growing Farms - C.N.A.	C.N.A - Cotton Marketing and Export
	Cotton Growing Farms - DUNAVANT	DUNAVANT - Cotton Marketing and Export
	Non-Growers - Tobacco Areas	
	Non-Growers - Cotton Areas	Transportation and Services:
	Livestock	Trading Services
	Fishing	Government Services
		Other Services
	Processing/manufacturing:	
	Food processing	
	Beverage processing	
	Other Processing/Manufacturing	
Commodities	Cash crops:	Processed foods/beverages:
	Raw Cotton – Dunavant	Cooking Oil
	Raw Cotton – C.N.A.	Sugar
	Packed Cotton – Dunavant	Salt
	Packed Cotton – C.N.A.	Tea/Coffee and spicies
	Raw Tobacco – MLT	Prepared Ready to Eat Foods
	Raw Tobacco – Dimon	Alcoholic Beverages
	Packed Tobacco – MLT	
	Packed Tobacco – Dimon	Services:
	Other agricultural raw and processed commodities:	Education
		Health
		Trading Services
	Maize Grain and Rice	Housing/Water/Electricity/Maintenance
	Maize Meal	
	Other Flours	Agricultural inputs:
	Bread/Biscuits/Pasta	Seeds - Other Products
	Beans and Groundnuts	Pesticides - Cepermetrin + Acephate
	Root Crops: Cassava/potatoes	Fertilizers - NPK + CAN + UREA
	Vegetables, Green Leaves and Fruits	Other inputs
	Coconuts	Non-foods and other commodities:
		Firewood and Coal
	Animals and animal products:	Fuel - Vehicles/Equipment/Spares
	Meat - Cow	Wood/Grass/Cane Products
	Meat - Goat	Textiles, wearing apparels and footwear
	Meat - Pork	Metal/blacksmithing Products
	Meat - Birds	Kitchen Utensils and other Home Apparel
	Fish and Sea/River Foods	Soap and Hygiene Products
	Milk and Eggs	Imported tobacco
		Other Commodities
Marketing Costs	Domestic Sales	
	Imports	
	Exports	

Source: Zambezi Valley Regional SAM

Table 4.3. Regional SAM Accounts: Factors, Institutions and Savings-Investment

Accounts	Description and Level of Disaggregation	
Factors	Land	Land
	Capital	Capital (general) Farm specific - MLT Farm specific - Dimon Farm specific - Dunavant Farm specific – C.N.A.
	Labor	Family Labor – Pre-harvesting Family labor – Harvesting and Marketing Hired Labor – Pre-harvesting Hired Labor – Harvesting and Marketing
Institutions	Government	Local Government
	Rest of the World	Domestic and Foreign Rest of the World
	Households	Cotton areas: Non-grower households Cotton areas: Grower households Tobacco areas: Non-grower households Tobacco areas: Grower households
Savings-Investment	Savings-Investment	Savings-Investment

Source: Zambezi Valley Regional SAM

4.3.1.3. The SAM as a Conceptual Framework

The SAM framework can be used as a conceptual tool to explore the impact of exogenous changes in variables such as exports from the region, government expenditures and a variety of investments on the socio-economic system and the resulting structure of production, factorial, and household income distributions. In this sense, the SAM becomes the basis for simple multiplier analysis and calibration of CGE models (Pyatt and Round, 1979, Dervis et al., 1982). The first question to address when using the SAM as a conceptual framework is to which accounts are considered exogenous and which are endogenous. Sadoulet and de Janvry (1995) define endogenous accounts as those for which changes in the level of expenditure directly follow any changes in income, while exogenous accounts are those for which we assume that expenditures are

set independently of income. It has been customary to consider the government, the rest of the world and the savings-investment accounts as exogenous, and activities, commodities, factors and households as endogenous.[37] To illustrate how the SAM approach is helpful in deriving the changes in income distribution and expenditure patterns by socio-economic groups resulting from a change in the structure of production due to exogenous shocks, Figure 4.1 presents the relationship among the endogenous SAM accounts. These transformations incorporate the mechanisms that translate value added from production into incomes of different types of households, via ownership of factors of production.

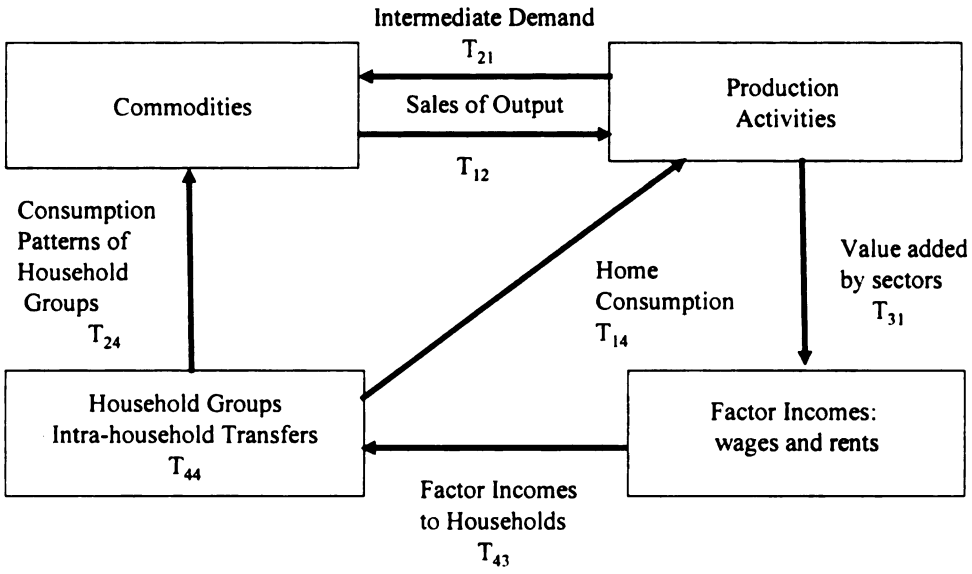
There are three key transformations to consider. First, in addition to the intermediate demand of inputs by the activities, transactions T_{21}, the level and the structure of output by different activities generate the aggregate demand for factors (labor, land, and capital), which brings employment linkages into the analysis. The stream of value added from the production side rewards the factors of production, with wages going to different types of labor, and rents going to land and capital. This is depicted in transactions T_3.

---

[37] An endogenous capital account would reflect some kind of internal flexibility of capital flows, while an endogenous rest of the world assumes that trade is relatively free between the region and outside areas.

Figure 4.1

Relationships Among Endogenous Accounts



Note: The direction of the arrows indicates payments between the accounts.
Legend (subscripts i or j): 1 = activities; 2 = commodities; 3 = factors of production; and 4 = households.
Source: Adapted from Thorbecke (1998)

Second, the transformation from factorial distribution to the distribution of income across household groups (transaction T_{43}) depends on which groups own which factors. For example, wage payment to hired labor goes to households that provide this type of labor; that can be both in agricultural or non-agricultural sectors. Likewise, rental income accrues to the owners of capital, land and other natural resources. Family labor is rewarded at shadow wages. Resource endowment, particularly land and human capital, is important at several levels. Landless households can be affected quite differently by development policy than smallholders and large farmers (Thorbecke, 1998).[38] Likewise,

[38] Although landlessness, as such, does not appear to be a serious problem in Mozambique, there is a strong positive relationship between access to land and smallholder welfare.

the better educated tend to be able to get jobs in better rewarded, more formal and organized sectors, while the less educated are limited to employment opportunities largely in traditional agriculture and manual jobs off-farm. Nevertheless, given the current level of technological development in Mozambique, even the effects of employment linkages in those low technology sectors are likely to be important, if policy is successful in generating increased rural output growth. It is worth noting that in the study region part of the hired labor force originates from Malawi, resulting in part of the labor payments leaking outside the region. The design of the SAM and the CGE model attempts to account for that.

The third transformation in Figure 4.1 (transaction T_{24}) yields the consumption patterns of the different household groups as they spend their additional incomes. It reveals the value of commodities/services purchased and consumed by those groups, providing crucial information on their living standards, and providing indications of likely induced effects and the potential to strengthen growth through consumption linkages, especially when they spend increasing shares of their incomes on locally produced goods.

Once the SAM is balanced, with all the analytically relevant disaggregation of selected endogenous accounts, it can be used to simulate the effects on the incomes of the endogenous accounts of shocks in the exogenous accounts; government, savings-investment or rest of the world. This can be done using either fixed price models (multiplier analysis) or CGE models; the latter allow for shocks in model parameters, such as tax rates, prices, sector productivities, and others. Appendix A details the SAM multiplier model.

The SAM multiplier model is limited in several ways. First, it assumes that all the endogenous sectors have unlimited capacity to supply goods and services, i.e., an infinitely elastic supply; a Keynesian demand-driven system without resource constrains (Sadoulet and de Janvry, 1995, Taylor and Adelman, 1996).[39] Second, prices are assumed fixed. This may be a reasonable assumption when the costs of trade with outside markets are low and the region is likely to be a price taker for most goods and factors. However, high costs for participation in those outside markets and imperfect substitutability between family and hired factors (e.g., labor) may results in endogenous prices for a number of regional goods and factors in Mozambique. Third, SAM multiplier models assume that production uses fixed proportions technologies (constant marginal productivity of factor inputs) and that average and marginal expenditure propensities are the same. Relaxing the assumption of linearity in production requires the use of CGE models, which we discuss in the next section.

4.3.2. The Zambezi Valley Regional Computable General Equilibrium Model

4.3.2.1. Introduction

The Zambezi Valley Regional Computable General Equilibrium model (ZVR-CGE) used in this essay is based on the IFPRI standard model of Lofgen *et al.* (2002). The standard CGE model accounts for all the payments recorded in the SAM. The calibration of the model, therefore, follows the SAM disaggregation of activities, commodities, factors and households previously described. All the relevant features introduced in the SAM to reflect the local economy and the issues at hand are mirrored in

[39] Appendix A presents an idea about some modifications to the model that allow to deal with this limitation.

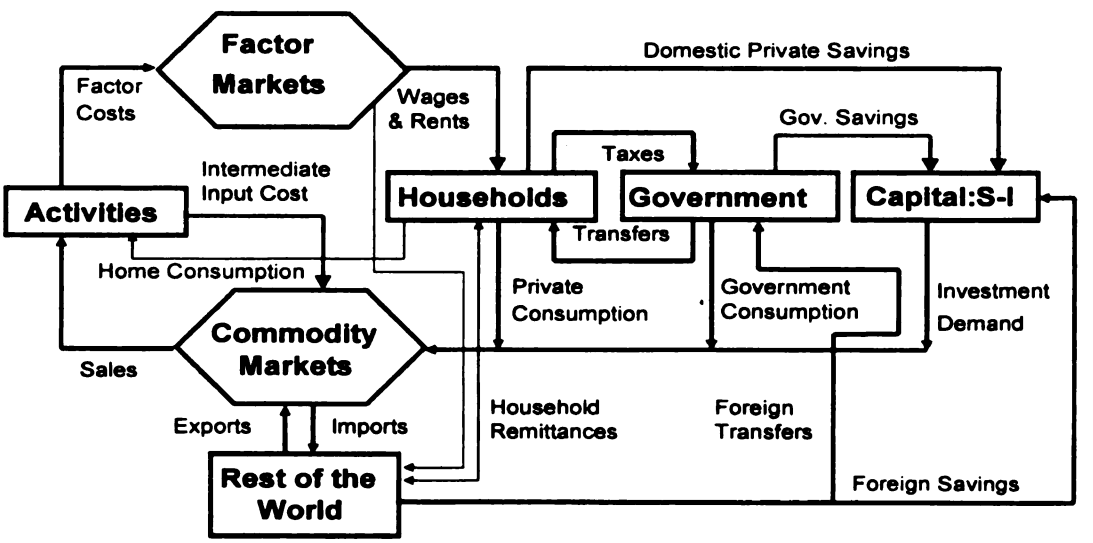
the CGE.

The model is written as a set of simultaneous equations, most of which are non-linear. First order optimality conditions capture the behavior of producers and consumers assumed to maximize profits and utility, respectively. Other equations include a set of constraints that have to be satisfied by the system as a whole, but are not necessarily considered by any individual actor. Such constraints cover markets for products and factors, and macro aggregates, i.e., savings-investment balance, government budget, and the balance of the current account of the rest of the world.

Figure 4.2 presents a stylized Structure of the model, indicating the flows between the various SAM accounts. In this section, we outline the standard model structure, and add some considerations with respect to interlinked transactions and sector expansion, and household typology and poverty analysis within the CGE framework.

Figure 4.2

Stylized Regional Model Structure



Source: Adapted from Lofgren *et al.* (2002)

The description of a CGE model structure is done by specifying the agents and their behavior, the rules that bring the different markets to equilibrium (Sadoulet and de Janvry, 1995), and closures to system constraints. For the regional ZVR-CGE, we specify (a) Activities, production and factor markets; (b) Institutions:Households, Government and the Rest of the World; (c) Commodity markets; (d) Macro closure rules for system constraints; and (e) model calibration. This section draws mostly on Lofgren *et al.*, 2002. We focus on the essential elements of the standard model and highlight features relevant for the regional model. In specifying the model structure, it is important to keep in mind the different sets and sub-sets of the SAM accounts. Considerations on choice of functional forms and tradability of commodities are sometimes differentiated across the different account sets.

4.3.2.2. Activities, Production and Factor Market Closures

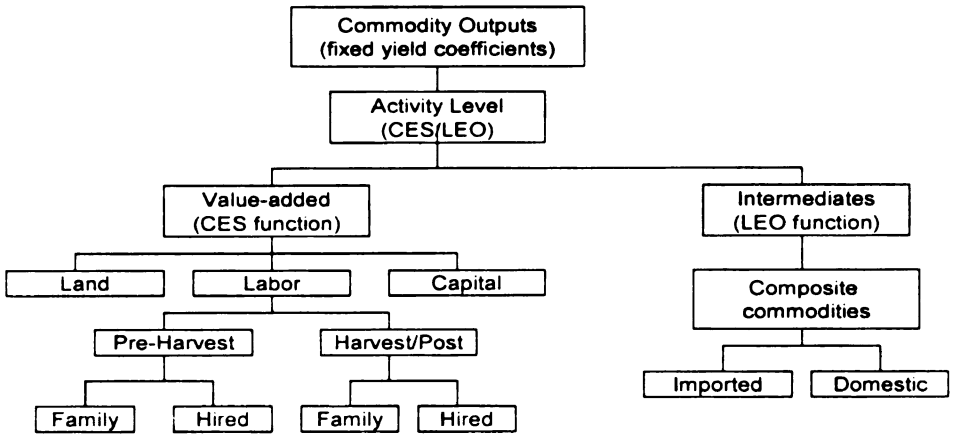
Each activity represents a producer that is assumed to maximize profits, i.e., the difference between revenues earned and the cost of intermediary inputs and payments to factors. Profits are maximized subject to a production technology that follows the structure represented in Figure 4.3. The top of the technology nest contains a Leontief (LEO) function of the quantities of aggregated factor value-added and aggregate intermediate inputs.[40] Value-added is defined as a Constant Elasticity of Substitution (CES) of primary factors, and the aggregate intermediary input is a LEO function of disaggregated intermediate inputs that can be domestically produced or imported. Figure

[40] We use the LEO alternative as the default for all activities. It should be noted, however, that a CES alternative at the top of the technology nest may be preferable for particular sectors if evidence supports the idea that available techniques allow for the variation in the aggregate mix of value-added and intermediate inputs.

4.4 illustrates the elasticity of substitution between factors and/or intermediates.

Figure 4.3

Structure of Production Technology



Note: CES – Constant Elasticity of Substitution Function LEO – Leontief Function

Source: Adapted by author from Lofgren *et al.* (2002)

Each activity produces one or more commodities according to fixed yield coefficients, e.g., a Tobacco Farming Activity produces tobacco, maize, and other food crops. Likewise a commodity may be produced by more than one activity, e.g., tobacco is produced by MLT and Dimon Tobacco Farms, and maize is produced by all agricultural activities.[41]

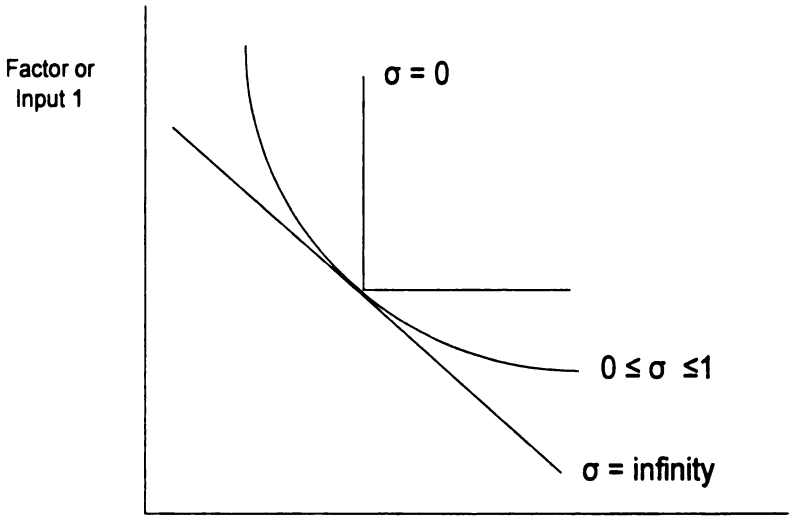
As profit maximizing agents, producers choose their levels of production and input use on the basis of prices in product and factor markets – each activity uses a set of factors up to the point where the marginal value product of each factor is equal to its

[41] Household survey data were used to compute the structure of crop production for the agricultural activities. The data also provided the information needed for household non-farm activities represented in the SAM. As explained earlier, the household groups defined in the SAM were defined on the basis of information from the survey data and the structure of activities.

wage or rent. Factor wages/rents may differ across activities when markets are segmented or even for mobile factors, when discrepancies emerge as a result of sector specific determinants.

Figure 4.4

Elasticities of Substitution



σ = 0 Leontief: no substitution
0 ≤ σ ≤1 Cobb Douglas and CES: Imperfect substitution
σ = infinity Perfect substitution

Source: Author

The Standard model offers alternative Factor Market Closures (FMC), i.e., mechanisms for equilibrating supply and demand in specific factor markets (land, labor, or capital). A description of each available factor market closure follows and is summarized in Table 4.4.

Table 4.4. Alternative Factor Market Closures

Variables		Factor Market Closures					
		Full Employment (Neoclassical) (FMOBFE)		Unemployment (FMOBUE)		Factor Market Segmentation (FACTFE)	
Variable	Description	FXD	FLX	FXD	FLX	FXD	FLX
QFS(F)	Quantity Supplied of Factor F	●			●		●
QFD (F, A)	Quantity Demanded of Factor F by Activity A		●		●	●	
WF (F)	Economy-wide wage/rent for Factor F		●	●		●	
WFDIST (F, A)	Activity-Specific Wage Distortion for Factor F	●		●			●

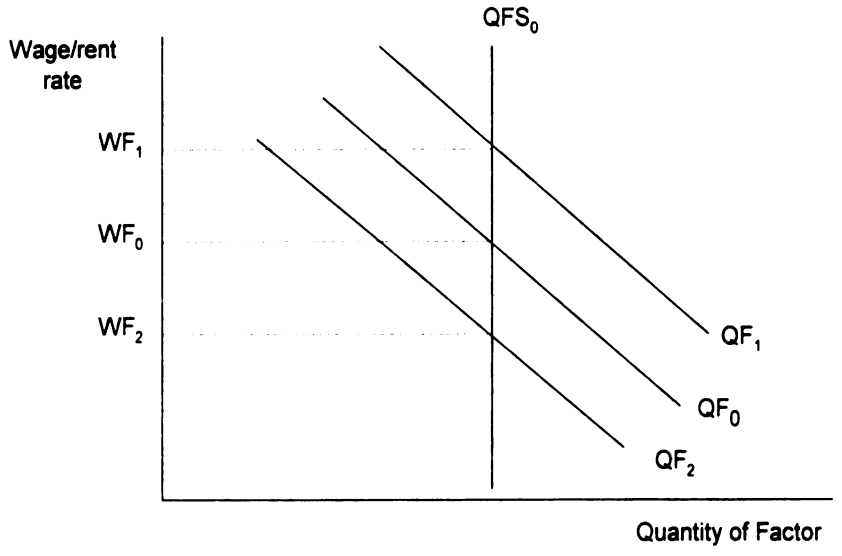
Notes: FXD – Factor is fixed; FLX – Factor is flexible; F – Factor; A – Activities. FACTFE – Factor is activity specific and fully employed; FMOBFE – Factor is mobile and fully employed; FMOBUE – Factor is mobile and unemployed.
Source: Author

The first factor closure is *the Factor is Mobile and Fully Employed (FMOBFE).* The default closure is to fix the supply of the factor at the observed base level, and allow variation in an economy-wide factor price variable; e.g., land rental rate, wage rate, or rate of return to capital.[42] This ensures that the sum of demands from all activities equals the total quantity supplied in the system (full employment). Under this closure, factors are mobile between the demanding activities. Each activity pays an activity-specific wage that is the product between the endogenously determined economy-wide wage and an exogenous activity-specific wage distortion term that is fixed in this closure. This is also called the neoclassical closure. Figure 4.5 illustrates this closure.

[42] This economy-wide factor price variable is not specific to each activity. It is an aggregate variable used to balance aggregate supply and aggregate demand of each factor. Each activity is assumed to have a price distortion factor that will influence the activity specific factor price.

Figure 4.5

Full Employment of Factors
Perfectly Inelastic Supply



QFS – Quantity of factor supply
QF – Quantity of factor demand
WF – Wage/rent (price of factor)

Source: Author

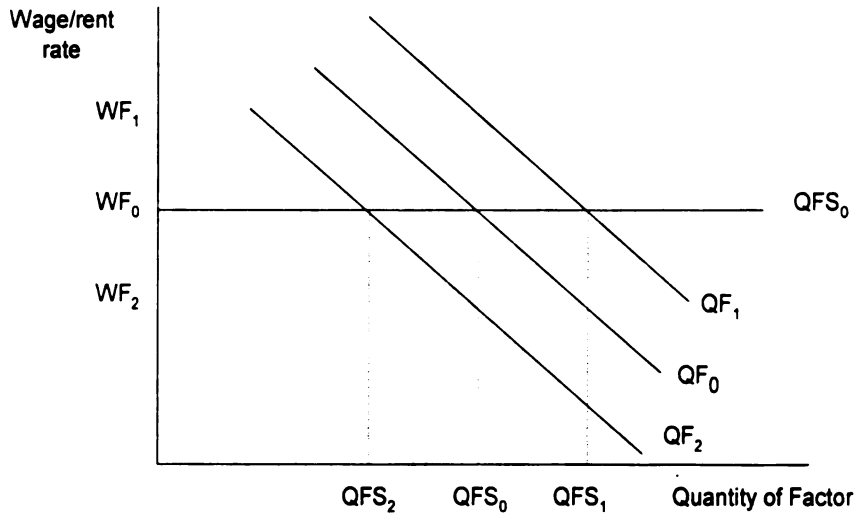
A second closure rule is *the Factor is Mobile and Unemployed (FMOBUE)*. This assumes that a factor is unemployed and the real wage/rent is fixed. In this closure, the economy-wide variable is fixed (exogenized) and the supply variable is endogenized. Each activity is free to hire any desired quantity of the factor at its fixed activity-specific wage. In essence, the supply variable merely records the total quantity demanded. This closure is graphically represented in Figure 4.6.

The Factor is Activity Specific and Fully Employed (FACTFE) is a third closure rule. Under this closure, the factor market is assumed to be segmented and each activity is forced to employ the observed base year quantity, i.e., the factor is activity specific.

More generally, it is appropriate when there are significant quality differences (or activity specificity) between units of a factor used in different activities (Lofgren *et al.*, 2002). In this closure, the quantity of activity-specific factor demands and the economy-wide wage are fixed while the activity specific wage terms and the supply variables are flexible.

Figure 4.6

Unemployment of Factors
Perfectly Elastic Supply



QFS – Quantity of factor supply
QF – Quantity of factor demand
WF – Wage/rent (price of factor)

Source: Author

4.3.2.3. Households, Government and Rest of the World

The institutional block of the standard regional CGE model describes the behavior of household groups, Government, and the Rest of the World. *Households* choose the

levels of consumption that maximize their utility on the basis of disposable income and prices. Household consumption covers marketed commodities, purchased at market prices, and home consumed commodities valued at their opportunity cost; the activity specific producer prices.[43] This feature accounts for the simultaneous decision making process of households as producers and consumers of certain commodities. That and the use of activity specific producer prices for home commodities and market prices for purchased commodities implicitly addresses the non-recursive nature of the household decision making process in this model. Household consumption behavior of market and home commodities is modeled according to Linear Expenditure System (LES) demand functions, derived from maximization of a Stone-Geary utility function subject to a consumption expenditure constraint.[44]

$$\text{Max U} = \sum_{c=1}^{n} \beta_c \ln\left(q_c - q_c^0\right) \tag{4.1}$$

$$\text{Subject to } \sum_{c=1}^{n} p_c q_c^0 + \sum_{c=1}^{n} p_c\left(q_c - q_c^0\right) = E$$

$$\text{With } \quad q_c \geq q_c^0$$

$$0 < \beta_c < 1$$

$$\sum_{c=1}^{n} \beta_c = 1$$

Where, q_c is the quantity of consumption of commodity c, q_c^0 is the subsistence or

[43] The standard SAM only disaggregates home consumption by activity and household, not by commodity, activity, and household. In the regional SAM households consume from activities that produce multiple outputs. To accommodate that, non-SAM data are needed to allocate home consumption across the commodities produced by each relevant multiple-output activity. Shares of home consumption of household farm outputs are derived from survey data for each agricultural, fishing and livestock activity.

[44] This utility function is a generalization of the Cobb-Douglas function and incorporates the idea that certain minimum amounts of each good must be bought.

minimal amount of the consumption of commodity c that must be bought by the household, β_c is the marginal share of consumption of commodity c, p_c is the price of commodity c, and E is the total household consumption expenditure.

The first-order condition results in a Linear Expenditure System (LES) which can be written as:

$$p_c q_c = p_c q_c^0 + \beta_c \left(E - \sum_{c=1}^{n} p_c q_c^0 \right) \tag{4.2}$$

This system can be interpreted as stating that expenditure on good c, given as $p_c q_c$, can be decomposed in two components. The first is the expenditure on a "base amount" q_c^0 of good c which is the minimum expenditure for which the consumer is committed. The second is a fraction β_c of the *supernumerary income*, defined as the income above the "subsistence income", $\sum_{c=1}^{n} p_c q_c^0$, needed to purchase base amount of all goods (Intriligator *at al.*, 1996). These two components correspond, respectively, to committed and discretionary expenditure on commodity c.

Since household consumption for the various groups in the SAM (h) is for two types of commodities, from the market and from home production, we have a two-component LES system, each with a structure similar to equation (4.2):

Consumption of marketed commodities

$$p_c^m q_{ch}^m = p_c^m q_{ch}^{0m} + \beta_{ch}^m \left(E_h - \sum_{c' \in C} p_{c'}^m q_{c'h}^{0m} - \sum_{a \in A} \sum_{c' \in C} p_{ac'}^{0h} q_{ac'h}^{0h} \right) \tag{4.3}$$

Consumption of home production

$$p_{ac}^{h} q_{ach}^{h} = p_{ac}^{h} q_{ach}^{0h} + \beta_{ach}^{h} \left(E_h - \sum_{c' \in C} p_{c'}^{m} q_{c'h}^{0m} - \sum_{a \in A} \sum_{c' \in C} p_{ac'}^{0h} q_{ac'h}^{0h} \right) \tag{4.4}$$

where,

E_h household consumption expenditures

q_{ch}^{m} quantity of consumption of marketed commodity c for household h

q_{ach}^{h} quantity of home consumption of commodity c from activity a for household h

p_c^m market price of commodity c

p_{ac}^h producer price of commodity c for activity a

β_{ch}^{m} subsistence consumption of marketed commodity c for household h

q_{ach}^{0h} subsistence consumption of home commodity c from activity a for household h

β_{ch}^{m} marginal share of consumption spending on market commodity c for household h

β_{ach}^{h} marginal share of consumption spending on home commodity c from activity a for household type h

Demand functions are derived by dividing both sides of each equation by the relevant price.

Government collects taxes and receives transfers from other institutions. The standard model includes variables that account for direct taxes from institutions and factors, value added and activities, import tariffs, export taxes, sales taxes, government factor incomes, and transfers from the RoW. In our regional SAM, representing a base situation and reflecting conditions on the ground, the regional government does not collect taxes on activities or domestic and foreign trade. We only account for the

collection of IRN (Imposto de Reconstrução Nacional) on a per head basis in rural communities, and substantial financing from the central Government and other institutions in the Rest of the World.[45] The government uses that income to buy goods and services (e.g., health and education) and transfer to other institutions (pensions to households). Government consumption is fixed in real terms and transfers are CPI-indexed. Government savings (surplus/deficit) is a flexible residual in the model; more details in Section 4.3.2.5 on macro closures.

The *Rest of the World* records transactions between domestic actors and the rest of the world, including imports, exports, and transfers. Commodity trade with the rest of the world is discussed in Section 4.3.2.4. Transfer payments between the rest of the world and domestic institutions and factors are fixed in foreign currency. Foreign savings, i.e., the current account deficit, is the difference between foreign currency spending and receipts.

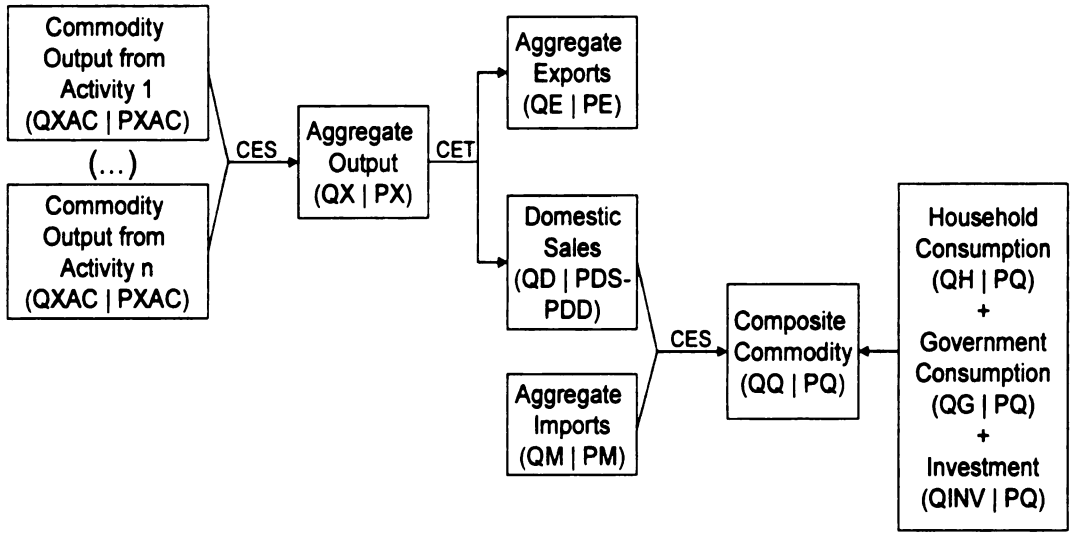
4.3.2.4. Commodity Markets

All commodities, except home consumed output, enter markets. Figure 4.7 shows the physical flow for marketed commodities with the indication of quantity and price variables relevant in each case.

[45] In the policy simulations, however, the model allows us to introduce alternative fiscal and quantitative trade policy measures.

Figure 4.7

Flows and Specification of Aggregation of Marketed Commodities



Note: CES – Constant Elasticity of Substitution CET – Constant Elasticity of Transformation
Source: Lofgren *et al.* (2002)

For marketed output, the first stage is the aggregation of each commodity produced by different activities. As a result of differences in timing, location and quality between different activities, these outputs are imperfectly substitutable. Therefore, commodity aggregation is done using a Constant Elasticity of Substitution (CES) function.

$$QX_c = \alpha_c^{ac}\left(\sum_{a\in A}\delta_{ac}^{ac} QXAC_{ac}^{-\rho_c^{ac}}\right)^{-\frac{1}{\rho_c^{ac}-1}} \qquad c \in CX \qquad (4.5)$$

where

CX set of domestically produced commodities

QX_c aggregate market production of commodity c

$QXAC_{ac}$ market output quantity of commodity c from activity a

α_c^{ac} shift parameter for domestic commodity aggregation function

δ_{ac}^{ac} share parameter for domestic commodity aggregation function

ρ_c^{ac} domestic commodity function exponent

Activity specific output is derived from the problem of minimizing the cost of supplying a given quantity of aggregated output subject to equation (4.5). As shown in equation (4.6), the optimal quantity of the commodity from each activity source (QXAC) is found at the point where marginal cost of the commodity from that activity equals its marginal revenue product. The activity specific quantity is inversely related to the activity-specific price (PXAC).

$$PXAC_{ac} = PX_c QX_c \left(\sum_{a \in A} \delta_{ac}^{ac} QXAC_{ac}^{-\rho_c^{ac}} \right)^{-1} \delta_{ac}^{ac} QXAC_{ac}^{-\rho_c^{ac}-1} \quad a \in A,\ c \in CX \quad (4.6)$$

where,

$PXAC_{ac}$ producer price of commodity c for activity a

PX_c aggregate producer price for commodity c

The choice between commodities from different activities is cast as an optimization problem. Equation (4.6) is the first-order condition determining profit maximization from selling the aggregate output, QX_c, at the price, PX_c, subject to the aggregation function and disaggregated, activity specific, commodity prices. For commodities with a single producer, the value of the share parameter δ_{ac}^{ac} is unity and as a result $QXAC_{ac} = QX_c$ and $PXAC_{ac} = PX_c$.

This aggregated domestic output (QX) is then, in the second stage, allocated to

exports (QE) and domestic sales (QD). It is assumed that suppliers seek to maximize sales revenue for any given aggregate output level, subject to imperfect transformability between exports and domestic sales expressed by a Constant-Elasticity-of-Transformation (CET) function.[46] For all commodities with output, we have

$$PX_c QX_c = PDS_c QD_c + PE_c QE_c \qquad c \in CX \qquad (4.7)$$

For commodities with both domestic sales (set CD) and exports (set CE),[47] such as maize, groundnuts, potatoes, goats, etc, the CET function is given by

$$QX_c = \alpha_c^t \left(\delta_c^t QE_c^{\rho_c^t} + \left(1 - \delta_c^t\right) QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}} \qquad c \in (CE \cap CD) \qquad (4.8)$$

First-order conditions for maximization of producer revenues given the two prices (PDS and PE) subject to the CET function and fixed quantity of domestic output QX, indicates that the optimal mix between exports and domestic sales is defined by the Export-Domestic Supply Ratio

$$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c} \cdot \frac{1 - \delta_c^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t - 1}} \qquad c \in (CE \cap CD) \qquad (4.9)$$

Equation 4.9 indicates that an increase in the export-domestic price ratio generates an increase in the export-domestic supply ratio, i.e., a shift towards the destination that offers the higher return.

For domestically sold output without exports and for exports without domestic sales, the output transformation is given by

[46] Following the small country assumption, export demands are infinitely elastic at given world prices. The supply price for domestic sales is equal to the price paid by domestic demanders.
[47] The set of domestic commodities without domestic sales is referred to as CDN, and the set on non exported commodities as CEN.

$$QX_c = QD_c + QE_c \qquad c \in (CD \cap CEN) \cup (CE \cap CDN) \qquad (4.10)$$

This equation allocates the entire output volume to one of these two destinations. In the Zambezi Valley Regional Model there are a number of commodities that are exclusively sold in the domestic market. For instance, all the raw tobacco and cotton produced by farming households is sold domestically to Trading-Exporting Contract Farming Firms that add value and export it packed to the rest of the world. The two commodities are clearly differentiated. While the raw tobacco and cotton is all sold domestically, the packed tobacco and cotton is all exported: there is no transformability between domestic consumption and exports for these commodities. See Table 4.5, for commodity tradability position in the Zambezi Valley economy.

Domestic sales (QD) and aggregate imports (QM) make up the composite supply in domestic markets (QQ). Absorption, i.e., the total domestic spending on domestic output and imports at domestic demander prices (net of sales tax, but inclusive of cost of trading inputs), is defined as

$$PQ_cQQ_c = PDD_cQD_c + PM_cQM_c \qquad c \in (CD \cup CM) \qquad (4.11)$$

In the standard model, the demand for these commodities is derived under the assumption that domestic demanders minimize costs subject to imperfect substitutability, captured by a CES aggregation function, also referred to as the Armington Function.

$$QQ_c = \alpha_c^q \left(\delta_c^q QM^{-\rho_c^q} + (1 - \delta_c^q) QD_c^{-\rho_c^q} \right)^{-\frac{1}{\rho_c^q}} \qquad c \in (CD \cap CM) \qquad (4.12)$$

Table 4.5. Tradability of SAM Commodities in the Zambezi Valley

Commodities Set (c)	Exported Commodities			Commodities Set (c) (continuation)	Imported Commodities		
	Domestic Sales Set (CD) $c \in CD$	Imports Set (CM) $c \in CM$	Exports Set (CE) $c \in CE$		Domestic Sales Set (CD) $c \in CD$	Imports Set (CM) $c \in CM$	Exports Set (CE) $c \in CE$
Raw cotton	•			Sugar/salt		•	
Packed cotton			•	Tea/Coffee		•	
Raw tobacco	•			Ready to eat foods	•		
Packed tobacco			•	Alcoholic beverages	•		•
Maize grain	•		•	Education/Health	•		
Rice	•	•		Trading services	•		
Maize meal	•			Housing and utilities	•		
Bread/Flours	•			Seeds		•	
Beans	•	•		Pesticides/Fertilizers		•	
Groundnuts/Roots	•		•	Other agro-inputs		•	
Vegetables	•		•	Firewood and charcoal	•		
Fruits	•	•		Fuel		•	
Coconuts		•		Wood/grass/cane	•		
Meat – cow	•	•		Textile/footwear	•	•	
Meat – goat	•		•	Metal/blacksmithing	•	•	
Meat – pork	•			Kitchen utensils	•		
Meat – birds	•		•	Soap and hygiene		•	
Fish/Milk/Eggs	•			Imported drink/tobacco		•	
Cooking oil		•		Other commodities	•		•

Source: Zambezi Valley Regional SAM

The domain of the CES function is limited to commodities that are both imported and domestically produced. The optimal mix between imports and domestic output is defined by

$$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1-\delta_c^q} \right)^{\frac{1}{1+\rho_c^q}} \qquad c \in (CD \cap CM) \qquad (4.13)$$

Equations 4.11 through 4.13 define the first-order conditions for cost minimization given the two prices (PDD and PM) and subject to the Armington function and a fixed quantity of the composite commodity (QQ). Equation 4.13 ensures that an increase in the domestic-import price ratio causes an increase in the import-domestic demand ratio, i.e., a shift away from the relatively more expensive source.

The composite commodity (QQ) is demanded in the domestic market in the form of Household consumption (QH); Government Consumption (QG); Investment (QINV); Intermediary input use (QINT); and demand for transaction inputs (QT):

$$QQ_c = \sum_{a \in A} QINT_{ca} + \sum_{h \in H} QH_{ch} + QG_c + QINV_c + QT_c \qquad c \in C \qquad (4.14)$$

4.3.2.5. Macro System Closures

The model allows for alternative closure rules for three macro balances: the current government account (GOV-B), the savings-investment balance (SI-B), and the current account of the balance of payments that includes the trade balance with the rest of the world (ROW-B). Table 4.6 presents the alternative closure rules for each of the macro balances and indicates default and alternatives chosen for the regional economy model.

The default closures in the regional model are chosen to best resemble the circumstances in the regional economy. The closure for the Government balance assumes

that all taxes, and the real government consumption are fixed and the Government savings (the difference between its current revenues and expenditures) is a flexible (endogenous) residual. Although it is an available option, given the limited role and discretion of the local Government in this model, we do not consider alternative closures where tax rates and government real consumption are endogenously determined.

For the external balance, the standard model applied to national economies normally assumes fixed foreign savings with flexible exchange rate. This particular closure implies that, if, *ceteris paribus*, foreign savings are below the exogenous level, a depreciation of the real exchange rate would correct the imbalance by reducing spending on imports and increasing earnings from exports. In sub-national models, the treatment given to the ROW-B depends on the structure of "foreign" trade and flows. For regional economies that trade exclusively with the rest of the country (domestic RoW), the exchange rate is assumed fixed at the one-to-one rate (fixed real exchange rate indexed to the model numeraire) and foreign savings (and the trade balance) are allowed to vary. In our model, however, given the evidence of massive trade between the region and the foreign RoW added to the massive use of foreign currency in those transactions, it is reasonable to account for a flexible exchange rate regime closure rule.[48] We will, therefore, use the default of a flexible exchange rate and fixed foreign savings, but also test the alternative of fixed exchange rate and flexible foreign savings.

[48] Given the extremely poor road and communications infra-structure in the region, most of the imports into the region are originated from Malawi. For the same reason, many of the identified exports, including maize, potatoes, tobacco, and others are directed into Malawi, and a great deal of imports are originated from that country. Factor payments to the rest of the world are also predominantly to Malawian migrant labor.

Table 4.6. Macro System Closures in the ZVR-CGE Model

Macro Balances and Available Closures		Default and Alternative Closures in the Regional Model	
Macro Balances	Definition of Available Closures	Default Closure	Alternative Closures
Government Balance (GOV-B)	GOV savings are flexible, direct tax rates are fixed	●	
	GOV savings are fixed, uniform direct tax rate point change for selected institutions		●
	GOV savings are fixed, scaled direct tax rate for selected institutions		●
Savings-Investment Balance (SI-B)	Investment Driven Savings (Savings adjust to given level of Investment) - Uniform mps rate point change for selected institutions		●
	Investment Driven Savings (Savings adjust to given level of Investment) - Scaled mps for selected institutions		●
	Savings Driven Investment (Investment level defined as a function of existing savings in the economy)	●	
	Investment is fixed absorption share – uniform mps rate point change		●
	Investment is fixed absorption - scaled mps		●
Rest of the World Balance (ROW-B)	Flexible Exchange Rate and Fixed Foreign Savings	●	
	Fixed Exchange Rate and Flexible Foreign Savings		●[1/]

[1/] Alternative macro closures tested in our experiments.
Source: Author

For the savings-investment balance, closures can be either investment driven (the value of savings adjusts to pre-defined investment levels) or savings driven (the value of investment simply adjusts to existing savings). We assume a savings driven closure, under which investment is determined from available savings from households and the local government. This implies that investment is endogenous and self-financed by the region. This is a reasonable assumption, given the missing and incomplete credit markets in rural Mozambique (Benfica, 2003). The alternative closure (investment driven savings) implicitly assumes that the government is capable of implementing policies that generate

the necessary private savings to finance fixed real investment levels. Given the limited Government modeling sophistication in the model, and under the current circumstances in the regional economy, this is not a realistic closure.

4.3.2.6. Model Benchmark Calibration

The benchmark of a CGE model is a solution of the model that replicates the observed economic data for the base year compiled in the SAM. The SAM records in its entries nominal values of transactions in the base year. The first step is to choose measurement units for all factors so that all factor prices are initially equal to one. Likewise, one chooses measurement units for the domestic commodities, imports and exports so that the prices of domestic goods and imports, the world price of exports and the exchange rate are all set equal to one in the base year. This normalization allows all initial quantities and prices to be computed, and parameters, including those for the production and utility functions that are directly computed from the shares to be derived (Sadoulet and de Janvry, 1995). The shares matrix provides the starting point for estimating parameters of non-linear, neoclassical production functions, factor demand functions and household expenditure systems in the CGE model. Results in Section 4.4 present a great deal of outputs that illustrate base year factor, intermediary inputs, and market and household expenditure shares derived from the SAM.

In addition to the shares provided by the SAM, the calibration of the CGE model requires that one defines three sets of elasticities: Production, Trade, and consumption. Table 4.7 lists and defines the different elasticities within each set.

Table 4.7. Elasticity Sets and Definitions

Elasticity Sets	Elasticities	Definition
Production	Output Aggregation	Output aggregation elasticity for commodity c
	Factor-Factor Substitution	Elasticity of substitution between factors
	Factor-Intermediate Substitution	Elasticity of substitution between aggregate factor and intermediate
Trade	Armington Elasticity	Elasticity of substitution between imports and domestic output in domestic demand
	Constant Elasticity of Transformation (CET) Elasticity	Elasticity of transformation between exports and domestic supplies in domestic marketed output
Household Consumption	Frisch parameter for household LES demand	Elasticity of the marginal utility of income with respect to income
	Expenditure Elasticity – Market Demand	Expenditure elasticity of market demand for commodity c by household h
	Expenditure Elasticity – Home Demand	Expenditure elasticity of home demand from activity a for commodity c by household h
	Commodity Value Share of Home Consumption	Value share for commodity c in home consumption of household h from activity a

Source: Author

The actual elasticity parameters used in the model were obtained thorough derivations from survey data and from the country data available from the GTAP (Global Trade Analysis Project) database.

The CGE model is homogeneous in all prices. A numeraire is chosen by fixing an aggregate price equal to one. The weights of such aggregate price can be the initial values of production in each sector. Commodity prices, wages and exchange rates are, therefore interpreted in real terms.

4.3.3. Interlinked Transactions and Expansion Paths

All raw cotton and tobacco production generated by smallholder growers in the Zambezi Valley Region originates from contract farming arrangements organized by four agro-industrial firms. As described in Chapter Three, those firms are assigned to specific geographical concession areas, where they provide inputs and extension assistance to

small farmers on credit, and are granted monopsony rights that entitle them for the purchase of all the output at predetermined prices. Given the failure in both input and output markets, the interlinked arrangements imply that firms have a monopoly in input markets and a monopsony in product markets. Given the lack of a wide range of alternative sources of cash income, this type of arrangement is extremely important for rural households in the region.

In the process of expanding their contract farming operations, firms - that have limited resources – will choose between alternative paths to do so. Essentially, they have the option to support (i) relatively less farmers each receiving substantial level of support (larger loans) and, therefore, planting larger areas with the crop; or (ii) a relatively lager number of farmers each receiving smaller loans and, therefore, planting relatively smaller areas with the crop.[49] While this is an important issue, the choices faced to decide which path is more appropriate depend on many factors that fall outside the scope of this study.

In this essay, we will assume that the contract farming operations represented in the region expand the size of their operations with the same factorial structure represented in the base scenario. As described later in this essay, expansion is combined with series of other shocks. We are ultimately interested in assessing the income and poverty effects of those shocks on the different household groups.

[49]Looking at the lenders' point of view, Gangopandhyay and Sengupta (1987) prove that a capital constrained lender interested in maintaining the level of benefits of a previously less constrained environment will sign a smaller number of contracts with loans equal to or larger than the ones provided under a less constrained situation. It can be argued, however, that given the concavity of the farmers' production functions, it may be better for the lender to sign a greater number of contracts with smaller loans provided to each farmer. This depends, obviously on the stage of production where farmers are operating.

4.3.4. Representative Households and Poverty Analysis in a CGE Framework

4.3.4.1. Introduction

In this Section, we discuss a framework for the analysis of the impact of economic shocks on poverty of household groups in a computable general equilibrium framework. The CGE model described in Section 4.3.2 incorporates information on how representative household groups earn and spend their incomes. That sort of information, including the rules governing factor markets, and household heterogeneity with respect to factor endowments, demographic composition, consumption patterns and market access, is important to assess the impact of exogenous shocks. Lofgren *et al.* (2003) point out three features necessary for such a framework. First, it must include shocks that are of interest regarding their potential differential impact on household groups. Second, it should be able to capture the impact of shocks on the extended functional distribution of incomes; the distribution of incomes across disaggregated factors that remunerate the household groups on the basis of ownership. Finally, it must map from this extended distribution across factors to household incomes with enough detail to generate information about the size distribution needed to capture poverty and inequality measures.

Approaches to undertake poverty analysis in a general equilibrium framework can be aggregated into two major categories: Micro-Simulation (MS) and Representative Household (RH) approaches. Each category has many variants.[50] The essence of the MS approach is to model the behavior of the individual agents, households and/or firms,

[50] It should be noted that no single approach dominates and the choice is predominantly dependent upon informational demands and operational constraints that vary across applications.

using a micro database linked to the standard CGE model through an integrated CGE/Micro-simulation model or, in a sequential fashion, with the CGE model feeding the micro-simulation model with price, income and employment data. Under the RH approach, a separate module generates, for each simulation, results for individual household income/expenditure by drawing on (1) a distribution function with known parameters and known representative household incomes; or (2) individual survey observations scaled using simulated changes in representative household income from the CGE model post-simulation results. Then, the results are used to perform standard poverty and inequality analysis. Such analysis may include, but is not limited to, poverty measures such as the F-G-T P_α class of indicators (poverty headcount, depth, and severity of poverty) and stochastic dominance analysis, and various inequality measures. In this study, given the nature of the available data and the implied operational feasibility, we choose to use the RH approach. We now detail this approach and the essential rationale and definitions for the stochastic dominance analysis used in this study.

4.3.4.2. The Representative Household Approach

The CGE models have a flexible number of representative households (RHs). Our ZVR-CGE model divides the households in two groups in each area, based on their diversification into cash cropping under contract. The RH approach assumes that, following an external shock in the economy, the intra-group distributions shift proportionally with the change in mean income. This means that the variance of each distribution is considered fixed, and exogenous to the model; if a shock increases mean income by δ, the income of each household within a group is raised by δ.

Previous literature reports cases of significant changes in intra-group distributions

in Asia in the mid-1980s (Huppie and Ravallion, 1991) and following the financial crisis of the 1990s. However, more recent evidence suggests that inequality increases as often as it falls during spells of growth in developing countries, and that neutrality is a defensible first-order approximation (Ravallion and Chen, 1997; Decaluwé *et al.*, 1999).[51] In the absence of compelling evidence in either direction in Mozambique, we adopt this neutrality assumption in our analysis. Dervis, de Melo and Robinson (1982), stress that the complete endogenization of intra-group distributions following shocks remains one of the biggest modeling challenges in studying income distribution in a general equilibrium context.

The procedure allows us to undertake a comparative analysis of the poverty income situation pre- and post-simulation. Such analysis can be done using (1) the Foster, Greer and Thorbecke (F-G-T) P_α class of decomposable poverty measures that allow the measurement of the proportion of the poor in the population (poverty incidence or head count ratio) and the depth and severity of poverty (poverty gap and squared poverty gap); or (2) the graphical comparative illustration on pre- and post-simulation cumulative distribution functions (CDFs) of income. Following Deaton (1997), we choose the second approach.[52]

[51] In a cross-country setting, Gugerty and Timmer (1999) found that whether inequality raises or falls depends on the initial distribution of assets; the broader the initial distribution of assets the more pro-poor are the effects of growth.

[52] In a CDF, the vertical axis goes from 0 to 100 and the horizontal axis shows our income measure. Suppose that we have a sample of 100 households (or people) ordered from poorest to richest. The CDF is just the graph of the observation number (which corresponds to percentile in this case) and the income measure. Under that approach, if a shock leads the entire CDF to shift to the right then the new economic environment stochastically dominates the base.

4.3.4.3. The Stochastic Dominance Approach to Poverty Analysis

Computations from our household survey allow us to rank the various household groups by mean income. However, it is important to test whether the ranking is robust to the choice of the poverty line.[53] This leads to a special type of robustness test, referred to as stochastic dominance, which deals with the sensitivity of the ranking of income levels between groups to the use of different poverty lines. The simplest way to do this - for the robustness of poverty comparisons based on the headcount index of poverty - is to plot the cumulative distribution of income for different household groups. One can then see whether the curves intersect. If they do not intersect, then the group with the highest curve is poorer than the other group. If they do intersect, then for all poverty lines below intersection, one group is poorer and for all poverty lines above the intersection, the other group is poorer.

Formally, instead of worrying about the proportion of the population with income below y, we consider y as being continuously distributed in the population with a Cumulative Distribution Function (CDF), $H(y)$. Let's consider that there are two household groups, with distributions $H_1(y)$ and $H_2(y)$, and we want to investigate whether we can determine that one group is poorer than the other. We consider that distribution $H_1(y)$ first-order stochastically dominates distribution $H_2(y)$ if and only if, for all monotonic non-decreasing functions $\varphi(y)$

$$\int_{y_0}^{y_n} \varphi(y) dH_1(y) \geq \int_{y_0}^{y_n} \varphi(y) dH_2(y) \qquad (4.15)$$

[53] Note that, while we are not computing measures requesting a specific poverty line, the validation of the approach still depends on the existence of a relevant range of poverty lines.

where the integral is taken over all relevant levels of income. Considering that $\varphi(y)$ is a valuation function and that monotonicity implies that more is better, distribution 1 can be labeled as better as it has more y, and it stochastically dominates distribution 2. An alternative equivalent way of putting condition (4.15) is that, for all y,

$$H_2(y) \geq H_1(y) \tag{4.16}$$

so that the CDF of distribution 2 is always at least as large as that of distribution 1. Graphically, it is always to the left of distribution 1 that is, therefore, ranked behind.

In discussing poverty, we need to follow a more restricted form of stochastic dominance in which inequality (4.16) holds only over a limited range $z_0 \leq y \leq z_1$, where the z are alternative poverty lines. If we have two distributions H_1 and H_2, representing two different household groups in a region, and we wish to find out which one shows more poverty and the extent to which the comparison depends on the choice of poverty line z, then if, for all poverty lines z

$$H_2(z) > H_1(z) \tag{4.17}$$

the poverty incidence will always be higher for the distribution H_2 when compared to distribution H_1. To test the robustness of the result, we need to graph the distributions we want to compare, and, if one lies above the other over the range of relevant poverty lines, the choice of poverty line within that range will have no effect on the outcome (Deaton, 1997).[54]

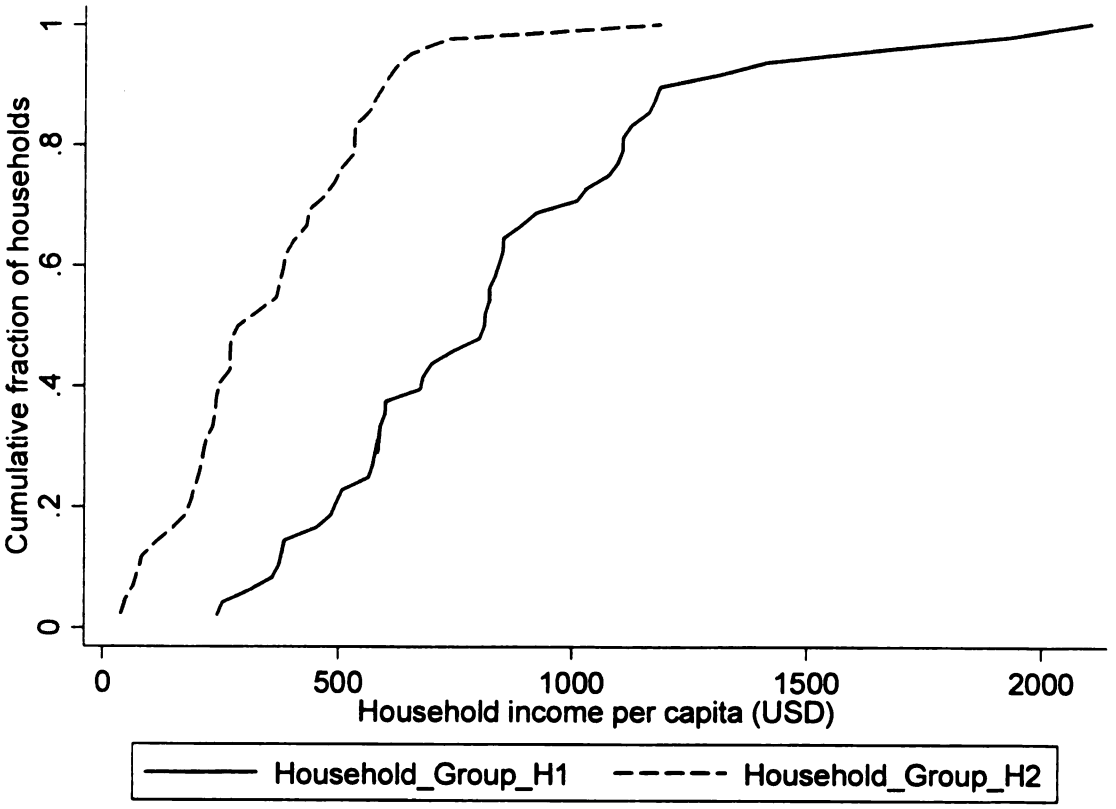
Figures 4.8 and 4.9, show hypothetical cumulative distribution functions for two household groups, H_1 and H_2, in two different regions. In Region 1 (Figure 4.8),

[54] The poverty rankings of the distributions will be robust to all choices of the poverty line if and only if one distribution first-order stochastically dominates the other.

distribution H_2 lies everywhere above distribution H_1. In that case, we can conclude that the poverty headcount will be higher in H_2 than in H_1, regardless of where we draw the poverty line z. In contrast, in Region 2 (Figure 4.9), the distribution functions cross, at z*, so we can only make such statements for ranges of poverty lines. In this case, poverty will be higher in H_1 for poverty lines less than z* and higher in H_2 for poverty lines greater than z*, where z* represents a poverty line of close to $500 per capita.

Figure 4.8

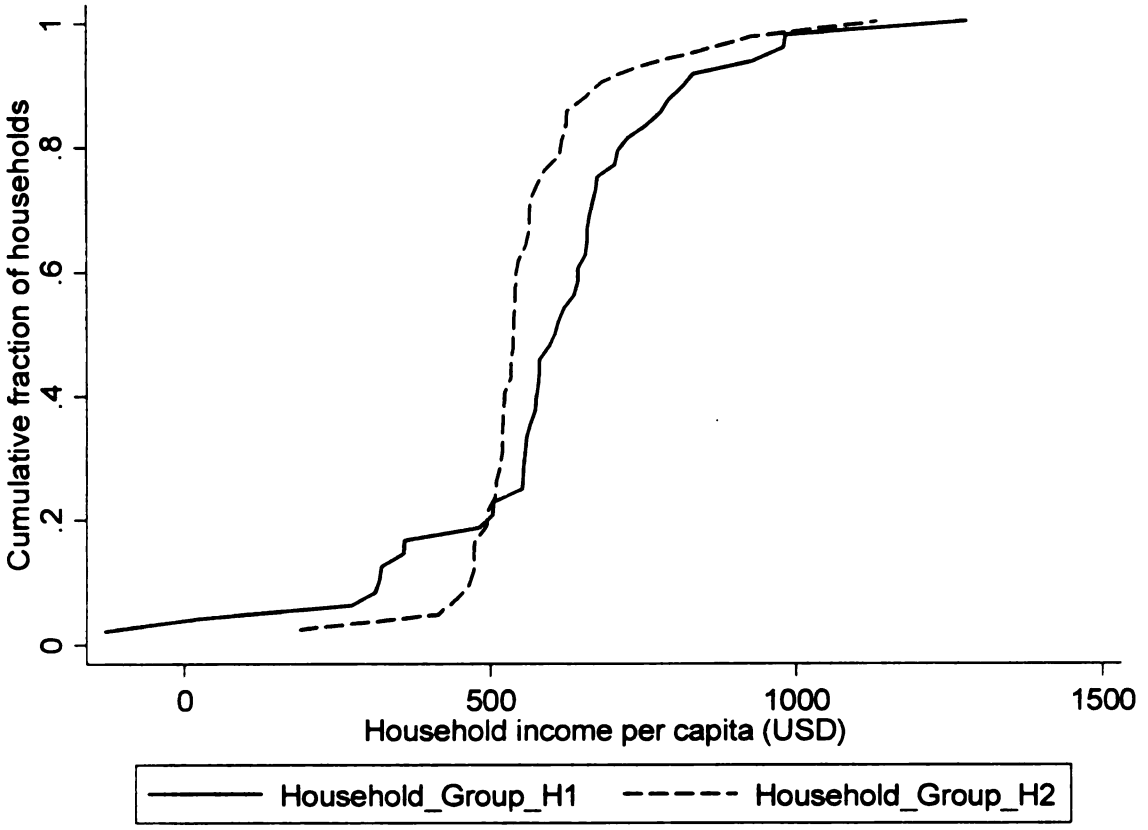
Distribution Functions of Income per capita, by Household Group
Illustrative Example - Region 1



Source: Author's hypothetical distributions

Figure 4.9

Distribution Functions of Income per capita, by Household Group
Illustrative Example Region 2



Source: Author's hypothetical distributions

This approach allows for the visual comparison of the impact of alternative simulations relative to the base. It also allows us to depict how income differentiation changes among household groups following shocks to the economy, by looking at pairs of CDFs (e.g., for different household groups) at the base relative to post shock scenarios.

In Section 4.4, we use survey data to illustrate a profile of poverty and inequality for the base year, along with other SAM based statistics. In Section 4.5 we undertake, with the use of stochastic dominance techniques, an analysis following a number of

economic shocks that result in changes in the income of RHs in the CGE model that are then used to scale household income in the survey database through the RH approach. Since we assume inequality neutrality in comparing pre- and post shock scenarios, no comparative inequality analysis is performed. The CGE model simulations are implemented using GAMS and the Poverty analysis using the DAD (Distributive Analysis/Analyse Distributive) Software.

4.4. Representative Characteristics of the Regional Economy

4.4.1. Introduction

This section provides a snapshot of the Zambezi Valley Regional Economy. It combines data from the household survey and the regional SAM to derive descriptive measures of the regional economy in the base year, including demographic and economic structure; structure of production, use of factors and intermediary inputs; remuneration of factor incomes to institutions and structure of household income and expenditure patterns; structure of domestic supply and demand, and foreign trade; and a poverty and inequality profile of rural households in the study area. The descriptive statistics in this section is intended to set the stage for a better understanding of the impacts of policies and exogenous shocks presented in Section 4.5.

4.4.2. Demographics and Economic Structure

The total population in the area is estimated at about 980,000 people, i.e., approximately 170,000 rural households. Out of those, 27,000 are cotton growing households, representing 159,000 people, 46,000 are tobacco growing households, representing 277,000 people, 66,000 are non-cotton growing households in cotton areas

and 31,000 are non-tobacco growing households in tobacco areas, representing 370,000 and 174,000 people, respectively.

Table 4.8 indicates that tobacco growers represent approximately 60% of the population in tobacco concession districts, but only about 28% of the total Zambezi Valley population. The incidence of cotton growers, within the concession districts and across the region, is much lower at 29% and 16%, respectively.

Table 4.8. Population Data for the Zambezi Valley Region

Population Groups	Number of People	Number of Households	Share in Area Population (%)	Share in Total Population (%)
Cotton Growing Areas	528,317	92,900	100.0	53.9
Non-Growers	369,523	65,986	71.0	37.7
Growers	158,794	26,914	29.0	16.2
Tobacco Growing Areas	451,069	77,248	100.0	46.1
Non-Growers	173,871	31,048	40.2	17.8
Growers	277,198	46,200	59.8	28.3
Total	979,386	170,148	-	100.0

Source: Computed from the ZV SAM-2003/4 and Survey data.

An analysis of the structure of the regional GDP shows that total absorption (private and government consumption plus domestic investment) represents approximately 94% of GDP, with private consumption being by far the most important component (Table 4.9). As previously mentioned, the role of the regional Government is limited which is reflected here in a negligible share of Government in GDP. The Zambezi Valley economy is relatively open, with the sum of imports and exports representing 40% of GDP. Given its relative self-reliance in food production and its orientation toward cash cropping exports, the trade surplus of 6.4% of GDP is not surprising. Potential exists for further increase in that surplus.

Table 4.9. Structure of the Regional GDP

Structure of Regional GDP	Value ($US)	Share (%)
Total Absorption	194,891,546	93.6
Private Consumption	180,316,323	86.6
Investment	11,868,395	5.7
Government Consumption	2,706,827	1.3
Trade Balance	13,325,918	6.4
Exports	48,306,452	23.2
Imports	(34,980,534)	(16.8)
Gross Domestic Product	208,217,464	100.0
Total Population (persons)	979,386	
GDP *per capita*	212.6	

Note: The values are estimated backwards, starting with the per capita incomes computed from Survey data, then expanding with current population figures to actual GDP that gets allocated according to shares extracted directly from the SAM (last column).
Source: Computed from the ZVR-SAM 2003/4 and Survey data.

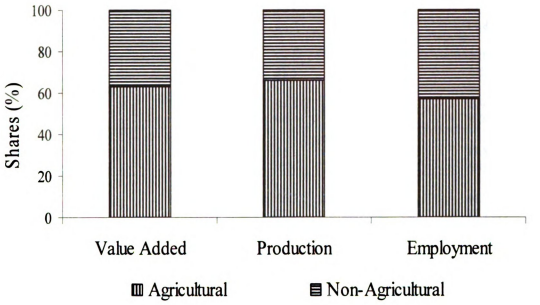
GDP per capita in the region is estimated at $ 213, varying between $109 and $125 among cotton non-growers and growers, and between $175 and $318 among tobacco non-growers and growers. Details on demographic comparisons among those groups of households were discussed in Chapter 3. Appendix Tables B.5 and B.6 present a Regional Macro SAM (at the highest level of aggregation), and selected characteristics of the Zambezi Valley households.

4.4.3. Structure of Production, Use of Factors and Intermediate Inputs

As one would anticipate, the Zambezi Valley economy is predominantly agricultural. Over 60% of the domestic production and domestic value added originates in agricultural activities. More than half of domestic employment also originates from agriculture (Figure 4.10). Although they confirm the dominance of agriculture, these numbers also indicate that the economy has a great degree of diversification.

Figure 4.10

Sectoral Structure of Value Added, Production and Employment



Source: Zambezi Valley Regional SAM

Table 4.10 presents the shares of factors and intermediates by activity. This kind of information is crucial in the analysis of the prevailing production technology in the model. The CGE model structure considers how these two components get substituted or complemented, assuming specific technological options. Here we just look at composition in the base year.

Table 4.10. Aggregate Factor and Intermediate Input Shares by Activity

Activities	Value Added Share (%)	Intermediate Input Share (%)
Tobacco Farms		
MLT	87.5	12.5
DIMON	86.2	13.8
Cotton Farms		
C.N.A.	98.0	2.0
Dunavant	98.5	1.5
Non-Cash Crop Farms		
Non-Tobacco	94.1	5.9
Non-Cotton	99.3	0.7
Other Primary		
Livestock	66.2	33.8
Fishing	100.0	0.0
Manufacturing		
Foods	55.3	44.7
Beverages	77.3	22.7
Other	100.0	0.0
Services		
Trading	65.3	34.7
Government	100.0	0.0
Other	71.3	28.7
Marketing/Export of Cash Crops		
MLT	2.3	97.7
DIMON	2.1	97.9
C.N.A.	4.2	95.8
Dunavant	3.1	96.9
Total	76.0	24.0

Source: Computed from the ZVR SAM-2003/4 and Survey data.

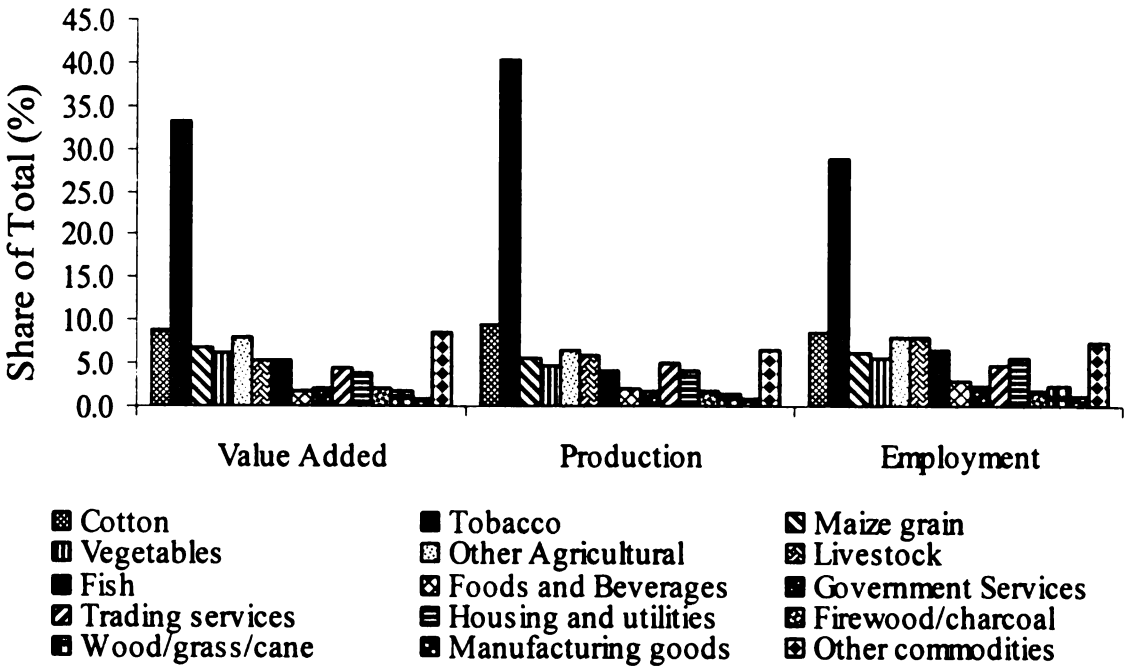
The analysis indicates that overall, value added constitutes 76% and intermediate inputs only 24%. There are important variations across major activities. First, all activities, with exception of the marketing/exporting operations, are predominantly value adding activities. Second, within agricultural activities, we note that given its relatively greater intensity in the use of chemical inputs, tobacco farms show relatively higher shares of intermediate input use, 13-14%, against just 2% among cotton growers and 0.7% among cotton non-growers. As expected non-tobacco growers in tobacco areas present higher shares on intermediates than farmers in cotton areas. This results from the important technological spillovers that are occurring in tobacco areas, in the form of

increased use of chemical inputs by non-growers. Finally, while fishing is a sector that uses exclusively factors such as labor and capital and no intermediates, livestock, manufacturing and some types of services (excluding government services) have a more balanced composition of shares between value added and intermediate inputs.

Looking at the distribution of value added, production and employment across commodities further illustrates the dominance of agriculture, particularly of primary cash cropping sectors, such as cotton, tobacco, and maize. While tobacco provides by far the greatest contribution to value added, production and employment, cotton frequently is not much more important than maize (a major export and food security crop in the region), vegetables, livestock and fish (Figure 4.11).

Figure 4.11

Shares of Value Added, Production and Employment, by Commodity

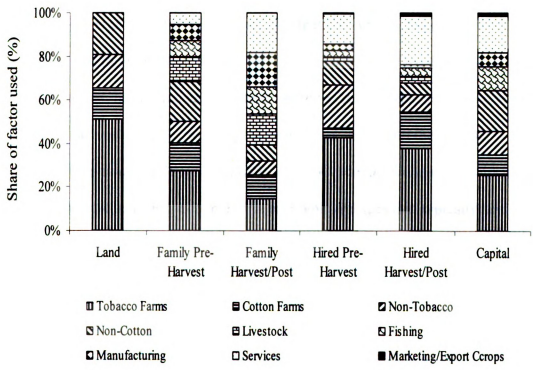


Source: Zambezi Valley Regional SAM

Figure 4.12 shows how factors of production get allocated across competing activities in the base year. It is evident that tobacco farms absorb a great deal of land and wage labor resources. In proportional terms, use of land by cotton growers and non-growing farms in both regions is very similar. Use of family resources in the pre-harvesting season is very much in line with the relative sizes of the population engaged in specific activities, i.e., the predominance of tobacco growers and cotton non-growers. In the post-season, there is a clear shift away from agriculture, with sectors such as livestock, fishing, manufacturing and services very much dominating.

Figure 4.12

Factor Shares Across Sectors of Activity



Source: Zambezi Valley Regional SAM

Tobacco farms absorb a great deal of hired labor in both seasons. Note, however, that in the post season, the importance of service activities grows significantly as the demand for this type of labor by cash cropping activities and exported oriented activities, such as maize (among non-growers in tobacco areas) shrinks. Appendix Tables B.7 through B.9, present a more disaggregated picture of factor shares across and within sectors of activity.

4.4.4. Factor Incomes to Institutions and Structure of Household Income

In the SAM/CGE model, factors (labor, land, and capital) are remunerated to the agents that own them, in proportions that mirror the structure of ownership. In our model of the Zambezi Valley region those agents include domestic households that reside permanently in the region, and foreign households that temporarily migrate to work as wage laborers. That migrant labor, which in some cases consists of experienced former tobacco smallholders, has played an important role in the recent expansion in the tobacco sector. In economy wide models, we are particularly concerned with the fact that payments to foreign households are potentially spent outside the economy, in which case it generates economic leakages, as opposed to economic linkages that typically are implied when incomes are spent domestically in domestically traded goods and services.[55]

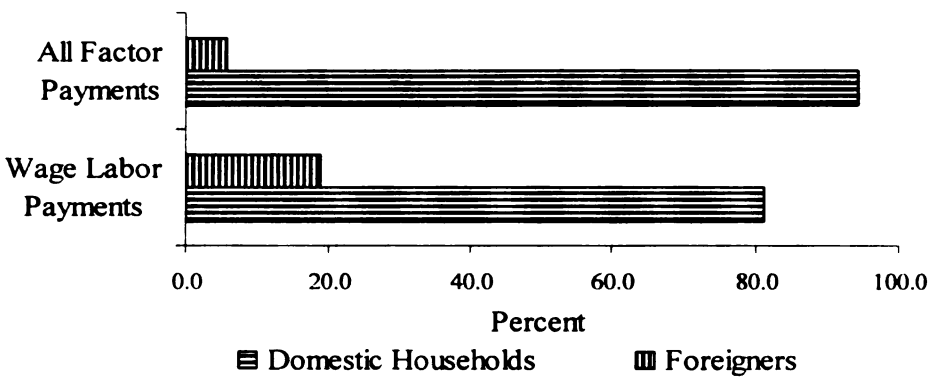
Figure 4.13 shows the distribution of factor payments between domestic and foreign households. It shows that the share of total factor payments to foreign households

[55] While the importance of the Malawian labor cannot be ignored, we should also avoid overstating it. In fact, a great deal of the Mozambican labor, both family and hired, has been exposed to tobacco growing in Malawi in the recent past. Also, in reality, due to close family ties, a great deal of the income can actually be spent in Mozambique as many people, in spite of their nationality keep resident status in both sides of the border.

is relatively small, just over 5%. The importance of foreign households is greater when we evaluate their share in the payments to hired labor in the region: they account for about 18% of the total wage labor bill. We ensure that, in modeling the factor payments in the SAM/CGE model we include factor payments to the rest of the world that mimic this situation to avoid overestimation of benefits to domestic households.

Figure 4.13

Factor Payments to Domestic and Foreign Households

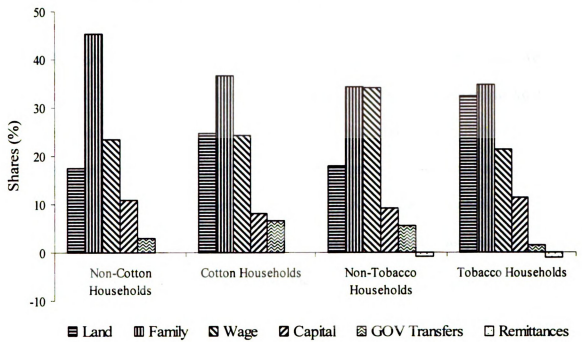


Source: Zambezi Valley Regional SAM

Wage labor is particularly important among non-tobacco growers in tobacco growing areas, for whom, as an income source, it is almost as important as the return to family labor. Figure 4.14 presents the structure of factor incomes (and net transfers) for each one of the household groups in the region.

Figure 4.14

Shares of Factors and Transfers in Household Income



Source: Zambezi Valley Regional SAM

There are several findings worth pointing out. First, in all cases, family labor is the single most important factor of production, only rivaled by land among tobacco growing households and wage labor among non tobacco growers. Second, households in the tobacco area are net senders of remittances to outside the region. Third, we were able to document a number of cases where households get relatively sizable (for rural standards) government transfers, such as pensions to war veterans. Finally, returns to land are significantly higher among cash cropping households. Detailed results are presented in Appendix Tables B.10 and B.11.[56]

[56] To contrast with this factor remunerations approach, we produced a set of survey based "structure of household income" statistics based on the income approach. See Appendix Table B.12.

4.4.5. Structure of Household Expenditure

Income earned by households in the region can be spent on consumption goods and services, saved, or transferred to other institutions, e.g., inter-household transfers, transfers to households outside the region or taxes to the government. In our model, we did not account for intra-household transfers, and transfers to the rest of the world were netted out and entered as net income to domestic households from the rest of the world. Transfers between domestic households and the government were also netted out and entered as net payments from government to households. As a result, household expenditure, as represented in the SAM, was reduced to home consumption, market purchases of goods and services, and private savings.

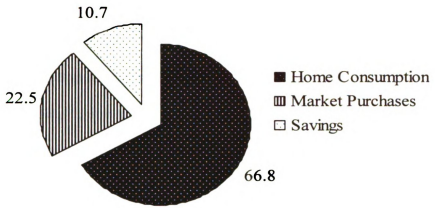
Figure 4.15, generated from the Macro SAM, presents the aggregate structure of household expenditure in the region. This structure is very typical of a rural developing economy, with the share of home consumption as the dominant category, and the prevalence of low savings rates.

Table 4.11 presents a more disaggregated structure of household expenditures that identifies sub-categories of home consumption and purchased goods and services, and breaks down the results by household group. These results were generated using both survey data to disaggregate the shares in home consumption, and the cash share expenditures retrieved from IAF to input on the different household groups.[57]

[57] The IAF expenditures were attributed by ranking household groups in both data sets, for the relevant enumeration areas as coded in the INE Master Sampling Frame. Although we averaged middle quartile cash expenditure shares from IAF and attributed them to the two middle income groups in our data set, the shares in the table for those two groups differ because we compute them over total income that includes home consumption.

Figure 4.15

Structure of Household Expenditure



Source: Zambezi Valley Regional SAM

Table 4.11. Structure of Household Expenditures - percent

Expenditure Category	Household Groups				All Region
	Cotton Areas Households		Tobacco Areas Households		
	Non-Growers	Growers	Non-Growers	Growers	
Home Consumption	73.4	64.5	67.0	63.7	66.8
Agricultural goods	59.8	58.0	56.9	58.4	58.3
Maize	31.3	33.4	28.8	28.4	30.0
Other	28.4	24.6	28.1	29.9	28.4
Animal/Animal prods	13.4	6.4	10.0	5.3	8.3
Foods and beverages	0.2	0.1	0.1	0.1	0.1
Marketed Goods/Services	18.3	25.8	22.6	24.0	22.7
Agricultural goods	1.7	4.6	4.0	4.3	3.7
Animal/Animal prods	1.1	4.0	3.5	3.2	2.9
Foods and beverages	1.5	3.6	3.1	3.7	3.1
Non-food items	12.9	12.4	10.9	12.4	12.2
Education	0.4	0.3	0.2	0.2	0.3
Health	0.7	0.9	0.8	0.3	0.6
Savings	8.2	9.8	10.5	12.3	10.6
Total	100.0	100.0	100.0	100.0	100.0

Source: IAF and Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004

Several results stand out. First, all household groups have a high home consumption share, dominated by the retained value of agricultural production and, to a less extent, livestock, particularly among non-growers. Second, while in cotton areas the value of retained maize is more important than all other agricultural products, in tobacco growing areas the situation appears to be more balanced with maize and other aggregated agricultural products exhibiting the same shares. Third, irrespective of household type or ranking, retained value of home made foods and beverages are extremely low. However, when it comes to marketed commodities, grower households tend to spend more in those items. Fourth, spending in animal/animal products is higher among cotton growers and all households in tobacco growing areas. Finally, against expectations, expenditure shares in goods with (typically) high income elasticity of demand, e.g. non-food items, health and education do not show any major differences across groups in the region. There are two possible explanations for this finding. First, it may be that, within the income ranges and preferences observed locally, demand for these goods is not income elastic. Second, the supply of public sector services such as health and education is relatively restricted (low density of schools and health posts), which by itself limits access; the absence of a reliable transportation system further reduces accessibility for all, regardless of income. In addition, while the cash cost may be low, the opportunity cost of sending a child to school, rather than having them work on the farm or in a business, can be high.

4.4.6. Domestic Supply and Demand, and Foreign Trade

As discussed earlier in this paper, the regional economy produces goods and services that are home consumed, sold domestically, and/or exported to outside the region. Some of the exported goods include cotton, tobacco, maize grain, groundnuts,

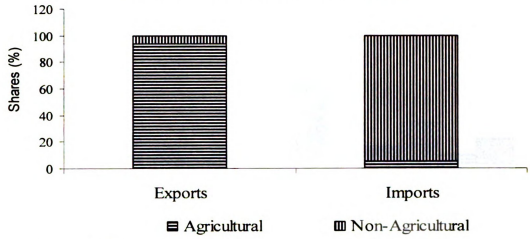
roots, vegetables, goats, alcoholic beverages, etc. While a great deal of domestic demand is for goods produced domestically, many consumption items, particularly non-primary, are actually imported from other parts of the country, or even brought in from neighboring countries. Examples of imported items include rice, salt, sugar, tea, seeds and chemical inputs, fuel, etc. See Appendix Table B.13 for a detailed list of imported and exported commodities and their importance. The Zambezi Valley economy is quite open to trade. In the analysis that follows, we will first look at the structure of imports and exports by sector. Then, we will look at the commodity structure of imports and exports in the region. Finally, we evaluate the share of exports in marketed output and the share of imports in domestic demand.

Figure 4.16 shows that the regional exports are predominantly agricultural. Only 6.6% of the exported value is in non-agricultural products, including small livestock (goats and birds) and home produced traditional beverages. In contrast, 95% of the imports consist of non-agricultural products, most of which are directly imported from Malawi.

Tobacco is by far the most important exported product in the region, about 74% of the exported value, followed by cotton with 10% and maize grain with 4% (Figures 4.17 and 4.18). Other commodities with at least 2% of the total export value include groundnuts, vegetables and goats. The most important imports are chemical inputs (fertilizers and pesticides) and seeds, about 31% of the total import value, followed by fuel with 19%, textiles/footwear and hygiene products with 9% each. Commodities with at least 2% import share include rice, beef, cooking oil, sugar and salt. Appendix Table B13 presents the results in greater detail.

Figure 4.16

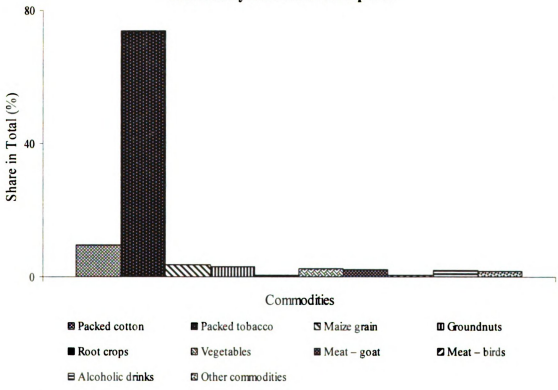
Sectoral Structure of Exports and Imports



Source: Zambezi Valley Regional SAM

Figure 4.17

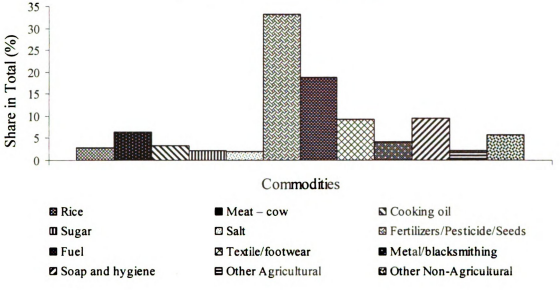
Commodity Structure of Exports



Source: Zambezi Valley Regional SAM

Figure 4.18

Commodity Structure of Imports

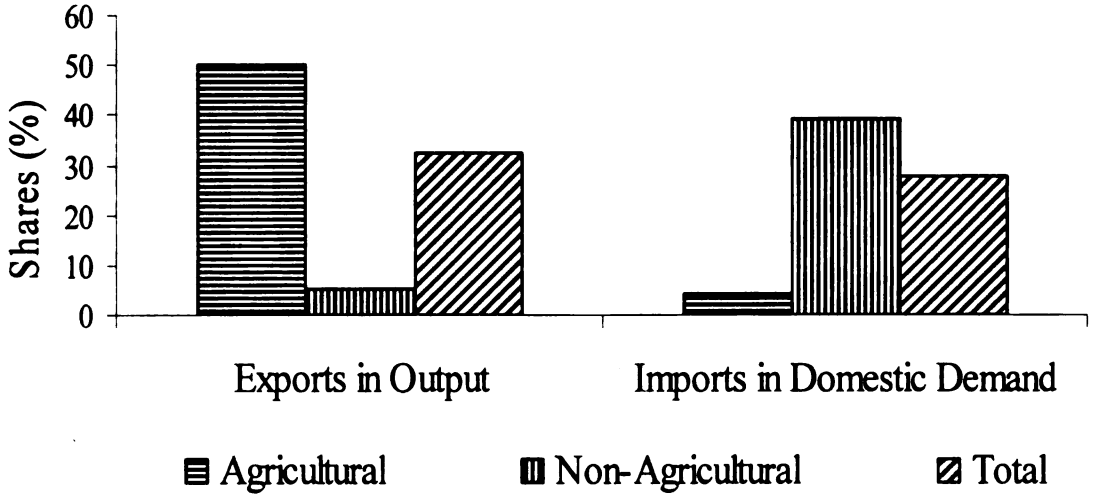


Source: Zambezi Valley Regional SAM

In the CGE model, the allocation of marketed output between domestic sales and exports, and the domestic consumption between domestically produced goods and imports are functions of relative prices. Figure 4.19 presents the share of exports in output and of imports in domestic demand for the base year. Of the total marketed output, about 32% is exported and the remainder is sold in the local market. Note that commodities such as cotton and tobacco are entirely exported, and about 50% of the marketed maize is exported. On average, only 5.3% of the non-agricultural sales are exported, against about half of the agricultural sales. This relatively high share of exported agricultural marketed output may seem large. However, this result is not surprising. In addition to the fact that cash crops are entirely exported, most of the agricultural food production is actually consumed on the farm and domestic markets for those food crops are relatively thin.

Figure 4.19

Shares of Exports in Output and Imports in Domestic Demand by Sector



Source: Zambezi Valley Regional SAM

Regarding the share of imports in domestic demand, we find a completely different picture. About 27% of domestic demand value is imported. Among agricultural commodities demanded, only 5% of the value is imported, while for non-agricultural commodities over 94% is imported. This is consistent with the prevailing regional commodity composition of imports, that is predominantly non-agricultural, and exports, that is predominantly agricultural.

4.4.7. Poverty and Inequality Profile

In this section, we present a profile of household income poverty and inequality in the Zambezi Valley cash cropping economies for the base year using data from the household survey. We use cumulative distribution curves of household income per capita to undertake stochastic dominance analysis of poverty, as described in Section 4.3.4.3.

The analysis of inequality uses coefficients of variation, Gini concentration ratios, and Lorenz curves.

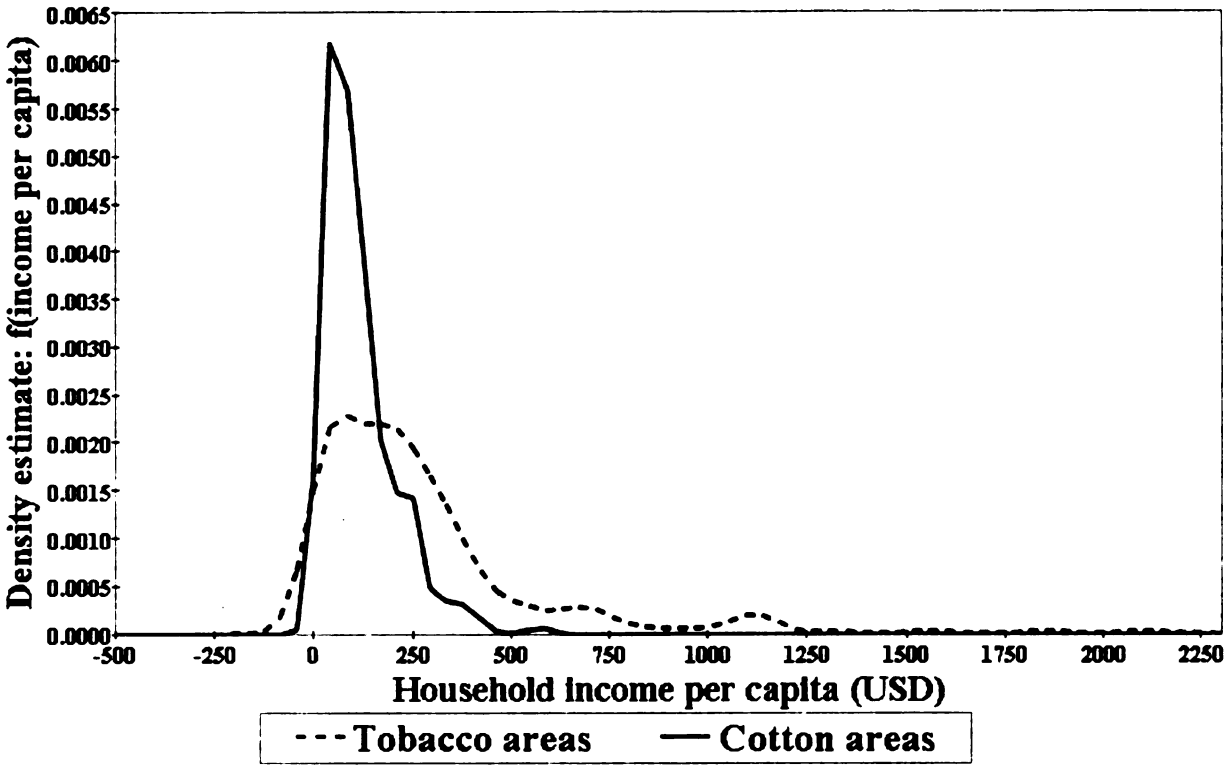
Income per capita differs substantially in the region between cotton and tobacco concession areas, with the latter exhibiting a clear advantage. Figure 4.20 illustrates the density curves for household income per capita by concession area, including all households irrespective of their cash crop growing status. Several points are worth noting. First, as expected in a rural African economy, both curves are skewed to the right. Second, tobacco areas present a wider dispersion of income.

As compared to cotton areas, tobacco areas appear to have a larger proportion of negative incomes per capita, but also a much greater share at the higher end of the income spectrum. Cotton incomes are much more concentrated around the lower end. Stochastic dominance analysis for the two concession areas, using distribution curves in Figure 4.21, shows that for any relevant poverty line, households in cotton areas are poorer than their counterparts in tobacco growing areas.[58]

[58] Note that as per the definitions introduced earlier, there is no first degree stochastic dominance over the entire income range; at unreasonably low poverty lines, the curve for the cotton areas dominates the one for the tobacco areas. This is somewhat expected, as tobacco growers with low yields will incur large losses due to high input costs.

Figure 4.20

Density Curves of Income per capita, by Concession Area
Zambezi Valley – Mozambique, 2003/2004

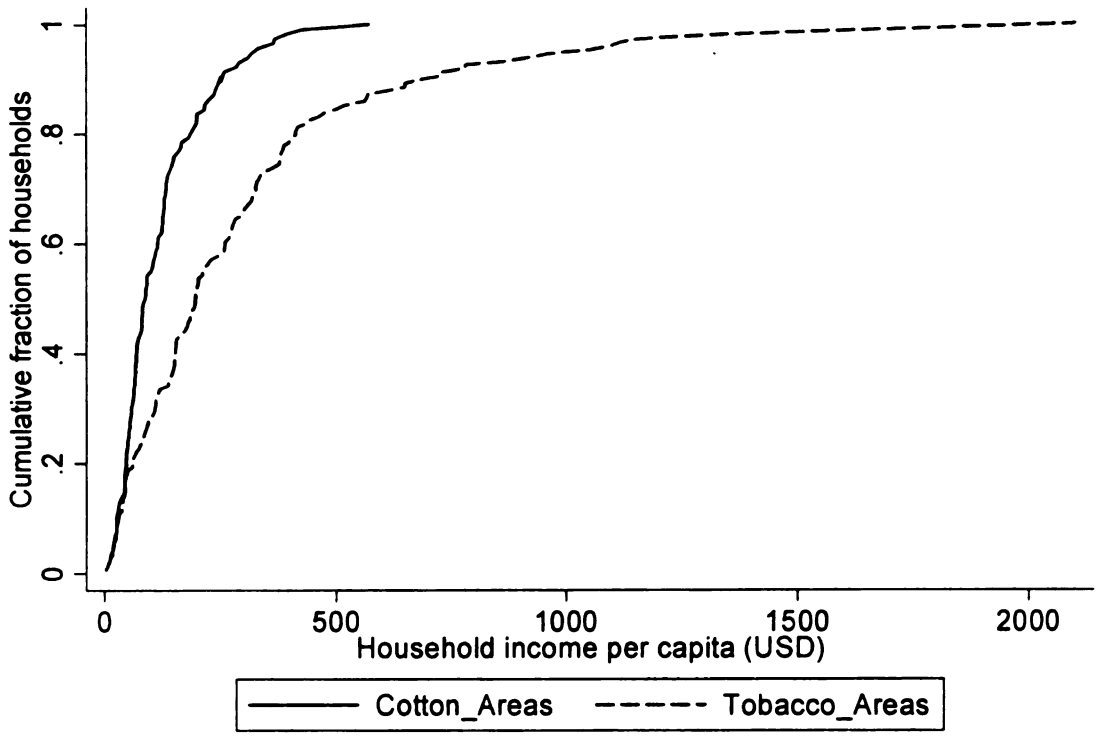


Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004

This CDF plot also confirms indications from the density curve that incomes per capita in cotton areas are significantly lower. Nearly all households in the cotton area earn incomes per capita lower than $400 per capita. More importantly, about 60% earn $100 or less, and 80% earn $200 or less. Top incomes in tobacco areas are close to $2,000, while 60th and 80th percentile incomes are about double those in cotton areas ($200 and $400, respectively). Median per capita incomes in cotton areas are approximately $88 against $184 in tobacco areas. Computed mean incomes per capita are $120 and $280, respectively.

Figure 4.21

Distribution Curves of Income per capita, by Concession Area
Zambezi Valley – Mozambique, 2003/2004



Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004

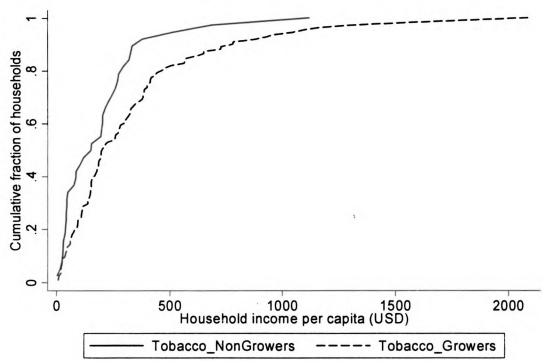
Differences in income from the cash crop contribute substantially to these overall income differences: mean and median income from cotton is $94 and $77, respectively, while the same figures for tobacco are $731 and $364. In Figures 4.22 and 4.23 we compare the cumulative distributions for growers and non-growers in tobacco and cotton concession areas, respectively.

In both areas, for poverty lines at or below median per capita incomes, comparisons are inconclusive. Indeed, in tobacco growing areas (Figure 4.22), the CDFs overlap at very low levels of less than $50. At levels $50-$150 the grower households dominate the non-growers, but the situation is again unclear around poverty lines near

area's median. For poverty lines defined above the median ($184 per capita), and more clearly above the mean ($280 per capita), grower households clearly dominate non-growers.

Figure 4.22

Distribution Curves of Income per capita, by Household Group
Tobacco Concession Areas



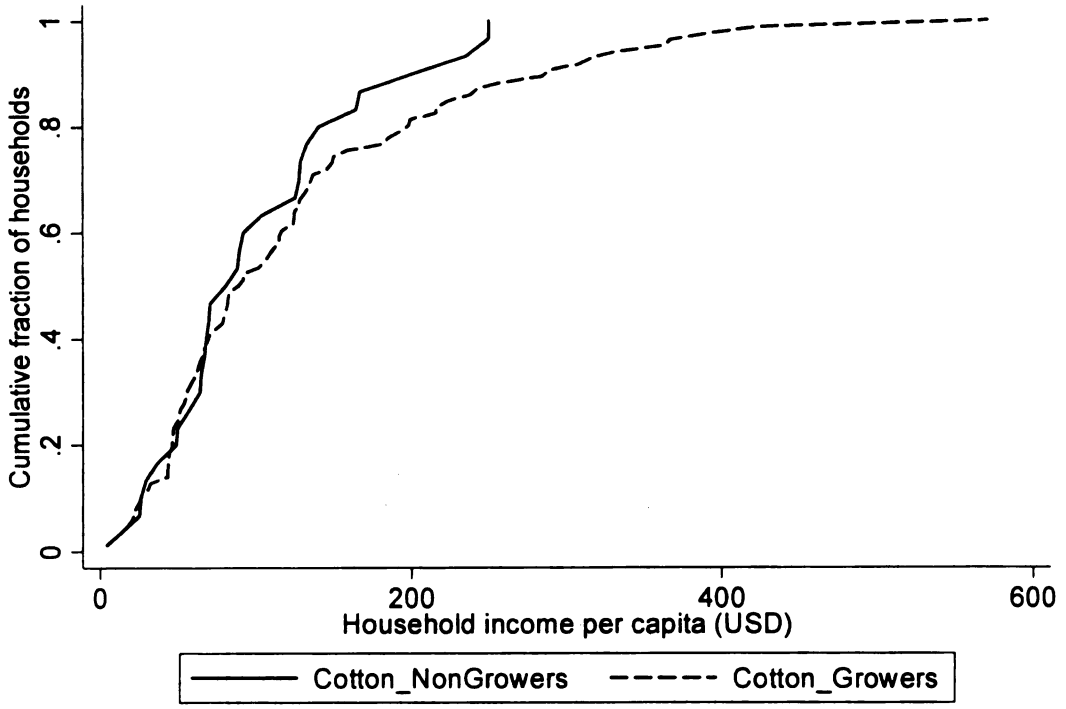
Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004

In cotton growing areas (Figure 4.23), poverty differences between the two groups are very unclear for all poverty lines define below mean per capita income. For poverty lines greater than the mean, i.e., over $120, growers clearly dominate non-growers, indicating that poverty incidence is greater among non-growers.

Figure 4.23

Distribution Curves of Income per capita, by Household Group

Cotton Concession Areas



Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004

In Table 4.12 and Figure 4.24 we present measures of inequality in the base year. By all standards, inequality appears to be more severe in tobacco concession areas when compared to cotton areas. This is illustrated by the higher coefficient of variation, 1.17 (tobacco areas) to 0.78 (cotton areas), higher Gini concentration ratio (0.54 and 0.40), and the fact that Lorenz curves for households in tobacco areas lie everywhere outside the Lorenz curves for households in cotton areas.

Table 4.12. Measures of Inequality

Household Groups in concession areas	Coefficients of Variation of per capita income	Per capita Income Concentration Ratios (Gini)
Tobacco Areas		
Non-grower households	1.06 (0.165)	0.52
Grower households	1.19 (0.102)	0.56
All households	1.17 (0.104)	0.54
Cotton Areas		
Non-grower households	0.64 (0.068)	0.35
Grower households	0.86 (0.064)	0.44
All households	0.78 (0.060)	0.40
All households in the Region	1.26 (0.101)	0.53

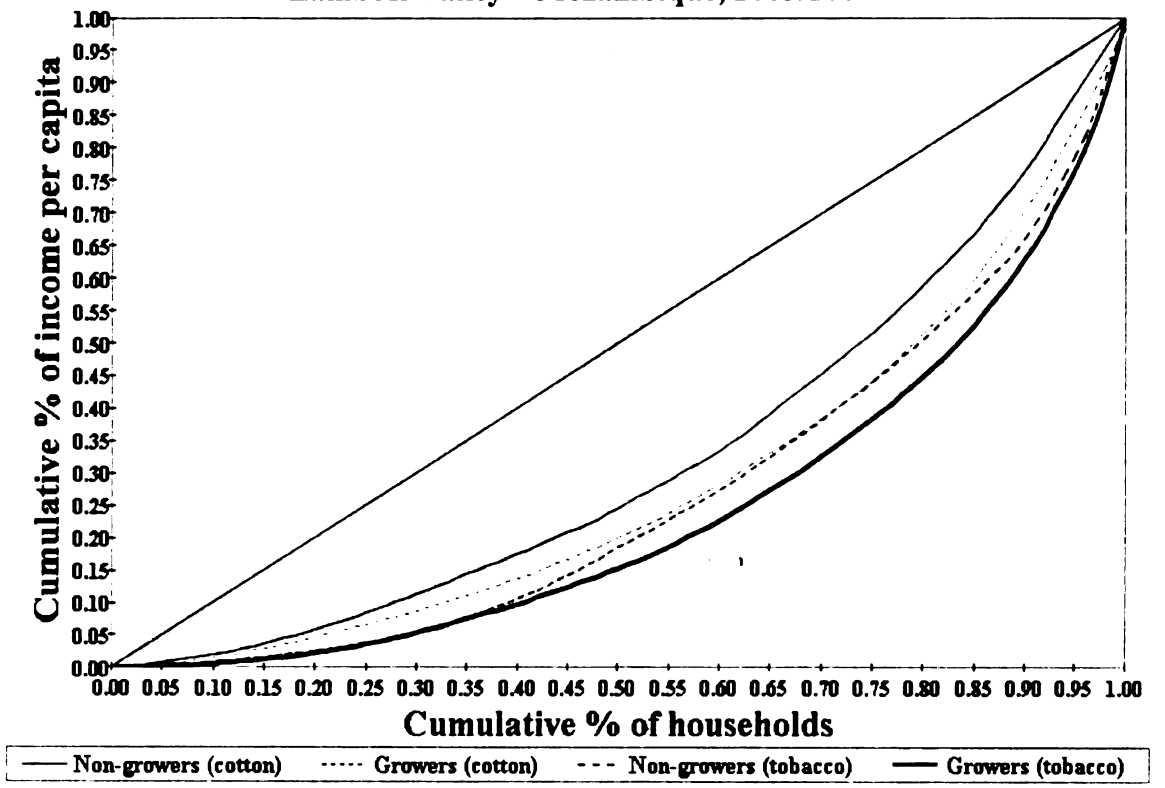
Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004.

Comparing inequality among groups within the same area shows, first, that in both areas inequality is more severe among cash crop growers. Second, these differences are more accentuated in cotton areas, where Gini ratios exhibit a difference of eleven points as compared to only 4 points in tobacco growing areas. The coefficients of variation give the same indication.

A visual interpretation of the Lorenz curves (Figure 4.24) provides further insights. It further clarifies that, in cotton areas, inequality is more accentuated among grower households, as their curve lies everywhere below the curve for non-growers. Forty five percent of the non-growers of cotton receive about 20% of the total income received by that group, while among growers, 45% receive only 15% of the group's total income. This higher level of inequality among cotton growers persists at all percentiles.

Figure 4.24

Lorenz Curves for Household Income per capita, by Household Group
Zambezi Valley – Mozambique, 2003/2004



Source: Zambezi Valley Cotton and Tobacco Concession Areas Study Survey, 2004

The picture is a bit different in tobacco areas. For instance, at population cumulative percentiles up to 40%, there are seemingly no differences between the two household groups. At that level, in each group 40% of the population receive just over 5% of the total income of the respective group, which indicates a very high level of inequality. Inequality becomes more severe among growers as we move up the curve; 60% of non-growers receive 25% of that group's total income while 60% of growers get only 20%.

4.5. Policy Simulations with the Regional CGE Model

4.5.1. Introduction

To assess the impact of expansion of cash cropping activities, and of alternative policies in cash cropping sectors on household per capita incomes, we have to consider a number of alternatives with respect to the availability of resources, and the extent of their mobility and allocation across various economic activities. In the CGE model we accomplish this by defining the specific mechanisms that guide factor market adjustments in the presence of exogenous shocks. Those alternative mechanisms are discussed in some detail in Section 4.3.2.2.

In Mozambique in general, and in the Zambezi Valley economy in particular, the issue of availability and mobility of resources is important for various reasons. Post war growth in agriculture has been primarily due to some area expansion (significant relative to the base, though still limited relative to its potential full employment) and labor force growth, with limited gains in crop productivity. In fact, a great deal of the growth in the Zambezi Valley cash cropping economies was possible due to the available pool of resources; these included land for scheme expansion, and labor, some of which was drawn from Malawi and from less dynamic domestic areas with fewer attractive employment opportunities.

There are some fundamental questions in this context. First, under what endowment/mobility scenarios can the Zambezi Valley economy continue to grow? In other words, can the simple injection of additional resources by the contract farming companies, without continued growth in land and labor supply and/or gains in the productivity of the existing resources, ensure growth in cash crop production that is

capable of generating broad based growth in the regional economy? Second, how do changes in world market conditions, e.g., fluctuations in import prices of inputs and export prices of outputs, affect the regional economy? Finally, how do all these changes compare to each other regarding their effects on household income levels? In this analysis, we consider selected exogenous economic shocks. While we have identified a large menu of interesting experiments, our analysis will be limited to the following shocks:

a. An increase in capital endowments specific to cash cropping.[59]

b. Productivity gains in cash cropping sectors;

c. Changes in world market conditions for tradable goods. The simulated shocks include:

   i. An increase in import prices for intermediate inputs, e.g., pesticides, fertilizers and seeds;

   ii. An increase in export prices for cash crops (cotton and tobacco), and maize grain;

d. A Government trade policy with respect to cash cropping sectors, e.g., export taxes.

The choice of experiments was based on an assessment of their importance for the current policy debate in Mozambique, ensuring a mix of exogenously determined variables, such as world prices,[60] discretionary variables like export taxes, and variables

[59] This includes the implicit increase in activity specific capital, resulting from increased support by firms to smallholders in terms of extension assistance and other support that increases their managerial ability. In reality, it is in fixed proportion to intermediate inputs in those activities, reflecting, therefore, a proportionally similar increase in the supply of intermediates by firms to smallholders.

[60] Note that world market conditions may actually change in an opposite direction. Therefore, one should keep in mind that there can be a change in the direction of the effects shown here. For example, a drop in

that can be influence by private sector actions such as productivity and the level of capital injections in cash cropping schemes. The assumption is that the Government may have the ability to influence private sector decisions through incentive mechanisms.

Some current circumstances, related to the choice of shocks include. First, there is still room for expansion of agriculture in Mozambique. Given the absence of a wide range of cash generating opportunities in rural areas, and the availability of land and labor resources, cash cropping is viewed as a potentially important sector where direct and indirect effects can be maximized. In the previous Chapter, the analysis indicates that profits in both sectors can be increased with the expansion in land area, but total crop and total household incomes grow significantly only in tobacco growing areas. We further investigate, in this section, the economy-wide effects of expansion in both sectors. Second, several studies in the cotton sector have emphasized low prices and poor productivity at the farm level as factors leading to the stagnation of cotton farmer incomes in Mozambique (World Bank, 2005; Tschirley *et al.*, 2005).[61] The analysis in Chapter 3, documents the low profitability of the crop relative to tobacco in the Zambezi Valley region.[62] We will assess the impact, on the different household groups, of increased productivity and prices. Third, a proposal to impose an export tax on raw tobacco, as a way of encouraging domestic processing, has been the object of great controversy in recent years. Benfica *et al.* (2005) discuss the implications of that policy in

---

world cotton/tobacco/maize prices will hurt household incomes and a decrease in import prices for inputs will be beneficial.

[61] In fact, Mozambique pays the lowest prices in the region; the 1998-2002 average producer prices were $0.16 per kilogram, compared to $0.22 in Zambia and Tanzania and $0.25 in Zimbabwe (Poulton *et al.*, 2001). Likewise, yields are amongst the lowest in Africa; 0.51 tonnes per hectare in 2003/04, compared to 0.9 tonnes in Zimbabwe and over 1.0 tonne in West Africa (Lemaitre et al., 2001).

[62] In the tobacco sector, with the exception of some indirect complains blamed on poor grading by companies, prices (and productivity) have not been much of a problem,

a cost-benefit framework, and conclude that the imposition of such a tax at this stage of development of the tobacco sector is not appropriate. We pursue the analysis of that policy within an economy-wide framework to better inform its possible implications to rural poverty. Fourth, given the importance of imported chemicals in the package supplied to cash crop growers (fertilizer for tobacco, and pesticides in both sectors), we analyse the implications of changes in their world prices to poverty in the study area. Finally, maize is an important crop both for food security and as a cash crop for many farmers in the region; some of it is actually exported to neighboring countries or deficit areas inside Mozambique. We assess the impact of changes in maize export prices to poverty reduction in the study area.

We conduct the analysis separately for each concession area. The justification for this separation is that there are no overlaps of firm concession areas, so that a household does not have the choice of moving into a different cash crop without physically moving from the area. Although migration occurs, we found no evidence that supports the idea that households were moving as part of a strategy to engage in alternative cash crops.

The implementation of the analysis on a sub-regional basis implied that the regional SAM had to be divided into two independent matrices with similar structures. The task of creating separate matrices was facilitated by the structure of the aggregated SAM that included highly disaggregated activity and household accounts mapped out on the basis of the relevant cash crops and conveniently linked by distinct factor accounts. Background data from the field survey originally used to generate the regional SAM, including its non-farm accounts, was also used in this separation. The SAMs were balanced separately through the Cross-Entropy method described in Chapter two and

used to calibrate two CGE models and undertake policy simulations.

Initially, for each area, we examined the simulations under the alternative scenarios, considering individual impacts (each simulation individually), and also combined simulations, where "a" (the injection of activity specific capital in cash cropping sectors) is implemented in conjunction with each of the other simulations. The scenarios experimented included: (a) full employment with full mobility of all factors; (b) full employment of capital with unemployment and full mobility of labor and land; and (c) unemployment and full mobility of all factors, except activity specific contract farming capital that is assumed fully employed at the post shock level. Note that the unemployment closure (c) implies that supply of resources is not restricted and can be brought into production to meet the demand from expanding activities. Results for the three scenarios are presented in Tables 4.13 and 4.14 for tobacco and cotton areas, respectively.

Table 4.13. Effects on Household Income of Alternative Simulations: Tobacco Areas

Simulations	--- % Changes in Household Income per capita ---					
	Full Employment		Semi-Unemployment		Unemployment	
	Non-growers	Growers	Non-growers	Growers	Non-growers	Growers
Individual Shocks:						
C. Farming Capital	1.42	-2.08	2.99	6.15	17.84	18.11
Productivity	4.21	3.34	8.43	11.63	17.95	30.09
Export price – Tobacco	3.94	3.79	4.01	4.88	23.19	44.02
Export price – Maize	2.24	1.50	5.90	6.94	31.38	53.06
Import price – Inputs	-0.71	-1.32	-1.88	-2.84	-4.50	-6.37
Export tax – Tobacco	-0.74	-4.52	-3.82	-7.28	-6.25	-10.4
Combined Shocks:						
Productivity	7.36	1.35	22.58	21.20	43.16	61.98
Export price – Tobacco	4.14	1.66	9.30	9.14	49.01	79.04
Export price – Maize	3.42	-0.62	12.15	8.78	47.60	67.54
Import price – Inputs	0.51	-3.16	3.34	-0.77	8.67	5.60
Export tax – Tobacco	0.02	-6.17	-0.78	-6.54	6.07	0.71

Notes: The individual shocks are in the magnitude of 15% in each case. The combined shocks include a 15% expansion in contract farming capital with another 15% shock. The Simulations use a Flexible Exchange Rate Closure.
Source: ZVR-CGE Model Simulations.

Table 4.14. Effects on Household Income of Alternative Simulations: Cotton Areas

Simulations	--- % Changes in Household Income per capita ---					
	Full Employment		Semi-Unemployment		Unemployment	
	Non-growers	Growers	Non-growers	Growers	Non-growers	Growers
Individual Shocks:						
C. Farming Capital	1.03	-1.92	4.43	1.22	14.20	13.46
Productivity	1.02	2.14	6.23	9.93	14.48	23.10
Export price – Cotton	0.64	2.06	2.21	4.07	5.71	9.33
Export price – Maize	1.80	2.12	4.71	5.42	21.44	31.06
Import price – Inputs	-0.11	-0.21	-0.32	-0.45	-1.17	-1.56
Export tax – Cotton	-0.16	-1.61	-1.02	-2.52	-2.20	-3.98
Combined Shocks:						
Productivity	1.34	0.30	6.06	5.84	31.20	40.46
Export price – Cotton	1.93	-0.25	7.81	5.70	20.54	23.71
Export price – Maize	2.84	0.06	3.38	1.30	39.83	49.94
Import price – Inputs	0.91	-2.10	4.00	0.75	12.88	11.72
Export tax – Cotton	0.65	-3.31	2.35	-1.86	11.39	8.59

Notes: The individual shocks are in the magnitude of 15% in each case. The combined shocks include a 15% expansion in contract farming capital with another 15% shock. The Simulations use a Flexible Exchange Rate Closure.
Source: ZVR-CGE Model Simulations.

In both areas, we find that under full employment of all factors, closure (a), economic expansion is very limited. Even if we assume that the existing factors are 15% more productive, the effects on household income are very limited, and we find little mobility of factors across activities. Likewise, the effects of changes in world market conditions, although resulting in the expected direction, are small. Under closure (b) the effects are more sizable. However, the full employment assumption of non-cash crop capital is highly unrealistic. Indeed, the non-cash crop stock of capital is very much like a complement of household labor supply in the region that is assume available/unemployed in this closure. This leads to limitations in the use of the available land and labor in the expansion process by the activities that receive capital injections, and also in the adjustment of other activities. In closure (c), where all factors are assumed to be available for use in the expansion process, we observe that household incomes are responsive to the various shocks. This closure also shows some important indications of indirect effects

of shocks in cash cropping sectors on non-grower households in the adjustment process through the marketing mechanisms.

We argue that closure (c) is the most realistic assumption in the Zambezi Valley, for three reasons. First, population pressure, land degradation, and the resulting low returns to agriculture in Malawi put increasing pressure on scores of people to migrate as laborers; cash cropping areas of Mozambique are one of the obvious destinations. Second, there are still localities in the study area that are not part of the concession system, leaving room for further expansion of land and labor. Third, an increasing number of people from other parts of Mozambique are willing to migrate to production areas if the returns are compensating. Urban unemployment and lack of economic opportunities are very real in Central Mozambique. This is true for both cotton and tobacco growing areas. Finally, within each area, the proportion of land area still uncultivated is relatively high,[63] which means that more land can be brought into production if additional labor is available in the region and capital is made available by profit seeking outgrower companies.

In the analysis that follows, we assume that all factors are fully mobile and available for use, following an injection of activity specific capital combined with a series of other shocks. Table 4.15 presents, for each concession area, the list of shocks and the effects on household income per capita by household type.[64]

[63] In 1995, the total arable land in Tete Province was estimated in 49,000 Square Kilometers (SKMs), of which 16 SKMs were used for permanent agriculture, 16,724 SKMs for shifting agriculture, and the reminder was grass land, wooded grassland and shrub.

[64] These results are based on a flexible exchange rate closure for the rest of the world. These results are consistent with the literature for developing countries.

Table 4.15. Effects on Household Income of Alternative Simulations, assuming unemployment and full mobility of factors

Simulations	Shock (% Change)	--- % Changes in Income per capita --- Household Types	
		Non-grower Households	Grower Households
Tobacco Areas			
Contract Farming Capital	15.0	17.84	18.11
+ Productivity	15.0	43.16	61.98
+ Cash Crop Export price	15.0	49.01	79.04
+ Export price – Maize	15.0	47.60	67.54
+ Import price – Inputs	15.0	8.67	5.60
+ Export tax	15.0	6.07	0.71
Cotton Areas			
Contract Farming Capital	15.0	14.20	13.46
+ Productivity	15.0	31.20	40.46
+ Cash Crop Export price	15.0	20.54	23.71
+ Export price – Maize	15.0	39.83	49.94
+ Import price – Inputs	15.0	12.88	11.72
+ Export tax	15.0	11.39	8.59

Source: Zambezi Valley CGE Model Simulation Results.

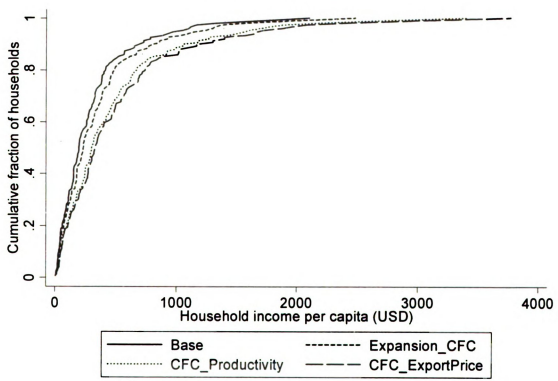
For simplicity, we set all shocks at 15% from the base values represented in the base year SAM. In the analysis that follows, we use the stochastic dominance approach described earlier whose outcomes mirror the results in the Table. We examine the impacts of each shock on the incomes of the two household groups in each area and examine the mechanisms through which they arise. While, the SAM base scenario represents a base year for an economy in equilibrium, it should be clear that model results are only representative of the direction in which a system will begin to change towards a new equilibrium until some (different) shock sets it on still another path; the length of run for the impacts to take effect is therefore undefined. In addition to that, population is assumed constant during the adjustment process.

4.5.2. Policy Simulations in Tobacco Concession Areas

Households in tobacco concession areas are very responsive to exogenous shocks. A 15% increase in capital specific to tobacco leads to an increase of approximately 18% in the incomes of both household groups. If that injection is accompanied by an increase in the productivity of the resources used in tobacco growing activities, both groups benefit significantly, with average incomes of growers increasing 62%, against 43% among non-growers.[65] Figures 4.25 through 4.27 present the CDFs for those simulations

Figure 4.25

Comparison of Poverty Effects of Simulations, Tobacco Areas Expansion, Productivity and Export Price



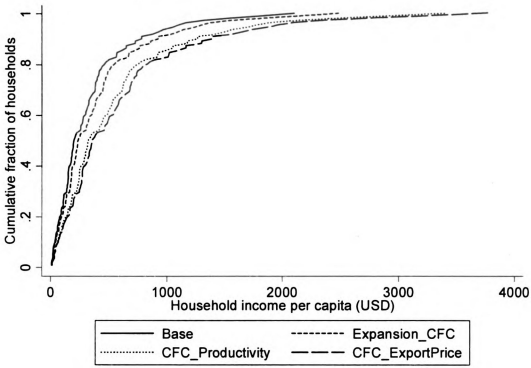
Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

[65] Expansion with higher tobacco world prices results in considerably higher growth rates, 49% in per capita incomes of non-growers and 79% in the incomes of tobacco growers.

for all households in tobacco areas, and for growers and non-growers, respectively, based on results in Table 4.15 and averages across all households.

Figure 4.26

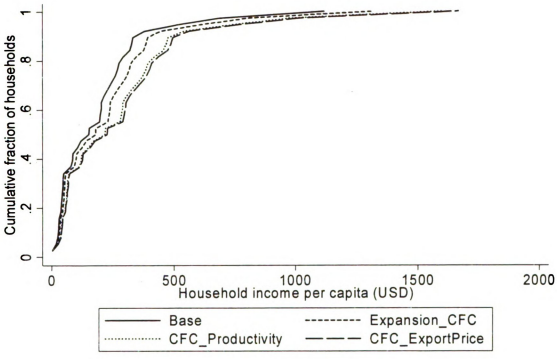
Comparison of Poverty Effects of Simulations, Tobacco Growers Expansion, Productivity and Export Price



Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

Figure 4.27

Comparison of Poverty Effects of Simulations, Tobacco Non-growers Expansion, Productivity and Export Price



Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

An evaluation of the mechanisms through which these effects take effect can be better understood, by stepping back to: 1) the flow diagram presented in Figure 4.1, that represents the generation of value added by economic activities, its remuneration to households based the structure of factor ownership in the base year and household consumption patterns; and 2) the structure of the economy in the base year represented in the SAM and illustrated in Section 4.4. In this Section, we use key results to illustrate the mechanisms in tobacco growing areas.

Model results indicate that initial growth generated in the tobacco sector generates

growth in the level of economic activity across all sectors. Table 4.16 presents the structure of the level of economic activity in the base, and the changes in economic activity by simulation.

Table 4.16. Base Shares and Changes in the Level of Activity by Simulation, Tobacco Areas

Economic Activities	Base Activity Level (%)	Changes in Economic Activity by Simulation				
		Expansion Only	Expansion w/ Productivity	Expansion w/ Export Price	Expansion w/ Input Price	Expansion w/ Export Tax
Tobacco Farms – MLT	35.1	15.8	47.6	31.5	9.3	4.1
Tobacco Farms – DIMON	10.0	15.4	46.6	30.4	9.7	1.3
Non-Tobacco Farms	14.7	15.9	42.2	49.1	6.6	10.3
Livestock	5.1	16.7	47.5	50.4	7.4	7.6
Fishing	3.6	18.0	53.2	60.3	7.3	7.2
Food processing	1.5	17.7	52.6	57.4	7.0	6.9
Beverage processing	0.9	8.5	26.8	27.6	9.3	10.0
Other Processing	1.9	18.1	55.2	65.1	6.4	6.9
MLT–Marketing/Export	12.4	15.8	47.6	31.5	9.3	4.1
DIMON–Marketing/Export	4.8	15.4	46.6	30.4	9.7	1.3
Trading Services	5.0	15.6	47.6	43.7	8.5	5.2
Government Services	1.4	18.1	54.7	66.0	6.9	7.2
Other Services	3.6	18.0	53.1	62.0	6.6	7.4
Total	100.0					

Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

Results in the Table show that while agricultural activities, particularly tobacco growing, and its associated value adding, dominate in terms of the base structure, growth in economic activity in other activities is also substantial; for example, expansion with productivity result in about 47% growth in the level of economic activity in tobacco activities, 42% in other agricultural (non-tobacco) activities, and of over 47% in almost all non-farming activities, including processing and services.

The relatively higher level of economic activity results in greater remunerations for grower and non-grower groups alike, via the increased demand of factors by the activities. For example in the case of expansion with productivity increases, Table 4.17

shows that tobacco growing activities increase their use of factors by about 30%, while other non-growing farming activities expand even further, about 42%.[66] Demand for labor by non-agricultural activities also expands dramatically. For example livestock, fishing, food processing, other manufacturing and trade, increase their demand for labor resources by an average of over 50%. These increases are a result of consumption linkages in the economy, as households demand additional goods and services with the increased incomes.

Table 4.17. Changes in Demand for Factors from Activities in Tobacco Areas

Economic Activities	% Change in Demand for Factors by Simulation				
	Expansion Only	Expansion with Productivity	Expansion with Export Price	Expansion with Input Price	Expansion with Export Tax
Tobacco Farms – MLT	15.9	30.8	35.2	8.9	3.5
Tobacco Farms - DIMON	15.4	29.7	33.6	9.3	0.6
Non-Tobacco Farms	15.9	42.2	49.1	6.6	10.3
Livestock	16.7	47.5	50.4	7.4	7.6
Fishing	18.0	53.2	60.3	7.3	7.2
Food processing	17.7	52.6	57.4	7.0	6.9
Beverage processing	8.5	26.8	27.6	9.3	10.0
Other Processing	18.1	55.2	65.1	6.4	6.9
MLT–Marketing/Export	15.8	47.6	31.5	9.3	4.1
DIMON–Marketing/Export	15.4	46.6	30.4	9.7	1.3
Trading Services	15.6	47.6	43.7	8.5	5.2
Government Services	18.1	54.7	66.0	7.0	7.2
Other Services	18.0	53.1	62.0	6.6	7.4

Source: Base year ZVR-SAM and ZVR-CGE Model Simulations

The actual magnitude of these impacts depends on the structure of factor use by economic activity, presented in Table 4.18 (that determines the actual change in the quantity used by each activity). As expected, tobacco growing activities demand the greatest share of all factors; over three quarters of the land, close to 50% of the pre-

[66] Note that the increase in demand for factors between MLT and Dimon is approximately the same – 30.9% and 29.7%, respectively, but the MLT base scenario demand level is much higher.

harvesting family labor, a quarter of the harvesting and post-harvesting family labor, over 50% of the waged labor throughout the season and about 45% of the capital. Demand for family and waged labor by non-agricultural activities is higher in the post harvesting season, when labor is released from agricultural tasks.

Table 4.18. Base Factor Use Shares by Activity, Tobacco Areas

Economic Activities	Use of Production Factors (Allocation across Activities) ---- % of Total Base Year ----					
	Land	Family labor PreHarvest	Family labor PostHarvest	Wage PreHarvest	Wage PostHarvest	Capital
Tobacco Farms – MLT	60.9	36.1	17.8	44.3	46.5	35.8
Tobacco Farms - DIMON	15.4	12.7	6.2	13.2	8.8	10.2
Non-Tobacco Farms	23.7	18.3	10.1	27.5	12.5	17.2
Livestock	0.0	12.2	15.5	1.0	2.9	0.0
Fishing	0.0	7.6	12.4	2.0	3.7	10.0
Food processing	0.0	1.4	3.1	2.0	0.2	1.1
Beverage processing	0.0	2.1	4.7	0.0	0.1	1.1
Other Processing	0.0	4.3	9.3	0.2	1.0	4.8
MLT–Marketing/Export	0.0	0.0	0.8	0.4	1.3	1.7
DIMONMarketing/Export	0.0	0.0	0.8	0.2	0.7	0.5
Trading Services	0.0	1.3	3.1	4.1	10.3	15.1
Government Services	0.0	0.0	0.8	4.1	8.1	0.0
Other Services	0.0	4.0	15.5	1.0	3.7	2.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: ZVR-CGE Model Simulations.

With the expansion and productivity increase, for example, additional factor incomes (Table 4.19), i.e., the value of the quantity of factors (land labor and capital) at market clearing wages/rents, generated in this process are substantial; remuneration to land increases in about 33%, while that for family labor increases in 42% on average (39% for pre-harvesting labor and 44% for harvesting and post harvesting), and for wage labor increases in 55% on average (52% for pre-harvesting labor and 58% for harvesting and post harvesting). Returns to activity specific capital are significantly high in the presence of productivity increases and increases in export prices. While increases in the

remunerations to activity specific capital as a result of a 15% injection, all else constant, are only 22%, a compounded shock with a simultaneous 15% gain in productivity generates an average increase of 300%. Since this capital is specific to grower households the direct implications are exactly on that group. The non-grower group also benefits substantially from this, but only indirectly through the remuneration to other factors. As noted in earlier sections, agricultural and non-agricultural activities in those areas are labor intensive, with a mix of family and wage labor. The factor income payments to each group reflect the original factor endowments in the SAM, summarized in Table 4.19. To a great extent, this helps explaining why impacts to non-grower groups are also substantial. In Table 4.19, we can see that relative to returns to family labor, wage labor (the fastest growing factor income) is relatively more important in non-grower households, about 35% of total income, against only 22% among growers (percentages from base structure). In that sense, an increase in labor hiring by growers and expanding non-farm activities gets predominantly remunerated to non-grower households implying that the income of those households increases accordingly.

It is worth noting that any expansion with or without productivity gains or price increases is very compensating for non-grower groups. For instance, results indicate that a simple expansion of 15% in the tobacco sector generates a 17.8% increase in non-grower incomes (all reflected as indirect effects), and only 18.1% among growers (almost entirely from direct effects).

If expansion in cash cropping schemes is accompanied by negative market events such as an increase in the price of inputs, or a government imposed export tax on tobacco, growth of household incomes slows down significantly.

Table 4.19. Base Shares and Changes in the Factor Remunerations, by Simulation

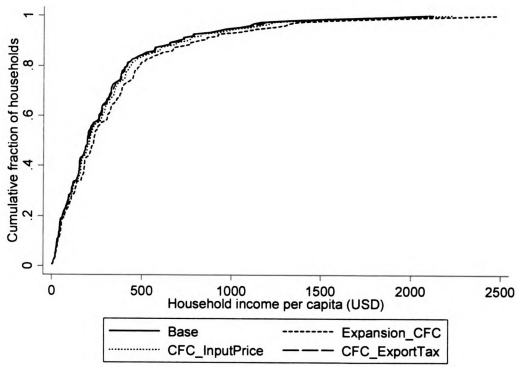
Households and Factors	Base Structure (%)	Changes in Factor Remunerations by Simulation				
		Expansion Only	Expansion with Productivity	Expansion with Export Price	Expansion with Input Price	Expansion with Export Tax
TOBACCO HOUSEHOLDS						
Land	32.2	15.8	33.3	38.2	8.4	4.7
Family Labor, Pre-harvesting	21.4	16.1	38.8	43.8	8.0	5.7
Family Labor, Harvesting/Marketing	14.1	16.5	44.3	49.9	7.6	6.5
Wage Labor, Pre-harvesting	12.6	22.4	52.1	60.6	10.9	7.2
Wage Labor, Harvesting/Marketing	9.0	24.2	58.2	66.6	11.7	7.1
Capital	3.0	16.4	47.6	50.8	7.4	7.5
Activity Specific Capital	7.7	22.0	300.0	440.0	-31.5	-65.0
TOTAL	100.0					
NON-TOBACCO HOUSEHOLDS						
Land	18.3	15.8	33.3	38.2	8.4	4.7
Family Labor, Pre-harvesting	21.7	16.1	38.8	43.8	8.0	5.7
Family Labor, Harvesting/Marketing	14.0	16.5	44.3	49.9	7.6	6.5
Wage Labor, Pre-harvesting	22.7	22.4	52.1	60.6	10.9	7.2
Wage Labor, Harvesting/Marketing	12.6	24.2	58.2	66.6	11.7	7.1
Capital	10.7	16.4	47.6	50.8	7.4	7.5
TOTAL	100.0					

Source: Base year ZVR-SAM and ZVR-CGE Model Simulations

In our simulations, an expansion that is accompanied by an increase in the price of imports for production inputs reduces income growth from 18% (in the injection alone simulation) to 8.7% among non-growers and only 5.6% among growers that get directly hit. This is illustrated in Figures 4.28 through 4.30 by distribution curves that just slightly dominate the base, which means a higher poverty incidence, at all the relevant poverty lines, relative to other simulations. Figure 4.28 shows the situation for all households in tobacco areas, and Figures 4.29 and 4.30 present effects for growers and non-growers, respectively. The export tax has the most devastating effects among growers whose incomes literally stagnate as a result. These results have serious policy implications that are discussed in detail later in this chapter.

Figure 4.28

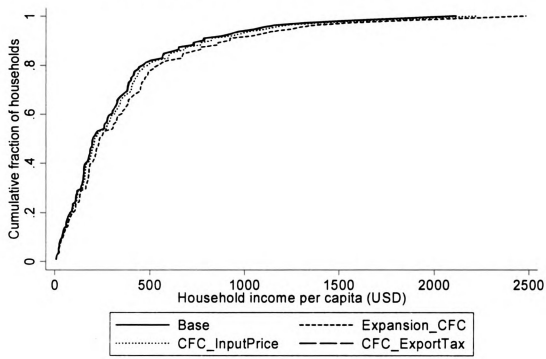
Comparison of Poverty Effects of Simulations, Tobacco Areas Expansion, Import Price of Inputs and Export Tax



Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

Figure 4.29

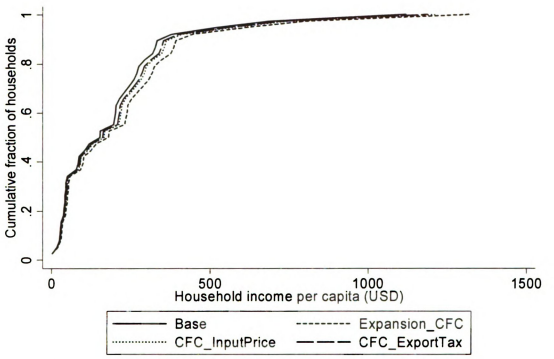
Comparison of Poverty Effects of Simulations, Tobacco Growers Expansion, Import Price of Inputs and Export Tax



Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

Figure 4.30

Comparison of Poverty Effects of Simulations, Tobacco Non-growers Expansion, Import Price of Inputs and Export Tax



Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

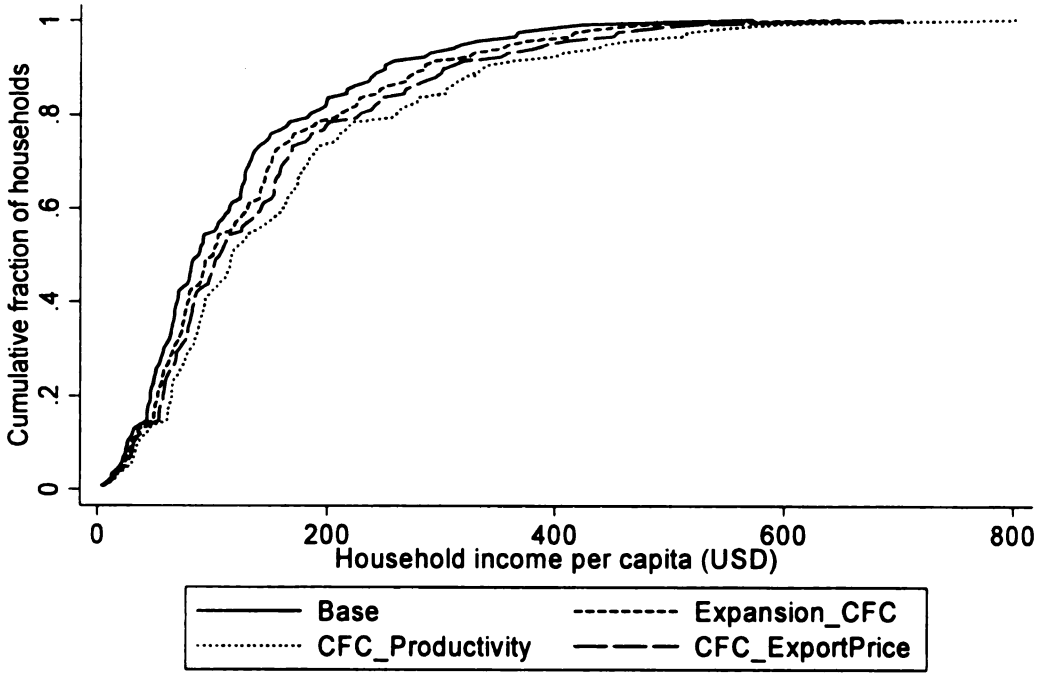
4.5.3. Policy Simulations in Cotton Concession Areas

Household income levels in cotton areas are relatively less responsive to economic shocks than those in tobacco areas. A fifteen percent injection of activity specific capital results in increases in household incomes of close to 14% for both growers and non-growers. This indicates that, without changes in cotton prices and the levels of productivity, the simple expansion of cotton production schemes results in almost equivalent expansion in per capita income of grower and non-grower households. Note that while grower income growth is predominantly attributable to direct effects,

non-grower incomes grow as a result of indirect effects.[67] If that expansion is accompanied by a 15% gain in cotton productivity, income growth is substantially higher; 31.2% among non-growers and 40.5% among cotton growers. An increase in the cotton export price generates income increases in the order of 20.5% among non-growers and only 23.7% among growers. Figures 4.31 through 4.33, present the comparison of poverty impacts of those simulations using CDFs for all households and separately for growers and non-growers in cotton areas. The CDFs are directly computed using the results presented in Table 4.15 for cotton areas and averages across all households.

Figure 4.31

Comparison of Poverty Effects of Simulations, Cotton Areas Expansion, Productivity and Export Price

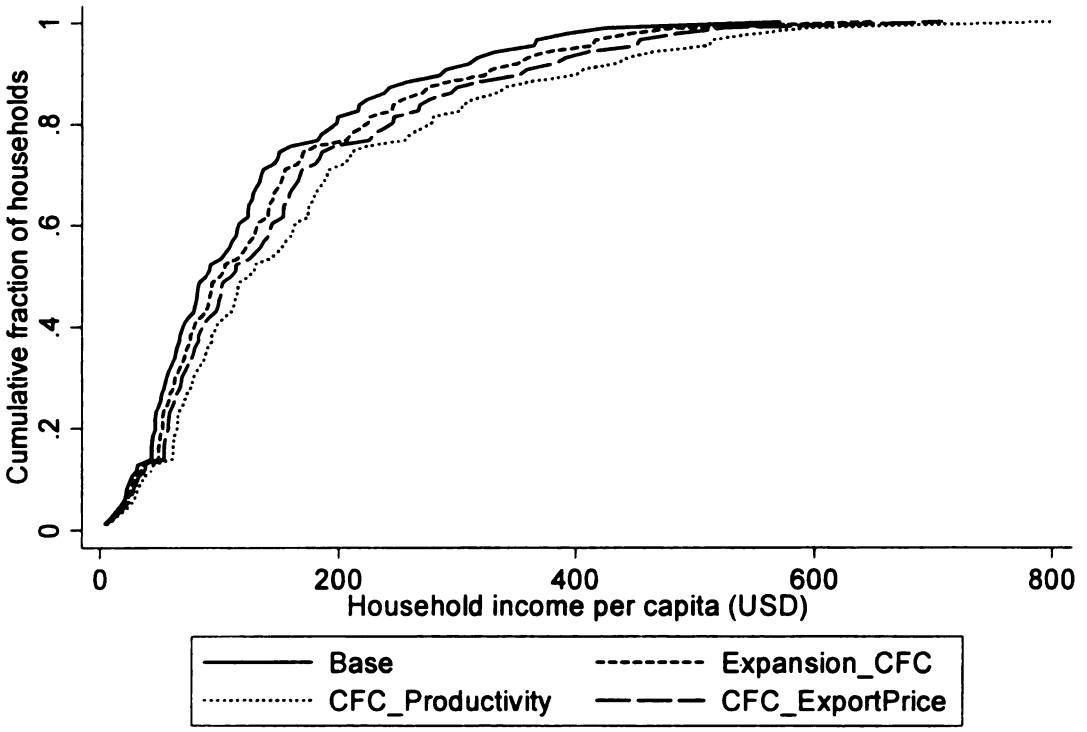


Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

[67] Increases in incomes are a result of a combination of changes (positive or negative) in quantities of factors used, and also changes (positive or negative) in wages/rents of those factors resulting from the adjustment process. Those incomes are remunerated to households in proportions corresponding to their original factor endowments.

Figure 4.32

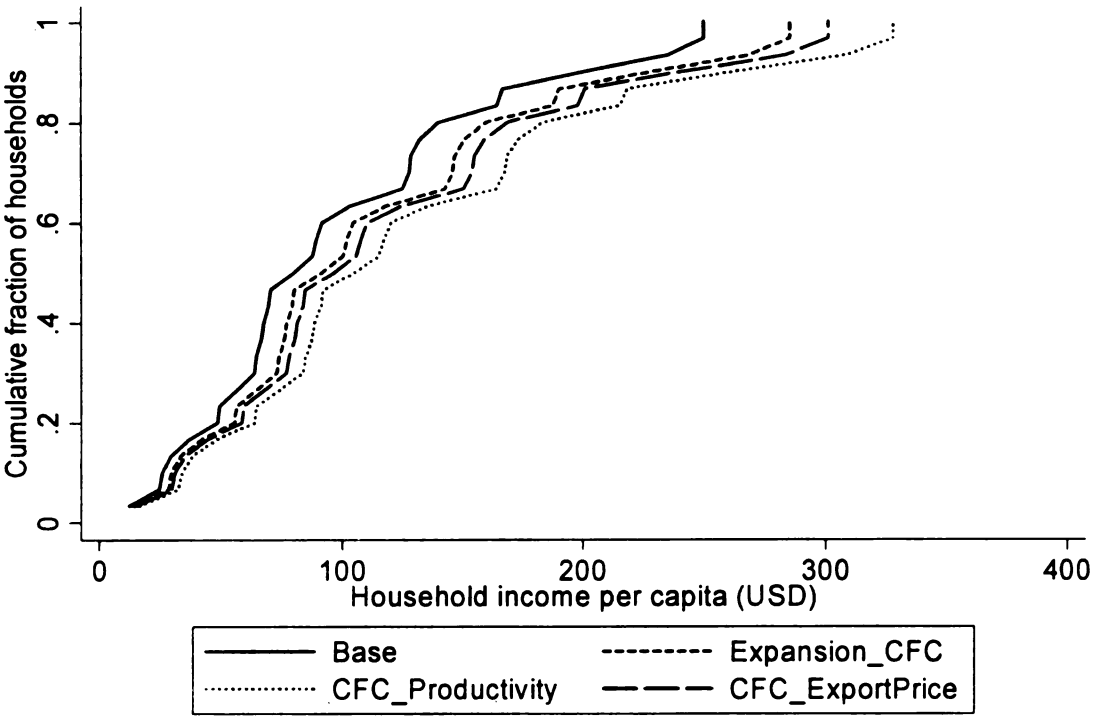
Comparison of Poverty Effects of Simulations, Cotton Growers Expansion, Productivity and Export Price



Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

Figure 4.33

Comparison of Poverty Effects of Simulations, Cotton Non-growers Expansion, Productivity and Export Price



Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

As expected, all these expansions generate additional demand for goods and services proportional to the increases in income for each group, but with variation across the different items reflecting household consumption demand patterns. Like in tobacco areas, we observe an expansion in the level of economic activity in all sectors. For example, in the case of expansion with productivity gains, direct increases in the level of activity of production and value-adding activities in cotton (averaging 44%) are higher than increases in the level of activity of other sectors such as non cash cropping agriculture (32%), livestock, fishing, food processing, manufacturing, and services, that

range from 34-37%. These impacts are detailed in Table 4.20, along with results for other simulations. The Table also shows the base period shares in economic activity.

Table 4.20. Base Shares and Changes in the Level of Activity in Cotton Areas

Economic Activities	Base Activity Level (%)	Changes in Economic Activity by Simulation				
		Expansion Only	Expansion w/ Productivity	Expansion w/ Export Price	Expansion w/ Input Price	Expansion w/ Export Tax
Cotton Farms – C.N.A.	24.6	14.6	44.7	20.2	13.7	10.1
Cotton Farms – Dunavant	3.7	14.5	42.7	19.7	13.6	11.1
Non-Cotton Farms	33.9	14.7	32.4	21.3	13.2	12.8
Livestock	7.9	14.6	35.2	21.4	13.2	12.1
Fishing	5.6	14.5	35.7	22.1	13.0	11.8
Food processing	2.2	14.5	36.6	21.4	13.1	11.8
Beverage processing	1.4	16.0	34.1	15.5	15.4	14.4
Other Processing	2.7	14.4	36.4	22.2	12.9	11.6
C.N.A.–Marketing/Export	4.5	14.6	44.7	20.2	13.7	10.1
Dunavant/Marketing/Export	0.5	14.5	42.7	19.7	13.6	11.1
Trading Services	5.0	14.9	37.9	20.1	13.7	11.9
Government Services	2.4	14.4	36.2	22.4	12.9	11.6
Other Services	5.4	14.5	35.6	22.1	12.9	11.8
Total	100.0					

Source: Base year ZVR-SAM and ZVR-CGE Model Simulations

In spite of that, the quantity of factors demanded from the cash cropping activities is weaker in percentage terms relative to the demand generated in other sectors. In fact, Table 4.21 shows that the quantity demanded of factors by activities with the productivity enhancing path results in an average increase in factor demand from cash cropping activities of about 26%, (27% among C.N.A. farmers and 26% among Dunavant farmers). Note that C.N.A. operations are significantly larger in the base year which results is a larger absorption of resources in absolute terms. Demand for factors among non-cash cropping farming activities increases 32.4%, while among all non-farming activities it grows 32%-38%. In contrast, an expansion without productivity gains but with an increase in cotton export prices, only results in increases in factors demand of

20%-22%, across all economic activities. Table 4.22 shows how factors are allocated across the different activities in the base period.

Table 4.21. Changes in Demand for Factors from Activities in Cotton Areas

Economic Activities	% Change in Demand for Factors by Simulation				
	Expansion Only	Expansion with Productivity	Expansion with Export Price	Expansion with Input Price	Expansion with Export Tax
Cotton Farms – C.N.A.	14.6	27.4	20.8	13.5	9.8
Cotton Farms – Dunavant	14.5	25.7	20.4	13.4	10.8
Non-Tobacco Farms	14.7	32.4	21.3	13.2	12.8
Livestock	14.6	35.2	21.4	13.2	12.1
Fishing	14.5	35.7	22.1	13.0	11.8
Food processing	14.6	36.6	21.4	13.1	11.8
Beverage processing	16.0	34.1	15.5	15.4	14.4
Other Processing	14.4	36.4	22.2	12.9	11.6
C.N.A.–Marketing/Export	14.6	44.7	20.2	13.7	10.1
Dunavant/Marketing/Export	14.5	42.7	19.7	13.6	11.1
Trading Services	14.9	37.9	20.1	13.7	11.9
Government Services	14.4	36.2	22.4	12.9	11.6
Other Services	14.5	35.6	22.1	12.9	11.8

Source: Base year ZVR-SAM and ZVR-CGE Model Simulations

Table 4.22. Base Factor Use Shares by Activity, Cotton Areas

Economic Activities	Use of Production Factors (Allocation across Activities) ---- % of Total Base Year ----					
	Land	Family labor PreHarvest	Family labor PostHarvest	Wage PreHarvest	Wage PostHarvest	Capital
Cotton Farms – C.N.A.	37.9	23.1	23.8	13.4	46.6	20.4
Cotton Farms – Dunavant	4.9	4.8	2.0	4.4	3.9	4.2
Non-Cotton Farms	57.2	41.1	19.0	41.5	15.8	44.9
Livestock	0.0	11.3	12.9	3.9	3.3	0.0
Fishing	0.0	7.4	11.5	6.6	5.0	10.7
Food processing	0.0	1.1	2.3	4.0	0.3	1.0
Beverage processing	0.0	2.0	3.7	0.0	0.1	0.7
Other Processing	0.0	4.1	7.9	0.7	1.3	4.8
C.N.A.–Marketing/Export	0.0	0.0	0.0	0.3	0.8	0.8
Dunavant/Marketing/Export	0.0	0.0	0.0	0.0	0.1	0.1
Trading Services	0.0	1.1	2.6	9.1	8.6	10.0
Government Services	0.0	0.0	0.0	13.1	9.9	0.0
Other Services	0.0	3.9	14.3	2.9	4.4	2.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: ZVR-CGE Model Simulations.

The resulting changes in factor remunerations (additional value of factor payments at market wage/rents), under the productivity gain path, are fairly balanced reflecting variations in wages/rents; remuneration to land increases in about 30%, while that for family labor increases in 33% on average (31% for pre-harvesting labor and 33% for harvesting and post harvesting), and for wage labor increases in 32% on average (33% for pre-harvesting labor and 31% for harvesting and post harvesting). Returns to activity specific capital average 200%, reverting exclusively to grower groups (see Table 4.23). While land is evenly distributed, non-growers, as the most populous group, have most of the labor available in the economy, and benefit from wage labor, particularly in the first part of the season (pre-harvesting) when it supplies over half of the wage labor. In the post harvesting, the initial employment between the two groups is quite similar with each group supplying about half of the labor.

This is a clear indication that productivity increases in cotton production allow for good prospects for expansion not only in the sector itself, but also in other sectors of the economy where resources can be productively employed, which leads to greater possibilities for increase in household incomes irrespective of cash cropping status. As pointed out in the beginning of this section, any expansion in cotton production results in some indirect employment effects to non-growers, even when benefits to growers are limited.

A somewhat surprising result in cotton areas is that, although slowing growth, the effects of adverse circumstances are less severe than in tobacco areas, although, as indicated in the Figures for both groups, poverty is more severe as compared to other scenarios. In fact, an increase in input import prices during expansion reduces income

growth from 14% to an average of 13% among non-growers and 12% among growers. It is clear that that scenario still dominates the base, indicating that poverty reduction occurs, but its magnitude is insignificant. A possible justification for this is that the input package in cotton areas is much cheaper than that in tobacco areas. On that basis, one can infer that price increases of this magnitude are not enough to shake the costs of cotton growers to the extent of impacting poverty significantly. The export tax has also a relatively small impact on poverty, but as expected grower households are relatively more negatively impacted.

Table 4.23. Base Shares and Changes in the Factor Remunerations, by Simulation

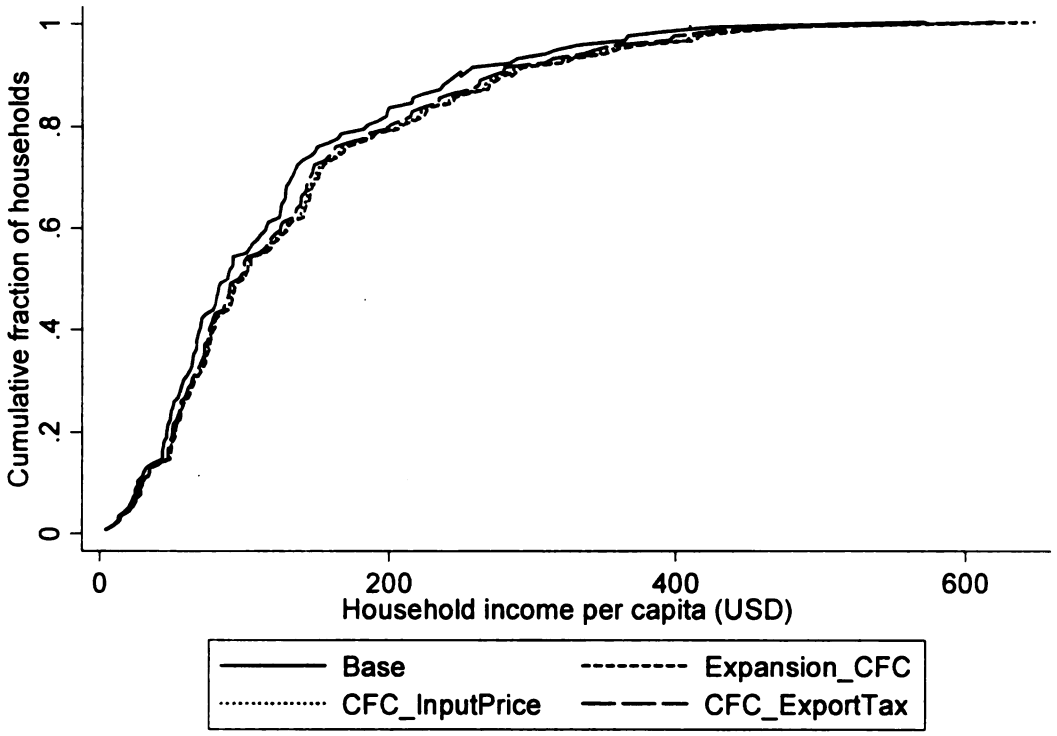
Households and Factors	Base Structure (%)	Changes in Factor Remunerations by Simulation				
		Expansion Only	Expansion with Productivity	Expansion with Export Price	Expansion with Input Price	Expansion with Export Tax
COTTON HOUSEHOLDS						
Land	27.2	14.7	30.2	21.1	13.3	11.6
Family Labor, Pre-harvesting	25.4	14.7	31.9	21.1	13.3	11.8
Family Labor, Harvesting/Marketing	13.9	14.6	32.9	21.2	13.3	11.6
Wage Labor, Pre-harvesting	11.0	14.6	33.1	21.3	13.2	11.9
Wage Labor, Harvesting/Marketing	14.5	14.6	31.3	21.1	13.3	11.0
Capital	1.7	14.7	34.2	21.2	13.2	12.4
Activity Specific Capital	6.4	10.5	200.0	85.0	0.75	-24.0
TOTAL	100.0					
NON-COTTON HOUSEHOLDS						
Land	18.2	14.7	30.2	21.1	13.3	11.6
Family Labor, Pre-harvesting	29.5	14.7	31.9	21.1	13.3	11.8
Family Labor, Harvesting/Marketing	16.8	14.6	32.9	21.2	13.3	11.6
Wage Labor, Pre-harvesting	13.4	14.6	33.1	21.3	13.2	11.9
Wage Labor, Harvesting/Marketing	9.8	14.6	31.3	21.1	13.3	11.0
Capital	12.3	14.7	34.2	21.2	13.2	12.4
TOTAL	100.0					

Source: Base year ZVR-SAM and ZVR-CGE Model Simulations

Cumulative distribution functions of the comparison of effects of the various simulations are presented for all households in cotton areas (Figure 4.34), as well as for growers (Figure 4.35) and non-growers (Figure 4.36).

Figure 4.34

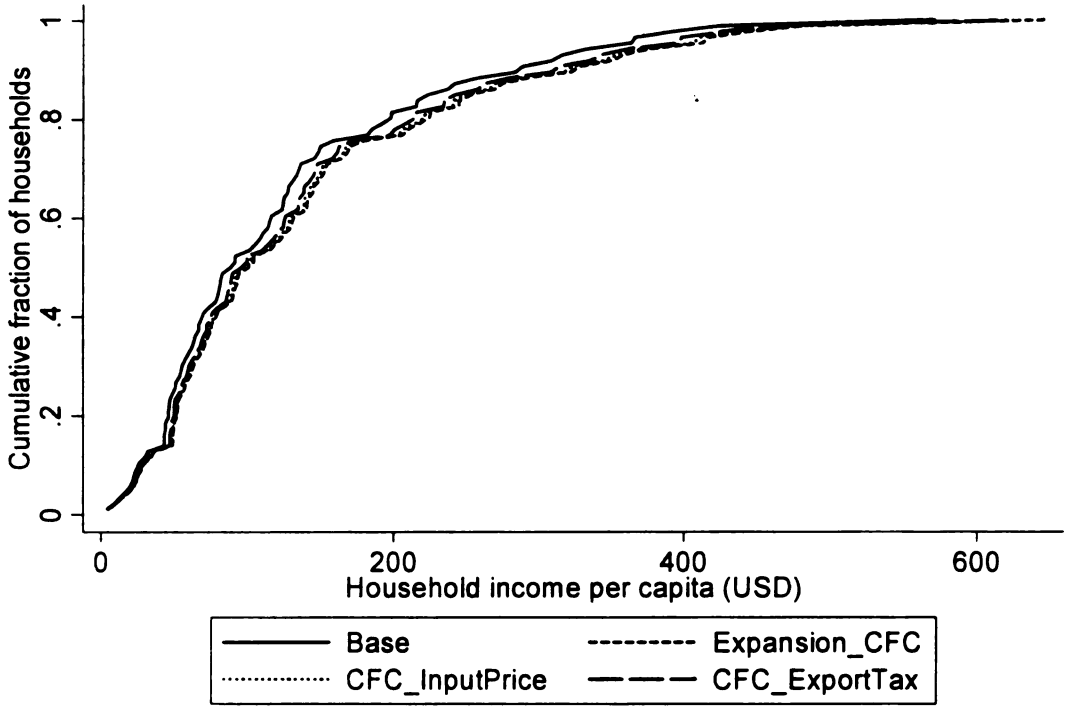
Comparison of Poverty Effects of Simulations, Cotton Areas Expansion, Import Price of Inputs and Export Tax



Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

Figure 4.35

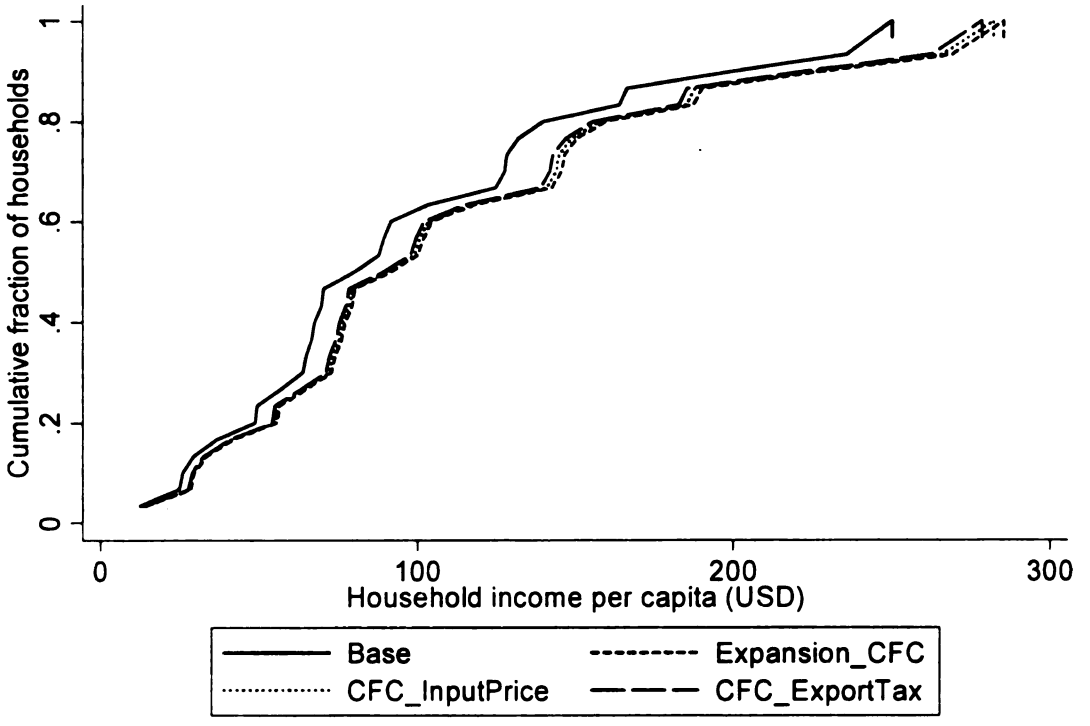
Comparison of Poverty Effects of Simulations, Cotton Growers Expansion, Import Price of Inputs and Export Tax



Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

Figure 4.36

Comparison of Poverty Effects of Simulations, Cotton Non-growers Expansion, Import Price of Inputs and Export Tax



Source: Base year Zambezi Valley Study Survey data ZVR-CGE Model Simulations

4.6. Summary of Policy Implications

A fundamental question in this essay is related to the extent to which strategies that rely on indirect effects can effectively be used to target rural poverty. In other words, can shocks to cash cropping sectors generate broad based income growth and poverty reduction effects? If so, how strong are those indirect benefits? We address this issue through the analysis of the poverty impacts of selected policy simulations – favorable and unfavorable shocks occurring concomitantly to expansion of contract farming schemes in cash cropping economies in the Zambezi Valley of Mozambique. Such shocks include

technology shifts, trade issues including increases in prices of imported inputs, changes in export prices of maize, cotton, and tobacco, and government export taxes.

In tobacco growing areas, expansion in the sector spreads growth to virtually all sectors of activity, including non-cash cropping agriculture and non-farming activities such as manufacturing and services; these growth results in greater remunerations for grower and non-grower households, via the increased demand of factors by those activities. The analysis suggests that in these areas, the benefits of expansion with higher tobacco prices have a very important poverty reduction impact, particularly among cash crop growers, even when productivity is assumed unchanged. However, a more balanced growth in incomes of growers and non-growers is obtained when productivity among growers increases. Increases in import prices of inputs and Government imposed taxes on tobacco exports significantly slow down income growth in rural areas, particularly among grower households. Since export price increases are uncertain, and almost as likely to occur as reductions, a productivity increasing effort is worth pursuing in tobacco areas to compensate for any losses resulting from exogenous factors, including increases in import prices of chemical inputs and seeds, and even reductions in export prices. Associated interventions can include strengthening of extension systems to ensure the use of proper techniques/field practices, better grading, and improved environmental management. Regarding foreign trade policy, the findings suggest that the Government needs to avoid the use of trade restrictions, such as export taxes, as they may undermine poverty reduction efforts by significantly slowing down income growth. On the other hand government and private businesses need to find ways to minimize the importing costs of intermediary inputs. While Mozambique has no power to influence world prices

of imported intermediaries, any policies that prevent further costs increases and actions that can help reducing transaction costs are welcome.

In the cotton sector, several studies have emphasized low prices and poor productivity at the farm level as factors leading to the stagnation farmer incomes in Mozambique (World Bank, 2005; Tschirley *et al.*, 2005).[68] This essay documents the low profitability of the crop relative to tobacco in the Zambezi Valley region. The concession model as applied in Mozambique, which precludes competition among companies and does not balance this with any effective performance monitoring system, must be considered an important contributor to the problem of low prices and also low productivity (Tschirley et al, 2006; Poulton et al. 2004); management subjected to little or not competitive discipline will be able to transfer inefficiency costs to farmers through low prices.

Simulation results indicate that, although limited when compared to tobacco areas, expansion in the cotton sector, even when benefits to growers are small, generates some expansion in non-cotton sectors where resources are productively employed. When that expansion is accompanied by productivity gains in cotton there is a much stronger broad-based income growth and poverty reduction effect, even greater than increased world prices. From a policy standpoint, because sustained increases in world prices are unlikely, this result is encouraging. All this suggests that continued expansion efforts in cotton focused on dealing with institutional issues and productivity enhancing technologies, as they succeed, will increase those benefits significantly. Interventions to

[68] In fact, Mozambique pays the lowest prices in the region; the 1998-2002 average producer prices were $0.16 per kilogram, compared to $0.22 in Zambia and Tanzania and $0.25 in Zimbabwe (Poulton *et al.*, 2004). Likewise, yields are amongst the lowest in Africa; 0.51 tonnes per hectare in 2003/04, compared to 0.9 tonnes in Zimbabwe and over 1.0 tonne in West Africa (Lemaitre et al., 2001). Tschirley et al (2006) assess the impacts of the sector's regulatory structure on this performance.

improve the business environment for the emergence and sustained growth of non-farm businesses are also important to fuel further growth.

Lastly, a set of additional policy considerations are worth pointing out. We find that, in both areas, households are heavily engaged in maize production and trade, and can benefit substantially from high export prices.[69] Benefits are more sizable among cash crop growers but poverty reduction among non-growers is also remarkable. While high export prices of maize are desirable, they are outside the control of Government and individual producers and traders. The important policy implication here is that Government needs to allow continued flows of maize between locations inside Mozambique, and exports to neighboring countries, such as Malawi and Zimbabwe, when those countries are faced with cereal deficits.[70] Given the limited effective demand inside Mozambique, and the high unit transportation costs in that domestic trade, this is a good opportunity that can help reduce poverty in rural communities on a broad based fashion, especially at times when prices are high. In this line, it is suggested that contract farming schemes in both areas include improved maize seeds, and productivity enhancing technologies to increase maize yields and maximize these potential impacts. In addition to income poverty reduction, improved maize yields also have important implications for household food security in those areas.

Finally, it is important to emphasize the need for complementary research in key aspects that fall outside the scope of this essay but which are crucial for the advancement of the sectors and for their sustained positive impact on broad based income growth and

[69] Note that the notion of trade here includes both exports to the domestic (other parts of Mozambique) and foreign (neighboring countries) rest of the world.

[70] Episodes of trade restrictions, particularly in border areas, have been more common as local practice than as an official central government policy; the latter is openly favorable to free trade. It is, therefore, important that government be more active in ensuring that local authorities do not prohibit maize trade.

poverty reduction. We suggest that strategies that emphasize improved coordination for facilitating investments in research and extension combined with area expansion and increased productivity and quality at the farm level should be identified and encouraged.[71] Research needs to continue focusing on the analysis of the implications of the current market and regulatory structure for competition and sector coordination, and suggest ways to overcome current constraints to maximize the effects of interventions on rural poverty.

[71] That can be achieved with high yielding quality seeds, the strengthening of extension systems for disseminating good field practices and grading standards, and sufficiently remunerative producer prices to ensure a continued and increasing participation of farmers in the sectors.

CHAPTER 5

SUMMARY OF FINDINGS AND POLICY IMPLICATIONS

5.1. Introduction

Poverty is widespread in Mozambique, with greater incidence in rural areas where the highest proportion of the population live and work. Livelihood strategies among rural households in the Zambezi Valley are predominantly based on agricultural activities, but income diversification is increasingly important. Cash income from agriculture comes predominantly from tobacco and cotton production. Due to cash constraints and poor access to inputs and credit by farmers, and high demand from buyers to meet quality and volume requirements, contract faming is the dominant form in the organization of transactions in those cash cropping sectors. As applied in Mozambique, government grants processing companies legal monopsony rights to buy all the output from contracted farmers in specified geographical areas; in return, processors, who need to spread their fixed costs over as much product as possible, provide inputs on credit and extension assistance to small farmers. Government additionally sets a minimum price for seed cotton, though not tobacco, each year. The selective nature of contract farming implies that not all households may have the chance to directly participate in these schemes; some households are excluded. A key question, then, is how large and widespread the indirect income effects of these schemes are, compared to the direct effects. The answer to these questions has a lot to say about the poverty reduction effects of such crops, and may generate insights about policies and programs to enhance these effects.

The general purpose of this study is to help guide government and donors in their decisions to allocate development resources to induce private sector investments that yield high profits to firms while generating broad based income growth and poverty reduction. Specific research objectives are as follows. First, we seek to understand the nature of contract farming schemes for cotton and tobacco, and the rationale for their persistence. Second, we develop econometric models to assess the determinants of farmer participation and profitability in contract farming. Those models are extended to assess the effects of participation on agricultural and total household incomes, accounting for threshold effects of education and land holdings to identify more precisely the types of farmers likely to benefit more from contract farming. Finally, we use an economy-wide model to account for feedback effects and evaluate the income poverty effects on different household groups of expansion and exogenous shocks in cash cropping sectors.

This study uses data from a two-round survey undertaken with households in tobacco and cotton concession areas of the Zambezi Valley of Mozambique. The study also uses household consumption data from the National Expenditure survey (IAF 2002-03) to derive household expenditure shares, and secondary data for the cotton and tobacco sectors, both at the aggregate and firm level. The household level survey collected data on the level of intermediate input use and the variation in factor use, particularly seasonality in labor demand and household decisions with respect to the use of family or wage labor and its allocation across competing activities. The survey also collected data on production and marketing of crops, livestock, and fishing, non-farm enterprises and wage labor, asset ownership, and remittance income. The data collected were used for the econometric analysis and for the construction of a Regional Social

Accounting Matrix for the Zambezi Vally (ZVR-SAM); this SAM served as the database for a Regional Computable General Equilibrium (ZVR-CGE) model developed to undertake policy simulations. In Section 5.2 we summarize the research findings. Section 5.3 presents a summary of policy implications and suggestions for future research.

5.2. Summary of Findings

In this Section we summarize the key research findings in this study. Therefore, we start with the findings on the institutional analysis, followed by the econometric analysis of determinants of participation and performance, and finally the economy-wide model results on the impact of exogenous shocks on rural poverty.

5.2.1. Organization of Production and Trade in Cash Cropping

The institutional/transaction costs analysis indicates that in both sectors contract farming arrangements appear as an institutional response to widespread failure in input, credit and output markets, and the lack of an effective public or private service provision network. The outgrower firms (ginners in cotton and multinational trading/exporting firms with processing facilities in neighbouring countries in the tobacco sector) need to ensure product quality and a large volume of purchases to reduce unit marketing and processing costs. In general, farmers have very few cash generating alternatives, so that input credit and a guaranteed output market appear as an important opportunity. Looking at specific factors related to production, marketing and processing characteristics of the crops, and a set of economic and political factors, the analysis concludes that some level of non-market vertical coordination is likely to emerge under these circumstances as pure spot markets are absent on both the input and the output sides and production

specifications require some degree of supervision and specific production techniques; this is particularly important in tobacco, which uses a wider range of productivity enhancing inputs and is more demanding in its field practice requirements. The analysis finds that full vertical integration, i.e., plantation type arrangements, is not feasible due to the labor intensive nature of the production process that would make labor supervision costs extremely high. Also, under a plantation type arrangement, the firms would be obliged to pay the statutory agricultural minimum wage which is generally higher than the informal wage that smallholders pay to hired labor and, in some cases, even higher than the implicit wage that most smallholders end-up earning as contract cash crop growers .

While contract farming allows these systems to function, asymmetric information and unbalanced bargaining power over issues such as prices and grading have emerged as barriers to its development. Furthermore, especially in cotton, low world market prices, low ginning outturns, and low productivity at the farm level have constituted major constraints. These are, in part, consequences of a wide range of market and coordination failures and weaknesses in the concession system, many of which are beyond the scope of this study; we focus first on understanding the direct effects of the systems as they currently exist, then examine economy-wide effects of expansion and exogenous shocks.

5.2.2. Econometric Analysis: Farmer Selection/Performance and Effects of Participation

For each sub-sector we use a standard sample selection model to assess the determinants of farmer participation and, to analyze the factors explaining the level of profits accruing to scheme participants. Then, we use a treatment effects model to assess whether farmer participation in contract farming schemes has a significant impact on levels of crop and total household. To identify the types of farmers that benefit from

participation, we investigate the effects of participation interacted with thresholds of educational attainment and land holdings.[72]

Probit results for *tobacco areas* indicate that household participation in tobacco contract farming schemes is more associated with endowments, technology, and income diversification opportunities and less with demographic characteristics. First, there are no effects of household head gender, nor effects of educational attainment. Second, the availability of draft animals, and the value of production tools increases the likelihood of farmer participation. Third, there are no land threshold effects on participation. Finally, households with greater livestock sales and wage labor are less likely to participate in contract farming schemes.[73]

Tobacco growing households exhibit highly variable profits; 30% lost money during our survey year, while average annual profits were $730.74, which represents nearly half of the value of their total crop production. The analysis of the determinants of tobacco cash income in the second step does not give evidence of sample selection bias. Once households choose to engage in tobacco production, some effects are observed. First, the level of education attained by the head of the household is not statistically significant. However, education plays an important role in determining access and outcomes in off-farm income in tobacco growing areas. Regression analysis using a two-stage procedure indicates that education of the household head is an important determinant of participation in both self-employment and wage labor in tobacco growing areas. However, only wage labor market earnings are statistically increased with the educational attainment of the head (regression results are presented in Appendix B).

[72] Education attainment and land area thresholds are also introduced in the profits determinants model.
[73] Each of the income diversification variables was tested for endogeneity, using the Hausman Test. In each case we failed to reject the null hypothesis of exogeneity.

Second, female headed households run less profitable tobacco farming operations, with profits that are, on average, $400 lower than those of their male counterparts. Third, land holdings have a large effect on profits only at the highest threshold level, with profits of land rich tobacco growing households averaging $780 over that of land poor tobacco growers; effects at lower levels of land holdings are not statistically significant.[74] Fourth, the value of household production assets has a positive and statistically significant effect on earnings. Finally, agro-ecological/location specific fixed-effects are observed; grower households in mid-high altitude areas have profits significantly higher than those of their counterparts in drier, lower altitude areas.

Model results for *cotton areas* in the first stage probit indicate that the likelihood of participation is not positively associated with the educational attainment of the household head. This is consistent across cotton areas in Mozambique, where more educated households show a higher propensity to engage in more profitable non-farm activities; two-stage regression analysis in cotton areas in the study region, however, show that there is a positive association between education and participation in non-farm self employment, but it is not statistically significant. Likewise, a non-statistically significant relationship is found between education and outcomes in non-farm activities. Some other results stand out. First, households that have larger areas of land are more likely to engage in a contract; all land threshold dummies are statistically significant. This is in sharp contrast with the tobacco results, which showed no impact of land holdings on participation. A possible explanation for this difference is that, while land is the single

[74] The finding of land threshold effects on performance but not participation suggests that access is not biased towards the land rich. While access to the schemes is more driven by factors other than land holdings alone (e.g., managerial ability), participation itself, all other factors equal, is more rewarding for land rich smallholders.

most important factor for cotton production (under the current technological package), participation in tobacco is more demanding, including the (unobserved) ability required to manage production resources in a more complex set of field activities. Second, unlike in tobacco areas, a higher value of production and marketing assets has no effect on the likelihood of participation in the schemes. Third, access to alternative sources of income, such as livestock and self-employment, reduces the demand for cotton production contracts. Due to the overwhelming use of family labor, wage labor income opportunities do not compete with direct participation in contract farming.

Cotton growing households also exhibit variable profits, with 20% incurring losses; average profits are only $93.60 per year, less than 20% of the value of their total crop production. Second stage OLS regression results for farmer performance in cotton schemes indicate the presence of sample selection bias. Among demographic variables, only the number of adult equivalents is statistically significant at 10%, each adding on average $37 per year.[75] Education of the household head is the only other demographic variable close to significant, which is a rough indication that, although highly educated heads tend not to participate in cotton farming, when they do, they may do better than the less educated ones. Furthermore, like in tobacco areas, total area owned is statistically significant only at the highest land holding quartile, where land rich cotton smallholders exhibit profits that are close to $150 higher than those of land poor cotton growers. Also, the value of production and marketing equipment increases returns to cotton. Finally, profits in all Dunavant locations are statistically lower than those in Gorongosa , a C.N.A. area.

[75] This result points to the relatively greater importance of family labor compared to hired labor in cotton areas. In tobacco areas, given the importance of wage labor, the availability of adults in the household is less important.

The *Treatment Effects Model* is designed to analyze the effect of participation associated with education attainment and land holding thresholds, on the levels of crop and total household income, controlling for other factors.

The model performs well in both areas and reveals some important results. In *tobacco areas* there are indications of significant returns to participation, but only at the highest land holdings threshold for both crop and total household income levels[76]; interaction effects of participation and land area owned dummies are only statistically significant and sizable ($1,306) at the highest land quartile. The magnitude and significance at that level is stronger for total household income ($1,576) suggesting that even larger farmers appear to not be giving up on profitable off-farm income generating opportunities. There are no participation-education threshold effects. This is a surprising result for a crop that requires careful management and which features steep price discounts for poor quality; further investigation is warranted. The model reveals that female headed households in tobacco areas earn lower crop incomes than their male counterparts ($488 less). However, differences in total income are not statistically different, which may suggest that off-farm income contributes to reduce gender differentiation in incomes in those areas. Higher value of production and marketing assets contributes to higher total household income. Finally, the model exhibits weak agro-ecological or location fixed effects. Likewise, incomes of participants across locations are relatively balanced.

The treatment effects model results for *cotton areas* show no statistically

[76] In tobacco growing areas, average total crop income at the household level is approximately $1,315 ($1,573 among growers and $596 among non-growers), while total household incomes (crop plus income from farm and non-farm activities off the household farm) is $1,606 ($1,815 among growers and $1,023 among non-growers).

significant returns to participation, even when land holdings and education thresholds are interacted with participation. This indicates that total crop and total household incomes[77] between cotton growers and non-growers, after controlling for demographic, factor and asset/technology endowments, and spatial factors, are not very different, and even income across participants differentiated by land or education attainment are not very different. Like in tobacco growing areas, but with an effect smaller in magnitude, higher value of production and marketing assets contributes to increased crop and total household income in cotton areas. There are no significant district fixed-effects in cotton areas.

5.2.3. Economy-wide Analysis: Income Poverty Effects of Expansion and Shocks

The econometric models gave some important indications regarding the importance of landholdings in cash cropping and the identification of the types of farmers that benefit from participation in the schemes.[78] These results lead to the question of how important the effects of expansion in cash cropping sectors are to different types of households. The ZVR-CGE model introduced in the analysis was intended to further investigate the effects on income growth and poverty reduction of cash crop expansion and of a series of exogenous events hypothesised to take place during expansion. Expansion was simulated as an increase in capital endowments specific to cash cropping sectors. The other exogenous shocks simulated were selected on the basis of current issues that are considered relevant for the sectors. They include increases in productivity, increase in export prices for tobacco, cotton and maize, increase in import prices for

[77] In cotton growing areas, average household total crop income is $479 ($518 for growers and $365 for non-growers), while total household incomes (crop plus income from farm and non-farm activities off the household farm) is $692 ($732 for growers and $574 for non-growers).

[78] Remember that land holdings threshold effects were statistically significant for both cotton and tobacco profits. Land holding threshold effects on participation were only strong for tobacco growers.

inputs, and a government imposed tax on cash crop exports. The discussion of policy implication in the next section contextualizes each of these shocks.

In the CGE model we assume full employment of activity-specific capital and unemployment with full mobility of all other factors. Model simulations suggest that growth rates of income and poverty reduction effects of expansion and exogenous shocks are sizable in both areas, but larger in tobacco areas.

In tobacco areas, an expansion of 15% combined with a 15% increase in export prices yields a greater impact than the same expansion with productivity gains of 15%. In fact, expansion with higher world prices results in an increase of 49% in per capita incomes of non-growers and 79% in the incomes of tobacco growers; expansion with increased productivity results in relatively lower, but still significant, growth rates of 43% and 62%, respectively. Model results indicate that this growth in per capita incomes of households (growers and non-growers) results from a number of linkage effects. Initial expansion in the sector generates increased level of economic activity across all sectors, including non-tobacco agricultural activities and non-farm activities. The relatively higher level of economic activity results in greater remunerations for grower and non-grower groups alike, via the increased demand of factors by those activities.

In contrast, in cotton growing areas, where productivity is extremely low, expansion with productivity gains has a relatively greater impact than expansion with increases in world market prices; growth in per capita incomes for cotton non-growers and growers is 31% and 40%, and 21% and 24%, respectively. Model results indicate that productivity gains (compared to price increases) in cotton areas generate a relatively higher and broader (beyond cotton itself) growth in the level of economic activity across

all sectors. That translates in an increase in the volume of cotton that is proportionally greater than the increase in price simulated, implying higher incomes to grower farmers. The relatively higher level of economic activity results in greater remunerations for grower and non-grower groups alike. It appears that the more efficient use of labor in cotton has important implications for other sectors as well. In fact, those activities are able to use more labor as a result, i.e., they exhibit a greater growth (in percentage terms) in labor demand although absolute base levels are typically higher in cotton production itself. We conclude that productivity increases in the cotton sector lead to good prospects for expansion in other sectors as well, and that it can potentially be beneficial to non-growers, even when benefits to growers are limited.

Adverse events such as input import price increases and export taxes slow down poverty reduction effects significantly. The damages of increased input prices are more severe in tobacco growing areas, where the input package is substantially more expensive. The effects of an export tax are more severe in tobacco growing areas where it significantly slows down the effects of otherwise successful expansion efforts. In both areas, better maize prices have very positive implications for poverty reduction.

The ZVR-CGE model results confirm several indications from the econometric analysis. First, effects of the cash crop on non-grower income growth and poverty reduction, though lower relative to grower groups, are significant. Greater demand for factors in response to increased demand for farm and non-farm goods and services, and its subsequent remuneration to household groups explains these broad based effects. Second, relative effects in favour of grower groups are more accentuated in tobacco areas than in cotton areas, confirming that grower households in tobacco areas are not giving

up on profitable non-farm opportunities that expand significantly as cash crop production expands.

5.3. Policy Implications and Future Research

In general, the cotton and tobacco sectors in Mozambique have provided a great deal of the rural population in concession areas with a secure source of cash income in areas where alternative income generating activities are limited. These cash crop sectors are currently faced with a number of pressing issues. In this section we look at those issues as they relate to the analysis presented in this study and the relevant implications for poverty reduction in the study region. Such issues include the effects of a proposed tobacco export tax on rural poverty; the implications of a cotton sector recovery that relies on enhanced productivity; labor migration and growth of the tobacco sector; interactions between rural education, cash cropping and poverty reduction; and a set of general issues such as maize trade, input distribution and environmental and technological spillovers.

First, a proposal to impose an export tax on raw tobacco, as a way of encouraging domestic processing, has been the object of great controversy in recent years. Benfica *et al.* (2005) discuss the implications of that policy in a cost-benefit framework, and conclude that the imposition of such a tax at this stage of the development of the tobacco sector is not appropriate, and suggest that other ways to promote investments in processing be found without compromising the long term sustainability of the sector. Findings in this study strongly reinforce this recommendation: a 15% export tax would eliminate any income gain to grower households from a 15% expansion of the tobacco sector, and would reduce income gains to non-growers from 18% to 6%. It is, therefore,

recommended that Government not embark on such policy as it is not consistent with its ultimate poverty reduction objectives.

Second, this study documents the low profitability of cotton (associated with low prices and low productivity) relative to tobacco in the Zambezi Valley region. Part of the reason for this poor performance relates to the nature of the cotton concession model as applied in Mozambique - which precludes competition and does not balance this with any effective performance monitoring system. Therefore, we suggest that high priority is given to the development of a more adequate management of the concession system in the near future.

In this study we find that increased profits in cotton can be achieved with increased farm size and a higher level of production assets. However, there are no landholding threshold effects on total crop income nor on total household income, which suggest that the cotton activity generates some, but not yet very strong, economic linkages that can sustain overall economic gains. This calls for policies aimed at higher yields at the farm level and the promotion of non-farm businesses in those economies. Economy-wide simulation results indicate that productivity gains in cotton have a broad-based income growth and poverty reduction effect, even greater than increased world prices; on a policy standpoint, because sustained increases in world prices are unlikely, this result is encouraging. This study suggests that maximizing the contribution of cotton to smallholder livelihoods will require increased productivity at the farm level, that can come about through improvements in the seed stock (quantity and quality), as well as in the input package, extension, and prices to farmers. Also, reforms currently underway need to be participatory and be given top priority by stackeholders (public and private)

interested in the sector and in smallholder welfare, in order to better explore the available alternatives.

Third, the successful expansion in tobacco production has been possible due to the readily available labor in border areas that is knowledgeable of tobacco cropping. Circumstantial evidence suggests that this labor force is a mixture of returned refugees (established in Malawi during the Mozambique Civil War), family members of these returnees, and a genuine new generation of Malawian migrant laborers, many of whom are former tobacco smallholders in Malawi that find the wage labor opportunities in Mozambique more profitable. In terms of our model, these patterns of employment raise concerns about possible consumption leakages; the corollary in popular sentiment is that this income should be going to Mozambicans, not Malawians. Yet, over 75% of the so called "Malawians" report spending 9-12 months working in Mozambique, which suggest that a great deal of their annual consumption takes place in Mozambique. In practice our study suggests that (i) income leakage is not a major problem, and (ii) availability of Malawian labor is important to the growth of the sector. A policy implication is that efforts to ensure that Malawi migrants gain some kind of permanent residency that leads them to spend more time and resources in the Mozambican territory can be helpful to feed expansion of the sector and spread its benefits in the local economy.

Fourth, the lack of effect of education, while somewhat expected in cotton areas, is surprising in a crop as demanding (in field management) as tobacco. We suggest that great scope remains for improving field practices, yields, and profitability; as companies strengthen their extension efforts and more farmers have more time to learn and apply

improved techniques, more educated farmers will begin earning higher returns from tobacco. The immediate policy implication is that incentives need to be put in place to push companies to strengthen their research and extension systems and allow those benefits to cash crop farmers and consequently spread poverty reduction effects in rural areas. More research in this area is needed.

A set of additional policy considerations are worth pointing out. First, maize is important both as a food security crop and a cash crop in these areas. Simulation results indicated that better export prices for maize reduce poverty in all areas and across all groups. Therefore, a continuation of a policy that does not restrict trade both in-country and across national borders is important. Second, although results indicate limited negative effects of high import prices for inputs, particularly in cotton areas, where the input package is relatively cheaper, measures aimed at reducing the costs of importation and transport are highly encouraged, as they can help minimize any negative effects from factors outside the control of domestic agents. Finally, the issue of technological and environmental spillovers requires more attention. On the positive side, survey results indicate that the use of fertilizers on maize by non-growers of tobacco in tobacco areas is very positive, given the strategic importance of that crop for poverty reduction and household food security. On the negative side, tobacco expansion leads to extensive tree cutting. Survey data indicate that the rate of tree cutting by tobacco growers far surpasses the rate of planting. If those trends are not halted, the long term consequences can be catastrophic. Specific actions to contain or reverse the situation are required.

Results in this research raise some issues that merit further investigation. One such issue, particularly in tobacco growing areas, is related to the significant effects of

participant land holdings at the highest quartile and its implications for the relationship between company expansion strategies (between one that focuses in a large number of smallholders versus another that favors a smaller number of larger farmers) and poverty reduction. On the one hand, we find that, although profitability is higher among those with more land, overall, larger farmers are not more likely than others to cultivate tobacco; in principle, one would expect farmers with more land wanting to get engaged in the crop, and concession companies pushing towards more support to larger farmers. Understanding why this is not happening is an important question to pursue through further research. On the other hand, our findings indicate that tobacco growers are less likely to engage in wage labor and many smaller tobacco farmers earn negative profits with the crop. In light of previous research indicating the occupational persistence of wage earners, especially those on the high end of the labor market (Tschirley and Benfica, 2002), and the increasing importance of wage labor in lifting rural incomes (Boughton et al., 2005), an implication of the continued expansion of tobacco area is that significant wage labor employment opportunities will be generated, bringing higher incomes to non-grower wage laborers. In this case, those left behind will be the smaller cash crop growers, who, in addition to being more likely to have a loss in the crop, also have little access to wage labor opportunities. Further research is necessary to better understand the factors behind these results and get a clearer indication, for each sector, on whether an expansion with lager farmers each getting relatively large levels of support is favored over one that emphasizes small sized farms.

Finally, there is need for complementary research in key aspects that fall outside the scope of this study but which are crucial for the advancement of the two sectors and

for their sustained positive impact on broad based income growth and poverty reduction. We suggest that strategies that emphasize improved coordination for facilitating investments in research and extension, combined with area expansion and increased productivity and quality at the farm level, should be encouraged. Furthermore, research needs to continue focusing on the analysis of the implications of the current market structure for competition and sector coordination, and suggest ways to overcome constraints and maximize the effects of interventions.

APPENDIX A
SAM MULTIPLIER ANALYSIS

The SAM (Social Accounting Matrix) based multiplier model evaluates the effects of exogenous income injections (shocks) on the endogenous accounts as a result of policy or program changes (Pyatt and Round, 1979 and 1985; Parikh and Thorbecke, 1996).

A balanced SAM requires that for each account incomes equal expenditures, i.e.,

$$\sum_j T_{kj} = \sum_j T_{ik} \qquad \text{(B.1)}$$

where k refers to a given row I and column j corresponding to the same SAM account.

Formally, for a SAM multiplier analysis, the SAM transactions matrix, T, is converted into a matrix of average shares (or average expenditure propensities), A_n,[79] by dividing the cells in each row ($T_{i,j}$) by the column sums (y_j):

$$A_{i,j} = T_{i,j} / y_j \qquad \text{(B.2)}$$

where $\sum_i A_{i,j} = 1$, for every j.

Deleting the rows and columns for the exogenous accounts from A_n yields a sub-matrix of endogenous shares, C_n, with the entries $Cn_{i,j}$.[80] The total income can now be

[79] This shares matrix provides raw material for much economic analysis. The intermediate input coefficients in cell A_{21} correspond to the Leontief input-output coefficients. The coefficients for primary factors in cell A_{31} are value added coefficients and give the factor distribution of income. Column coefficients for commodity accounts represent domestic and import shares, while those for households, government and investment represent expenditure shares for these final demanders. This matrix is the base for the multiplier model explained in this section. This matrix is also provides the starting point for estimating parameters of non-linear, neoclassical production functions, factor demand functions and household expenditure systems of the type introduced in the CGE model in the next section.

[80] Note that using average expenditure shares implies unitary expenditure elasticities, and hence the computed average expenditure propensities are constant over any incremental exogenous injection, which constitutes a major limitation. One mechanism used to relax this restriction is to incorporate marginal rather than average expenditure propensities in the C matrix prior to computing the M matrix, with the help

computed as

$$Y_n = C_n Y_n + X \tag{B.3}$$

where X is exogenous income.

From this, it follows that

$$dY_n = C_n dY_n + dX \tag{B.4}$$

$$dY_n = M_c dX \tag{B.5}$$

where the square matrix $M_c = (I - C_n)^{-1}$ is the multiplier matrix, the inverse of the 'identity matrix (I) less the SAM coefficients matrix of the endogenous accounts'.

The Multiplier, M_c, contains production effects in the rows corresponding to the sectors and the income effects in the rows corresponding to factors and households. Consider the multiplier matrix with entries $Mc_{i,j}$, where I represents the rows and j the columns. Since M_c is a square matrix, the number of i's and j's is the same. The effects of an injection or increase in exogenous demand for a sector – the effect of one additional dollar – is given by the entry corresponding to that sector, i.e., in the main diagonal i=j. The effect of that same dollar on the production of other sectors is found in that same column j, but in the rows I that refer to those other sectors, and can be interpreted as the production linkage effect. Total production multipliers can be estimated by summing the multiplier of all sectors ($Mc_{i,j}$) for the given j column of the impacted sector. The impact on individual household groups can be read from the individual rows and the total effect is the sum of the individual impacts – read vertically in the column corresponding to the impacted sector. Likewise, the impact of transfers to the household groups can be

---

of consumer expenditure survey data (Thorbecke and Jung, 1996; Parikh and Thorbecke, 1996). Lack of detailed information on household consumption behavior in rural areas may prevent that.

inferred by reading the multipliers, in the respective column of the impacted group, for the different sectors of activity, factors and households.

More generally, therefore, the change in the incomes of the endogenous accounts (dY_n) – a column vector – can be derived by pre-multiplying the exogenous change (dX) – a column vector – by the SAM multiplier matrix (M_c) – a square matrix. Note that this a multiplication of a matrix with a vector, and that the vector of changes has a number of rows corresponding to the number of endogenous accounts and the entries will be non-zero for the accounts that are being injected and zero for the others.

Also, there are leakages (L) in this process, i.e., part of the additional income (dY_n) will be leaked through induced demand for imports, induced government revenues or induced savings. This can be represented as $dL = BdY_n$, where B represents the leakage propensity of the economy.

Table A.1 summarizes the SAM multiplier process. Y_n is the vector of total income or expenditures of the endogenous accounts; X is the sum vector of the expenditures of the exogenous accounts; L is the column vector of the exogenous accounts, C_n is the square matrix (n.n) of average shares of the endogenous accounts; and B is the rectangular matrix (m.n) of the coefficients with exogenous accounts as rows and endogenous accounts as columns. The lower part of the table defines the important concepts.[81]

The regional multiplier matrix represents estimated total, direct and indirect

---

[81] All the endogenous accounts have to balance at a new equilibrium. Since the SAM as a whole as to balance, the sum of the exogenous accounts also have to balance.

effects of exogenous income injections on the endogenous accounts of the regional SAM. The regional input-output (Leontief) multiplier matrix (M^L) is one component of the M_c matrix, which captures production linkages between economic activities that take place in the region. In addition, the M_c matrix also captures expenditure linkages induced by changes in production activities through their effect on incomes in the region. These expenditure linkages are typically stronger than production linkages in many rural Sub-Saharan African contexts (Haggblade et al, 1987, Delgado et al, 1998). To test the relative strength of consumption linkages as opposed to production linkages, this study will decompose the sectoral value added multipliers into direct, indirect and induced effects.[82]

Table A.1. Endogenous and Exogenous Sub-Matrices

		Endogenous				Sum	Exogenous			Sum	Total
	Accounts	1	2	3	4		5	6	7		
1	Activities	Endogenous									
2	Commodities	Transactions				N	Injections			X	Y_n
3	Factors	(C_nY_n)					X				
4	Households										
5	Government	Leakages					Exogenous				
6	Investment	(B_LY_n)				L	Transactions			t	Y_x
7	Rest of Region										
	Totals	Y'_n					Y'_x				

Definitions:

$M_c = (I - C_n)^{-1}$	Matrix of multipliers
dX	Vector of shocks
$dY_n = M_cdX$	Vector of impacts
$dL = BdY_n$	The leakages

Source: Adapted from Pyatt and Round (1979).

These SAM based fixed-price multiplier model assumes that all the endogenous

[82] The so-called induced effect is the result of including household income and expenditure linkages in multiplier estimation and can be taken as a measure of the strength of the consumption linkages. The direct effect is simply the value added per unit of output and the indirect effect is the residual.

sectors have unlimited capacity to supply goods and services, i.e., an infinitely elastic supply - a Keynesian demand-driven system without resource constrains (Sadoulet and de Janvry, 1995, Taylor and Adelman, 1996). In order for the full multiplier effects to occur, excess capacity and unused resources must prevail so that prices don't change with changing levels of output. Such an assumption may not hold true for agricultural activities in many developing countries (Thorbecke, 1998). If constraints on regional resources such as land, labor, seeds or chemical inputs (e.g., as a result of market imperfections) are binding, they need to be taken into account when modeling the impact of exogenous changes. Subramanian and Sadoulet (1990) and Lewis and Thorbecke (1992) deal with the issue by imposing constraints on the production of selected sectors in the form of perfectly inelastic supply. Parikh and Thorbecke (1996), in what they call mixed multipliers, allow for the possibility of inelastic supply response beyond predetermined output levels in selected sectors.[83] The logic underlying those modified multipliers, following Parikh and Thorbecke (1996), is as follows. Production capacity levels are defined for sectors assumed to be constrained. While excess capacity is available in the constrained sector, the fixed-price multiplier, M_c, holds. Once the defined capacity is reached, the mixed multiplier, M_m, can be used for the remaining demand.

[83] Haggblade et al.(1991) develop a price endogenous model to compare results with standard fixed-price models (Semi-Input-Output, Input-output and Economic Base). The model relaxes two key simplifying assumptions of the standard multiplier models: (i) it accommodates an upward-sloping supply curve for non-tradables, and (ii) allows for substitution among inputs (without imposing any specific functional form on production) rather than insisting on a fixed-coefficient Leontief production technology. They conclude that price endogeneity reduces multipliers substantially.

APPENDIX B

SELECTED OUTPUT TABLES

Table B.1. Determinants of MSE Income, Two Stage Model in Tobacco Areas

Explanatory Variables	Parameter Estimates							
	1st Stage: Has MSE Income? [1/]				2nd Stage: Net MSE Income			
	Coeff	z	P > |z|	LS[2]	Coeff	t-stat	P > |t|	LS[2]
Contract Farming	0.251	0.88	0.38		-532.02	1.33	0.19	
Demographics [3/]								
Female headed household	-0.452	0.90	0.37		-334.92	1.59	0.12	
Age of household head	0.036	2.47	0.01	**	0.27	0.05	0.96	
Labor adult equivalents	-0.215	1.76	0.08	+	-44.73	0.74	0.46	
Education: 1-3 years	1.029	2.76	0.01	**	95.56	0.42	0.67	
Education >3 years	0.909	2.52	0.01	**	538.93	1.51	0.13	
Assets and Technology [4/]								
Area_Q2	1.009	2.72	0.01	**				
Area_Q3	0.319	0.73	0.45					
Area_Q4	0.208	0.42	0.67					
Use of Animal traction	-0.763	1.48	0.14					
Value of manual tools	-0.003	0.64	0.52					
Value of other equipment	-0.001	0.42	0.68					
Fertilizer in Maize	0.007	0.02	0.98					
Agro-Ecological Effects								
Mid-Altitude								
Angónia/MLT	-0.321	0.64	0.52		111.98	0.72	0.47	
Mualádzi/DIMON	-0.134	0.28	0.78		733.94	1.37	0.18	
Macanga/MLT	0.161	0.33	0.74		-99.95	0.40	0.69	
Lower Altitude								
Marávia/MLT	- 0.477	0.82	0.42		-161.37	0.64	0.52	
Luia/DIMON (dropped)								
Inverse Mills Ratio (λ)					-130.79	0.31	0.76	
Constant	-1.312	1.65	0.10	+	411.82	0.70	0.48	
Number of observations	159				94			
Wald chi2 (17)	30.60							
Prob > chi2	0.02							
Pseudo R2	0.17							
Log pseudo-likelihood	- 90.24							
F (11, 82)					0.60			
Prob > F					0.82			
R – Squared					0.25			
Root MSE					842.08			

[1/] Probit equation for participation, 1 if has MSE income, 0 otherwise. [2/] Level of significance (LS): + 10%, * 5%, ** 1%. [3/]No schooling (Education=0) is excluded. [4/] Quartile 1 (Area_Q1) is excluded. MSE income and value of assets are expressed in $US.

Source: Zambezi Valley Tobacco Concession Areas Study, 2004.

Table B.2. Determinants of Wage Labor Income, Two Stage Model –Tobacco Areas

Explanatory Variables	Parameter Estimates							
	1st Stage: Has Wage Labor? [1/]				2nd Stage: Wage Labor Income			
	Coeff	z	P > | z |	LS[2]	Coeff	t-stat	P > | t |	LS[2]
Contract Farming	-0.781	2.55	0.01	**	144.11	0.95	0.35	
Demographics [3/]								
Female headed household	1.713	3.06	0.00	**	437.26	2.82	0.01	**
Age of household head	-0.018	1.16	0.25		2.68	0.58	0.56	
Labor adult equivalents	-0.276	2.14	0.03	*	58.88	1.42	0.17	
Education: 1-3 years	0.122	0.30	0.76		52.76	0.69	0.49	
Education >3 years	0.715	1.79	0.07	*	408.92	2.71	0.01	**
Assets and Technology [4/]								
Area_Q2	-0.715	1.79	0.07	*				
Area_Q3	0.116	0.27	0.79					
Area_Q4	0.584	1.19	0.23					
Use of Animal traction	0.324	0.52	0.60					
Value of manual tools	-0.004	0.81	0.42					
Value of other equipment	-0.001	0.34	0.74					
Fertilizer in Maize	0.435	1.16	0.25					
Agro-Ecological Effects								
Mid-Altitude								
Angónia/MLT	- 0.277	0.61	0.54		-200.97	1.41	0.16	
Mualádzi/DIMON	-1.454	2.71	0.01	**	-125.97	0.77	0.44	
Macanga/MLT	-0.786	1.57	0.12		-313.96	2.04	0.05	*
Lower Altitude								
Marávia/MLT	-0.636	1.17	0.24		-419.57	2.59	0.01	**
Luia/DIMON (dropped)								
Inverse Mills Ratio (λ)					-30.86	0.19	0.85	
Constant	1.830	2.19	0.03	*	-130.39	0.77	0.45	
Number of observations	159				47			
Wald chi2 (17)	49.12							
Prob > chi2	0.00							
Pseudo R2	0.29							
Log pseudo-likelihood	-76.27							
F (11, 35)					5.90			
Prob > F					0.00			
R – Squared					0.53			
Root MSE					254.24			

[1/]Probit equation for participation, 1 if has Wage Labor income, 0 otherwise. [2/] Level of significance (LS): + 10%, * 5%, ** 1%. [3/]No schooling (Education=0) is excluded. [4/] Quartile 1 (Area_Q1) is excluded. Wage labor income and value of assets are expressed in $US.

Source: Zambezi Valley Tobacco Concession Areas Study, 2004.

Table B.3. Determinants of MSE Income, Two Stage Model in Cotton Areas

Explanatory Variables	Parameter Estimates							
	1st Stage: Has MSE? [1/]				2nd Stage: Net MSE Income			
	Coeff	z	P > | z |	LS[2]	Coeff	t-stat	P > | t |	LS[2]
Contract Farming	-1.057	3.56	0.00	**	48.87	0.90	0.37	
Demographics [3/]								
Female headed household	-0.896	1.34	0.18		62.70	1.06	0.30	
Age of household head	-0.005	0.40	0.69		-0.09	0.06	0.95	
Labor adult equivalents	-0.155	1.43	0.15		-48.51	1.08	0.29	
Education: 1-3 years	-0.007	0.02	0.99		-74.18	1.34	0.18	
Education >3 years	-0.453	1.08	0.28		37.90	0.74	0.46	
Assets and Technology [4/]								
Area_Q2	0.153	0.40	0.69					
Area_Q3	0.911	2.16	0.03	*				
Area_Q4	0.134	0.27	0.79					
Use of Animal traction	0.502	0.67	0.51					
Value of manual tools	0.022	1.22	0.22					
Value of other equipment	-0.002	0.80	0.43					
Agro-Ecological Effects								
Chiuta/Dunavant	0.383	0.81	0.42		53.06	0.57	0.57	
Chifunde/Dunavant	0.058	0.12	0.90		9.15	0.13	0.90	
Caia/C.N.A.	0.071	0.17	0.87		143.65	1.40	0.17	
Moatize/C.N.A.	0.542	1.16	0.25		-1.12	0.02	0.99	
Maríngue/C.N.A.	-0.415	0.87	0.38		103.42	0.71	0.48	
Gorongosa (dropped)								
Inverse Mills Ratio (λ)					-98.55	0.77	0.45	
Constant	1.725	2.30	0.02	*	209.13	1.93	0.06	+
Number of observations	117				79			
Wald chi2 (17)	35.43							
Prob > chi2	0.01							
Pseudo R2	0.19							
Log pseudo-likelihood	- 55.94							
F (12, 66)					0.78			
Prob > F					0.67			
R – Squared					0.21			
Root MSE					189.41			

[1/] Probit equation for participation, 1 if has MSE income, 0 otherwise. [2/] Level of significance (LS): + 10%, * 5%, ** 1%. [3/]No schooling (Education=0) is excluded. [4/] Quartile 1 (Area_Q1) is excluded. MSE income and value of assets are expressed in $US.

Source: Zambezi Valley Tobacco Concession Areas Study, 2004.

Table B.4. Determinants of Wage Labor Income, Two Stage Model - Cotton Areas

Explanatory Variables	Parameter Estimates							
	1st Stage: Has wage Labor? [1/]				2nd Stage: Wage Labor Income			
	Coeff	z	P>|z|	LS[2]	Coeff	t-stat	P>|t|	LS[2]
Contract Farming	0.117	0.35	0.73		-96.76	1.72	0.10	**
Demographics [3/]								
Female headed household	0.120	0.19	0.85		420.58	2.54	0.02	*
Age of household head	-0.017	1.06	0.29		-8.41	2.92	0.01	**
Labor adult equivalents	0.042	0.33	0.74		65.23	3.42	0.00	**
Education: 1-3 years	0.388	0.86	0.39		-99.75	0.74	0.47	
Education >3 years	-0.070	0.14	0.89		-158.69	1.42	0.17	
Assets and Technology [4/]								
Area_Q2	-0.272	0.61	0.54					
Area_Q3	-0.487	0.98	0.33					
Area_Q4	-0.024	0.04	0.97					
Use of Animal traction	0.595	0.75	0.45					
Value of manual tools	-0.010	0.40	0.69					
Value of other equipment	-0.003	1.09	0.28					
Agro-Ecological Effects								
Chiuta/Dunavant	2.196	3.30	0.00	**	402.11	1.42	0.17	
Chifunde/Dunavant	2.539	3.56	0.00	**	466.82	1.47	0.15	
Caia/C.N.A.	1.871	3.04	0.00	**	352.73	1.34	0.19	
Moatize/C.N.A.	1.666	2.65	0.01	**	316.03	1.37	0.18	
Gorongosa/CNA (dropped)								
Inverse Mills Ratio (λ)					241.23	1.31	0.20	
Constant	-1.261	1.29	0.20		-159.27	0.37	0.72	
Number of observations	98				41			
Wald chi2 (18)	25.61							
Prob > chi2	0.0598							
Pseudo R2	0.26							
Log pseudo-likelihood	-49.11							
R – Squared					0.48			
Root MSE					160.86			

[1/]Probit equation for participation, 1 if has Wage Labor income, 0 otherwise. [2/]Level of significance (LS): + 10%, * 5%, ** 1%. [3/]No schooling (Education=0) is excluded. [4/]Quartile 1 (Area_Q1) is excluded. Wage Labor income and value of assets are expressed in $US.

Source: Zambezi Valley Tobacco Concession Areas Study, 2004.

Table B.5. Regional MACROSAM Structure (%)

(Receipts)	Expenditures							
	Activities	Commodities	Factors	Households	S-I	GOV	ROW	Total
Activities		74.6		66.8				
		(50.8)		(49.2)				(100.0)
Commodities	24.0	6.5		22.5	100.0	29.7	102.4	
	(35.3)	(6.5)		(24.4)	(6.4)	(1.6)	(25.9)	(100.0)
Factors	76.0							
	(100.0)							(100.0)
Households			94.2			70.3	-2.5	
			(97.2)			(3.4)	(-0.6)	(100.0)
S-I				10.7			-20.6	
				(182.0)			(-82.0)	(100.0)
GOV							20.7	
							(100.0)	(100.0)
ROW		18.8	5.8					
		(74.4)	(25.6)					(100.0)
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

Note: The following payments were netted out: HH to ROW, HH to GOV and ROW to Factors.

Table B.6. Selected Characteristics of Zambezi Valley Smallholder Households

	Cotton Areas					Tobacco Areas				
	Type of Farmers (mean values)		Statistical Significance of the Difference			Type of Farmers (mean values)		Statistical Significance of the Difference		
	Non-Growers	Growers	t-Stat	P > |t|	LS[2]	Non-Growers	Growers	t-Stat	P > |t|	LS[2]
Demographic Characteristics										
Household Size	5.4	6.0	1.11	0.27		6.0	5.9	-0.35	0.73	
Female Headed Households – Percent	6.7	5.7	-0.18	0.86		11.9	5.1	-1.49	0.14	
Education of the HH Head – years	3.4	2.6	-1.88	0.06		2.8	3.2	1.00	0.32	
Education of HH Adults – years	4.3	3.8	-1.10	0.27		4.0	4.5	1.05	0.29	
Age of the Household Head – years	40.4	44.3	1.46	0.15		40.5	38.5	-0.95	0.34	
Labor - Adult Equivalents	3.2	3.5	0.86	0.39		3.7	3.5	-0.88	0.38	
Farm Assets										
Total Area – hectares	2.8	4.0	2.58	0.01	**	4.4	6.9	2.84	0.01	**
Reported Value of Manual Tools $US	11.8	12.9	0.61	0.54		15.6	28.6	2.16	0.03	*
Reported Value of Equipment $US	33.4	46.8	0.97	0.33		36.9	66.6	2.58	0.01	**
Use of Animal Traction	6.6	5.7	-0.18	0.86		4.7	7.7	0.64	0.52	
Use of Hired Labor										
Permanent Labor – Percent Using	3.3	9.2	1.03	0.30		31.0	71.8	4.98	0.00	**
Use of Chemical Inputs										
Fertilizer – Maize	0.0	0.0	-	-		21.4	32.5	1.35	0.18	
Fertilizer – Vegetables	0.0	0.0	-	-		7.1	12.0	0.86	0.39	
Income Diversification - Percent										
Livestock	90.0	90.0	0.05	0.96		95.2	94.0	-0.29	0.77	
Self-employment	86.7	60.9	-2.65	0.01	**	47.6	63.2	1.77	0.08	+
Wage Labor Employment	40.0	33.3	-0.66	0.51		47.6	23.1	-3.01	0.00	**
Household Income - $US										
Net Household Income	692.4	872.7	1.27	0.21		1,170.8	2,060.1	2.68	0.01	**
Net Agricultural Income	364.5	518.2	1.50	0.14		595.5	1,572.7	3.11	0.00	**
Net Household Income per capita	108.6	124.9	0.76	0.45		174.7	318.1	2.36	0.02	*
Net Agricultural Income per capita	65.8	86.7	1.13	0.26		98.3	274.2	3.18	0.00	**
Wage Labor Income	80.6	42.2	-1.24	0.22		122.3	80.8	-0.92	0.36	
Self-employment (non-agricultural)	56.0	32.1	-0.60	0.55		185.9	90.2	-1.14	0.26	
Number of Observations	30	87				42	117			

Level of significance (LS): + 10%, * 5%, ** 1%. Source: Zambezi Valley Cotton and Tobacco Concession Areas Study, 2004.

Table B.7. Factor Shares Across Sectors of Activity

Activities	Factors						Total
	Land	Labor				Capital	
		Family Labor		Hired Labor			
		Pre-Harvest	Harvest and Post	Pre-Harvest	Harvest and Post		
Tobacco Farms	51.0	27.5	14.8	42.8	37.8	25.8	35.3
MLT	40.5	20.3	10.9	32.8	31.8	19.8	27.5
DIMON	10.5	7.2	3.9	10.0	6.0	6.0	7.8
Cotton Farms	14.4	12.7	10.8	4.6	16.7	9.2	11.6
C.N.A.	12.8	10.5	9.9	3.5	15.4	7.6	10.1
Dunavant	1.6	2.2	0.9	1.1	1.3	1.6	1.5
Non-Cash Crop Farms	34.5	28.2	14.0	30.1	13.5	29.8	26.4
Non-Tobacco	15.3	9.9	6.2	19.5	8.2	11.1	12.2
Non-Cotton	19.2	18.3	7.8	10.6	5.3	18.7	14.2
Other Primary	0.0	18.9	16.5	5.0	7.1	10.6	10.6
Livestock	0.0	11.6	14.3	1.9	2.9	0.0	5.2
Fishing	0.0	7.3	12.2	3.1	4.2	10.6	5.4
Manufacturing	0.0	7.5	15.7	3.0	1.5	6.6	5.2
Foods	0.0	1.3	2.8	2.7	0.3	1.0	1.3
Beverages	0.0	2.0	4.1	0.0	0.1	0.7	1.1
Other	0.0	4.2	8.8	0.3	1.1	4.9	2.8
Services	0.0	5.2	18.2	13.8	21.9	16.4	10.4
Trading	0.0	1.2	3.0	6.0	9.4	14.0	4.3
Government	0.0	0.0	0.0	6.4	8.7	0.0	2.2
Other	0.0	4.0	15.2	1.4	3.8	2.4	3.9
Marketing/Export of Cash Crops	0.0	0.0	0.0	0.5	1.5	1.7	0.5
MLT	0.0	0.0	0.0	0.3	0.9	1.0	0.3
DIMON	0.0	0.0	0.0	0.1	0.3	0.4	0.1
C.N.A.	0.0	0.0	0.0	0.1	0.3	0.3	0.1
Dunavant	0.0	0.0	0.0	0.01	0.02	0.03	0.006
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study, 2004.

Table B.8. Factor Shares within Sector of Activity: Agricultural, Livestock and Fishing Activities

Factors	Activities							
	Tobacco Farms		Cotton Farms		Non-Cash Crop Farms		Other Primary	
	MLT	DIMON	C.N.A.	Dunavant	Non-Tobacco	Non-Cotton	Livestock	Fishing
Land	35.5	32.6	30.5	25.6	30.1	32.6	0.0	0.0
Labor	57.4	59.8	62.0	64.1	61.0	54.4	100.0	80.8
Family	22.2	27.9	36.7	40.0	25.2	36.7	86.9	61.0
Pre-harvesting	16.7	21.0	23.3	32.2	18.3	29.1	49.6	30.1
Harvesting/Post	5.5	6.9	13.4	7.8	6.9	7.6	37.3	30.9
Hired	35.2	31.9	25.3	24.1	35.8	17.7	13.0	19.8
Pre-harvesting	20.4	22.0	5.9	13.0	27.3	12.9	6.1	9.9
Harvesting/Post	14.8	9.9	19.4	11.1	8.5	4.8	6.9	9.9
Capital	7.1	7.6	7.4	10.3	8.9	13.1	0.0	19.2
All Factors	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study, 2004.

Table B.9. Factor Shares within Sector of Activity: Agricultural, Livestock and Fishing Activities

Factors	Activities					
	Manufacturing			Services		
	Foods	Beverages	Other	Trading	Government	Other
Land	0.0	0.0	0.0	0.0	0.0	0.0
Labor	92.4	94.0	93.0	67.7	100.0	94.1
Family	53.3	93.2	75.9	16.2	0.0	75.8
Pre-harvesting	22.8	41.7	33.3	6.5	0.0	22.7
Harvesting/Post	30.5	51.5	42.6	9.7	0.0	53.1
Hired	39.1	0.8	7.1	51.5	100.0	18.3
Pre-harvesting	36.5	0.2	2.1	23.7	49.8	6.0
Harvesting/Post	2.6	0.6	5.0	27.8	50.2	12.3
Capital	7.6	6.0	17.0	32.3	0.0	5.9
All Factors	100.0	100.0	100.0	100.0	100.0	100.0

Note: Trading and export activities engaged in Contract farming were assumed with: (1) No Family Labor; (2) Hired pre-harvesting: 18.0%; (3) Hire harvesting and post harvesting: 43.0%; and (4) Capital: 38.5%.

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study, 2004.

Table B.10. Factor Income Distribution across Household Types

Activities	Factors						Transfers		Total
	Land	Pre-Harvest	Harvest and Post	Pre-Harvest	Harvest and Post	Capital	GOV	ROW	
Cotton Growing Areas	32.5	45.3	41.7	33.8	42.7	37.5	51.3	2.1	39.3
Non-Growers	16.2	28.7	26.7	21.8	21.2	24.7	20.1	0.3	23.0
Growers	16.3	16.6	15.0	12.0	21.5	12.8	31.2	1.8	16.3
Tobacco Growing Areas	67.5	54.7	58.3	66.2	57.3	62.6	48.7	97.8	60.6
Non-Growers	14.3	17.9	18.7	30.5	22.9	17.8	32.1	30.0	19.8
Growers	53.2	36.8	39.6	35.7	34.4	44.8	16.6	67.8	40.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Computed from the ZV SAM-2003/4 and Survey data.

Table B.11. Shares of Factors and Transfers in Household income (%)

Factors and Net Transfers from GOV and ROW	Shares of Factors and Transfers in Household income (%)				
	Cotton Area Households		Tobacco Area Households		All Households
	Non-Growers	Growers	Non-Growers	Growers	
Land	17.5	24.7	17.8	32.4	24.8
Labor	68.7	60.9	68.4	55.9	62.2
Family	45.4	36.6	34.3	34.6	37.4
Pre-harvesting	29.0	23.6	20.9	20.9	23.2
Harvesting/Post	16.4	13.0	13.4	13.7	14.2
Hired	23.3	24.3	34.1	21.3	24.8
Pre-harvesting	13.6	10.5	22.0	12.5	14.3
Harvesting/Post	9.7	13.8	12.1	8.8	10.5
Capital	10.9	8.0	9.1	11.2	10.2
Government Transfers	3.0	6.5	5.5	1.4	3.4
Remittances	- 0.01	-0.1	-0.9	-1.0	-0.6
All Factor Payments	100.0	100.0	100.0	100.0	100.0

Note: Trading and export activities engaged in Contract farming were assumed with: (1) No Family Labor; (2) Hired pre-harvesting: 18.0%; (3) Hire harvesting and post harvesting: 43.0%; and (4) Capital: 38.5%.
Source: Computed from the ZV SAM-2003/4 and Survey data.

Table B.12. The Structure of Household Income in the Zambezi Valley Smallholder Economy

Income Components	Cotton Growing Areas						Tobacco Growing Areas						All Zambezi Valley Region	
	Non-Growers		Growers		All Area		Non-Growers		Growers		All Area			
	$US	%	$US	%	$US	%	$US	%	$US	%	$US	%	$US	%
1. Agricultural Income	490.2	63.3	658.5	78.6	615.3	74.7	743.8	70.8	1,817.5	86.4	1,533.9	82.3	1,144.5	79.1
1.1. Food crops	490.2	63.3	473.5	54.7	477.8	56.9	743.8	70.8	944.5	48.1	891.4	54.1	716.1	55.3
1.1.1.Retained food	446.2	59.5	448.7	51.9	448.1	53.9	654.7	63.6	911.7	46.3	843.8	50.9	676.1	52.1
1.1.2. Sold food	43.9	3.8	24.8	2.8	29.7	3.0	89.1	7.2	32.7	1.8	47.6	3.2	40.0	3.2
1.2. Cash crops	0.0	0.0	185.0	23.9	137.6	17.8	0.0	0.0	873.1	38.3	642.5	28.2	428.4	23.8
2. Livestock	72.3	14.2	85.4	10.4	82.0	11.4	79.5	8.6	90.1	5.8	87.3	6.5	85.1	8.6
3. Self-employment	56.0	10.8	32.1	5.2	38.3	6.7	185.9	7.5	90.2	3.8	115.5	4.8	82.8	5.6
4. Wage labor	80.6	12.8	42.2	4.0	52.0	6.2	122.3	10.6	80.8	4.9	91.7	6.4	74.9	6.3
5. Transfers/pensions	0.0	0.0	70.7	3.9	52.6	2.9	64.6	4.1	25.7	1.3	36.0	2.1	43.0	2.4
6. Remittances/Net	(6.6)	(1.1)	(16.2)	(2.2)	(13.8)	(2.0)	(25.3)	(1.8)	(44.2)	(2.1)	(39.2)	(2.0)	(28.4)	(2.0)
6.1. Received	17.7	2.4	10.3	1.7	12.2	1.8	10.2	1.5	13.2	1.0	12.5	1.1	12.4	1.4
6.2. Sent	(24.3)	(3.6)	(26.6)	(3.8)	(26.0)	(3.7)	(35.6)	(3.2)	(57.4)	(3.1)	(51.7)	(3.1)	(40.8)	(3.4)
Household Income														
Total ($US/HH)	692.4	100.0	872.7	100.0	826.5	100.0	1,170.8	100.0	2,060.1	100.0	1,825.2	100.0	1,401.8	100.0
Per capita ($US)	108.6		124.9		120.7		174.7		318.1		280.2		212.6	
Number of Observations	30		87		117		42		117		159		276	

Source: Zambezi Valley Cotton and Tobacco Concession Areas Study, 2004.

Table B.13. Economic Structure in the Base: Export and Import Shares

Exported Commodities	Shares of Exports		Imported Commodities	Shares of Imports	
	In Total Exports (%)	In Marketed Output (%)		In Total Imports (%)	In Domestic Demand (%)
Packed cotton	9.6	100.0	Rice	2.9	74.9
Packed tobacco	73.7	100.0	Beans	1.2	31.7
Maize grain	3.6	50.0	Fruits	0.4	41.9
Groundnuts	3.2	87.5	Coconuts	0.6	100.0
Root crops	0.7	41.9	Meat – cow	6.5	71.8
Vegetables	2.6	45.0	Cooking oil	3.4	100.0
Meat – goat	2.3	32.6	Sugar	2.2	100.0
Meat – birds	0.6	28.6	Salt	2.1	100.0
Alcoholic drinks	1.9	29.6	Tea/Coffee	0.2	100.0
Other commodities	1.8	24.0	Seeds	2.3	100.0
			Pesticides	1.5	100.0
			Fertilizers	30.7	100.0
			Other agro-inputs	2.6	100.0
			Fuel	18.8	100.0
			Textile/footwear	9.3	80.6
			Metal/blacksmithing	4.1	77.3
			Soap and hygiene	9.5	100.0
			Imported drinks/tobacco	1.7	100.0
Total	100.0	32.1	Total	100.0	27.4
By Sector			By Sector		
Agricultural	93.4	50.0	Agricultural	5.1	4.2
Non-Agricultural	6.6	5.3	Non-Agricultural	94.9	39.0
Total	100.0	32.1	Total	100.0	27.4

Source: Zambezi Valley Regional SAM, 2003/4.

REFERENCES

Angrist, J. (2001). *Estimation of Limited Dependent Variable Models with Dummy Endogenous Regressors: Simple Strategies for Empirical Practice*. Journal of Business and Economic Statistics, 29, 1, pp. 2-15.

Arndt, C. (2002). *HIV/AIDS, Human Capital, and Economic Prospects for Mozambique*. International Food Policy Research Institute, TMD Discussion paper # 88.

Arndt, C. (2005). *The Doha Trade Round and Mozambique*. World Bank Policy Research Working Paper No. 3717 http://ssrn.com/abstract=821406

Ballard, C., D. Fullerton, J. Shoven, and J. Whalley (1985). *A General Equilibrium Model for Tax Policy Evaluation*. University of Chicago Press.

Bardhan, P. (1989). *The New Institutional Economics and Development Theory: A Brief Critical Assessment*. World Development 17, 1389 - 1395.

Bardhan, P. and C. Udry (1999). *Development Microeconomics*. Oxford University Press.

Barnow, B., G. Cain, and A. Goldberger (1981). *Issues in the Analysis of Selectivity Bias*. In E. Stromsdorfer and G. Farkas, eds., *Evaluation Studies Review Annual*, Vol. 5, Beverly Hills: Sage Publications.

Benfica, R., D. Tschirley and L. Sambo (2002).*The Impact of Agro Industrial Investments on Poverty Reduction in Rural Mozambique*. DAP/MSU, Research Report No. 51E.

Benfica, R. (2003). *Agricultural and Agro-Industrial Investment Strategies, Broad-based Income Growth and Poverty Reduction in Rural Mozambique: A Regional Economy-wide Approach*. Ph.D. Dissertation Research Proposal. Department of Agricultural Economics, Michigan State University.

Benfica, R., A. Miguel, J. Zandamela, N. Sousa, D. Boughton, D. Tschirley, and H. Marrule (2004). *How to Avoid Killing the Chicken That Lays the Golden Eggs: An Analysis of the Potential Impacts of An Export Tax on Raw Tobacco in Mozambique*. DAP/MSU, Flash No. 42p.

Benfica, R., A. Miguel, J. Zandamela and N. Sousa (2005).*The Economics of Smallholder Households in Tobacco and Cotton Growing Areas of the Zambezi Valley of Mozambique*. DAP/MSU, Research Report No. 59E.

Boughton, D., D. Mather, D. Tschirley, T. Walker, B. Cunguara, E. Payongayong (2005). *What is driving Mozambique's rural income growth? A comparative analysis of the 1996 and 2002 national agricultural sample surveys*. Draft DAP/MSU, Research Report.

Boughton, D., D. Mather and D. Tschirley (2004). *Income Growth in Rural Mozambique 1996-2002: A Challenging Comparison - Interim results based on TIA 96 and TIA 2002.* Powerpoint presentation prepared for a technical discussion at The World Bank, November 17, 2004.

Carrilho, J., R. Benfica, D. Tschirley and D. Boughton (2002). *Qual o Papel da Agricultura Comercial Familiar no Desenvolvimento Rural e Redução da Pobreza em Moçambique?* Paper presented by João Carrilho at a Seminar of the *Associação Moçambicana de Ciências e Tecnologias.*

Cook, M. and Chaddad, F. (2000). *Agro-industrialization, of the Global Food Economy: Bridging Development Economics and Agribusiness Research.* Agricultural Economics 23 (3) 207 - 218.

DAD 4.2 : Distributive Analysis/Analyse Distributive – User's Manual (2003). Software developed by Jean-Yves Duclos and Araar Abdelkrin, and Programmed by Araar Abdelkrin and Carl Fortin (Université Laval – MIMAP Project)

de Janvry, A. and E. Sadoulet (1987). *Agricultural Price Policy in General Equilibrium Models: Results and Comparisons. AJAE,* 231-246.

de Janvry, A. and E. Sadoulet (1999). *Agricultural Price Policy, Employment, and Migration in a Diversified Rural Economy: A Village-Town CGE Analysis from Mexico. American Journal of Agricultural Economics* (81) 653-622.

Deaton, A. (1997). *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy.* Published by The John Hopkins University Press for World Bank.

Decaluwé, B., A. Patry, L. Savard and E. Thorbecke (1999). *Poverty Analysis Within a General Equilibrium Framework.* Working Paper 9909, CRÉFA 99-06.

Delgado, C., J. Hopkins and V. Kelly (1998). *Agricultural Growth Linkages in Sub-Saharan Africa.* IFPRI, Research Report Number 107.

Delgado, C. (1999). *Sources of Growth in Smallholder Agriculture in sub-Saharan Africa: The Role of Vertical Integration of Smallholders with Processors and Marketers of High-value Added Items.* Agrekon 38 (1999): 165-189.

Dervis, K., J. de Melo and S. Robinson (1982). *General Equilibrium Models for Development Policy.* Part II: Computable General Equilibrium Models. Cambridge University Press.

Donovan, C. (2004). *Agricultural Growth and Poverty Reduction in Mozambique.* Paper prepared for the World Bank Video-Conference "Attacking Poverty in Mozambique" held in Washington DC and Maputo on January 13, 2004.

Dorward, A., J. Kydd, and C. Poulton (1998). *Smallholder Cash Crop Production Under Market Liberalization: A New Institutional Economics Perspective*. CAB International.

Dorward, A. (2001). *The Effects of Transaction Costs, Power and Risk on Contractual Arrangements: A Conceptual Framework for Quantitative Analysis*. Journal of Agricultural Economics 25 (2), 59 - 73.

Gangopadhyay, S. and K. Sengupta (1987). *Small Farmers, Money Lenders, and Trading Activity*. Oxford Economic Papers, 39.

Greene, W. (2003). *Econometric Analysis*. Fifth Edition. Prentice Hall.

Glover, D. (1984). *Contract Farming and Smallholder Schemes in Less Developed Countries*. World Development Vol. 12 (11/12), pp. 1143-1157.

Glover, D. and K. Kusterer (1990). Small Farmers, Big Business: Contract Farming and Rural Development. New York: St. Martin's Press.

Goldsmith, A. (1985). *The Private Sector and Rural Development: Can Agribusiness Help the Small Farmer?* World Development Vol. 13 (10/11), pp. 1125-1138.

Government of Mozambique (2001). *Plano de Acção para a Redução da Pobreza Absoluta, 2001-2005 (PARPA I)*.

Government of Mozambique (2005). *Plano de Acção para a Redução da Pobreza Absoluta, 2006-2009 (PARPA II)*.

Gugerty, M., and C.P. Timmer (1999). *Growth, Inequality and Poverty Alleviation: Implications for Development Assistance*. Mimeo.

Haggblade, S., P. Hazell and J. Brown (1987). *Farm/Non-farm Linkages in Rural Sub-Saharan Africa: Empirical evidence and Policy Implications*. Agriculture and Rural Development Department.The World Bank.

Haggblade, S., J. Hammer and P. Hazell (1991). *Modeling Agricultural Growth Multipliers*. American Journal of Agricultural Economics, Vol. 73: 361-74.

Hazell, P. (1984). *Rural Growth Linkages and Rural Development Strategies*. Presented in the 4th European Congress of Agricultural Economics.

Heckman, J. (1979). *Sample Selection Bias as a Specification Error*. Econometrica, Vol. 47, No.1 (Jan 1979), pp. (153-162).

Horus (2004). *Estudo Complementar para o Melhoramento da Estratégia no Sector do Algodão em Moçambique*. Draft.

Huppie, M. and M. Ravallion (1991). *The Structural Structure of Poverty During an Adjustment Period: Evidence for Indonésia in the Mid-80s.* World Development 19 (12).

Jaffee, S. and J. Morton, eds. (1995). *Marketing Africa's High-value Foods: Comparative Experiences of an Emergent Private Sector* (Dubuque, Iowa, USA: Kendall/Hunt Publishing);

INE (2000). Mozambique 1997 Population Census.

Intriligator, M., R. Bodkin and C. Hsiao (1996). *Econometric Models, Techniques, and Applications*, Second Edition. Prentice Hall. New Jersey.

Jaffee, S. and Morton, J., eds. (1995). "Marketing Africa's High-value Foods: Comparative Experiences of an Emergent Private Sector". (Dubuque, Iowa, USA: Kendall/Hunt Publishing);

Key, N. and D. Runsten (1999). *Contract Farming, Smallholders, and Rural Development in Latin America: The Organization of Agro-processing Firms and the Scale of Outgrower Production.* World Development Vol. 27, No. 2, pp. 381-401.

Klein, P. (1995). *Empirical Research in Transaction Costs Economics: A Review and Assessment.* The Journal of Law, Economics and Organization, Volume 11, number 2.

Lemaitre, P., Fok, M. and Jeje, J.J. (2001). *Cotton Sub-sector Study.* Final Report. Maputo: IAM.

Lewis, B. and E. Thorbecke (1992). *District Level Economic Linkages in Kenya: Evidence Based on a Small Regional Social Accounting Matrix.* World Development, Vol. 20, No.6 (881-897).

Little, P. and M. Watts (1994). *Living Under Contract: Contract Farming and Agrarian Transformation in Sub-Saharan Africa.* Madison: University of Wisconsin Press.

Lofgren, H., R. Harris and S. Robinson (2002). *A Standard Computable General Equilibrium (CGE) Model in GAMS.* IFPRI - Microcomputers in Policy Research, No.5.

Lofgren, H., S. Robinson, and M. El-Said (2003). *Poverty and Inequality Analysis in a General Equilibrium Framework: The Representative Household Approach.* Chapter 15 - The World Bank toolkit.

Lofgren, H., and S. Robinson (1999). *Non-separable Household Decisions in a computable General Equilibrium Model.* American Journal of Agricultural Economics, Vol. 81 (3): 663-670.

Maddala, G. (1983). *Limited Dependent and Qualitative Variables in Econometrics.* New York: Cambridge University Press.

Minot, N. (1986). *Contract Farming and its Effect on Small Farmers in Less Developed Countries*. Working Paper 31 (East Lansing, Michigan, USA: Michigan State University).

MPF/IFPRI/Purdue University (2004). *Poverty And Well-Being In Mozambique: The Second National Assessment*. Maputo-Mozambique.

North, D. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.

Ofiço, A. O. and Tschirley, D. (2003) *An Overview of the Cotton Sector in Mozambique*. Mimeo.

Parikh, A. and E. Thorbecke (1996). *Impact of Rural Industrialization on Village Life and Economy: A Social Accounting Matrix Approach*. Economic Development and Cultural Change 44 (2): 351-377.

Poulton, C., P. Gibbon, B. Hanyani-Mlambo, J. Kydd, W. Maro, M. Larsen, A. Osorio, D. Tschirley and B. Zulu (2004). *Competition and Coordination in Liberalized African Cotton Market Systems*. World Development Vol. 32, No. 3, pp. 519–536.

Pyatt, G. and J. Round (1979). *Accounting and Fixed Price Multipliers in a Social Accounting Framework*. Economic Journal Volume 89 (356): 850-873.

Pyatt, G. and J. Round (1985). *Social Accounting Matrices: A Basis for Planning*. The World Bank, Washington.

Ravallion, M., and S. Chen (1997). *What Can New Survey Data Tell Us About Recent Changes in Distribution and Poverty*. The World Bank Economic Review, 11.

Robinson, S., A. Cattaneo and M. El-Said (1998). *Estimating a Social Accounting Matrix Using Cross Entropy Methods*. International Food Policy Research Institute, TMD Discussion paper # 33.

Rodgers, G. (1986). *The Theory of Output-Income Multipliers with Consumption Linkages: An Application to Mauritania*. PhD Dissertation, University of Wisconsin, Madison, Wisconsin.

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

Staatz, J. (1988). *The New Agricultural Economics: Applications of Transaction Cost / Institutional Analysis to Agricultural Economics*. Seminar Presented to the Scientific Society for Finnish Agriculture and the Faculty of Agriculture and Forestry, University of Helsinki.

SataCorp. (2003). *Stata Statistical Software: Release 8.0.* College Station, TX: Stata Corporation.

Stone, R. (1978). *The Disaggregation of the Household Sector In the National Accounts.* World Bank Conference on Social Accounting Methods In Development Planning, Cambridge.

Strasberg, P. (1997).*Smallholder Cash-Cropping, Food-Cropping and Food Security in Northern Mozambique.* Ph.D., Dissertation, Michigan State University, East Lansing, Michigan.

Subramanian, S. and E. Sadoulet (1990). *The Transmission of Production Fluctuations and Technical Change in a Village Economy: A Social Accounting Matrix Approach.* Economic Development and Cultural Change 39 (1): 131-73.

Tarp, F., C. Arndt, H. Jensen, S. Robinson and R. Heltberg (2002). *Facing the Development Challenge in Mozambique: An Economywide Perspective.* IFPRI Research Report # 126.

Taylor, J. Edward, G. Dyer and A. Yunez-Naude (2005). *Disaggregated Rural Economywide Models for Policy Analysis.* World Development, Volume xx, No. xx, xxx-xxx (In the Press).

Taylor, J. E. and I. Adelman (1996). *Village Economies: The Design, Estimation and Use of Villagewide Economy Models.* Cambridge University Press.

Taylor, J. E., A. Yunez-Naude, and G. Dyer (1999). *Agricultural Price Policy, Employment, and Migration in a Diversified Rural Economy: A Village-Town CGE Analysis from Mexico.* American Journal of Agricultural Economics, 81, 653-662.

Thorbecke, E. and H.S, Jung (1996). *A Multiplier Decomposition Method to Analyse Poverty Alleviation.* Journal of Development Economics 48: 279-300.

Thorbecke, E. (1998). *Social Accounting Matrices and Social Accounting Analysis* (Chapter 7, in *Methods of Interregional and Regional Analysis*, by Isard, W., I. Azis, M. Drennan, R. Miller, S. Salzman, and E. Thorbecke. Ashgate Publishing Company, Brookfield, VT.

Tschirley, D. and M. Weber (1994). *Food security strategies under extremely adverse conditions: The determinants of household income and consumption in rural Mozambique.* World Development, Vol. 22:2 (159-173).

Tschirley, D. and R. Benfica (2001). *Smallholder Agriculture, Wage Labor and Rural Poverty Alleviation in Land-Abundant Areas of Africa: Evidence From Mozambique.* The Journal of Modern African Studies, Vol. 39:2 (333-358).

Tschirley, D. (2002). *Some Characteristics of Pro-Poor Growth and Policy Implications for Mozambique. Flash* No. 29E, Ministry of Agriculture and Rural Development, Department of Policy Analysis, Mozambique. http://www.aec.msu.edu/agecon/fs2/mozambique/flash29e.pdf

Tschirley, D., A. Ofiço, and D. Boughton (2005). *Mozambique Country Study.* Collaborative Research Project on Competition and Coordination in Cotton Market Systems in Southern and Eastern Africa.

Tschirley, David, Colin Poulton, and Duncan Boughton (2006). *The Many Paths of Cotton Sector Reform in Eastern and Southern Africa: Lessons from a Decade of Experience.* Forthcoming in Cotton, Natural Resources and Society in Sub-Saharan Africa, William G. Moseley and Leslie C. Gray, Eds.

Walker, T., D. Tschirley, J. Low, M.Tanque, D. Boughton, E. Payongayong, and M. Weber (2004). *Determinants of Rural Income, Poverty and Perceived Well-Being in Mozambique in 2001-2002.* MADER/DE/DAP Research Report # 57E.

Warning, M. and W. Hoo (2000). *The Impact of Contract Farming on Income Distribution: Theory and Evidence.* Presented at the Western Economics Association International Annual Meetings.

Warning, M. and N. Key (2002). *The Social Performance and the Distributional Consequences of Contract Farming: An Equilibrium Analysis of the Arachide de Bouche Program in Senegal.* World Development Vol. 30, No. 2, pp. 255-263.

Williamson, O. (1991). *Comparative Economic Organization: The Analysis of Discrete Structural Alternatives.* Administrative Science Quarterly 36, 269 - 296.

Willis, R., and S. Rosen (1979). *Education and Self- Selection.* Journal of Political Economy, 87, pp. S7 – S36.

Wooldridge, J. (2000). *Introductory Econometrics: A Modern Approach.* South Western College Publishing.

Wooldridge, J. (1999). *Econometric Analysis of Cross-Section and Panel Data.* Massachusetts Institute of Technology.

World Bank (2005). Study on Contract Farming and Supply Chain Financing in Mozambique.