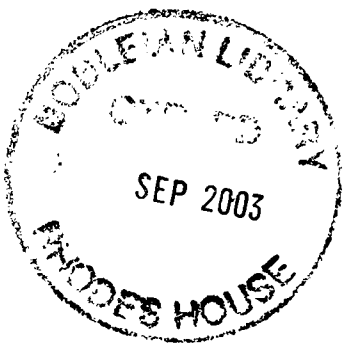
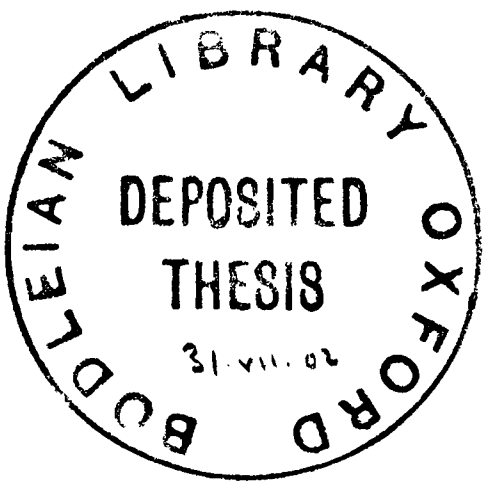
Coping with Peace:
Post-War Household Strategies in Northern Mozambique

Thesis Submitted for the Degree of
Doctor of Philosophy in Economics





Tilman Brück
St Cross College
University of Oxford
Oxford
Trinity Term 2001

Abstract

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The objective of this thesis is to understand how poor farm households in developing countries are affected by and cope with the legacy of internal war. The theoretical analysis is based on a peasant household model for land abundant countries as war can be shown to weaken markets, re-enforce household subsistence and increase overall land abundance. The empirical analysis uses regression techniques and a household survey from post-war northern Mozambique to assess the implications of the war legacy for land access, coping strategies, and household welfare.

The key findings include that war can enhance the degree of land abundance while also creating barriers to land access for some households, thus re-defining land abundance as a household-level concept. Land emerges as the least war vulnerable asset thus encouraging households to shift to land-based subsistence activities during the war. The experience of war increases the number of endogenously determined land variables, which should therefore be reflected in models of African land use.

The thesis advances the literature of household coping strategies by focussing on little researched post-disaster and war-induced strategies. Households are found to respond to indirect war effects and thus to rely on subsistence and non-market activities and to make selective use of markets. Surprisingly, social exchange does not play a large role for insuring incomes.

Finally, the thesis finds that the war legacy continues to depress household welfare for many years after the end of the conflict, which is attributed to a variety of poverty traps. Importantly, and in contrast to other studies of post-war Mozambique, education and cotton adoption are not found to enhance household welfare significantly but a larger area farmed does. The findings indicate that post-war reconstruction policy should re-capitalise household endowments and stimulate rural markets as part of a broadly based programme of rural development.

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Abbreviations and Acronyms

2SLS	two-stage least squares
ACE	adult consumption equivalent
Agricom	formerly state-owned agricultural marketing board of Mozambique
BM	Binswanger and McIntire model (1987)
Cinpofin	a cotton JVC in northern Mozambique
coef	coefficient
Comecon	trading bloc led by Soviet Union
CPI	consumer price index
CRS	constant returns to scale
DEA	Dept. of Agricultural Economics, Ministry of Agriculture, Maputo
FAO	Food and Agriculture Organisation of the United Nations
FDI	foreign direct investment
Frelimo	Mozambican party of government since independence
FSP	Food Security Project at the Ministry of Agriculture, Maputo
GDP	gross domestic product
GNP	gross national product
ha	hectare
HDI	human development index
IAF	1996-97 national Mozambican household survey
IMF	International Monetary Fund
IV	instrumental variables
JVC	joint venture company
kg	kilogram
ln	natural log
Lomaco	Lonhro-Mozambique Agro-Industrial Company (a JVC)
LSM	living standard measurement
LSMS	living standard measurement survey
LTC	Land Tenure Center at the University of Wisconsin-Madison
MAP	Mozambican Ministry of Agriculture, Maputo
min	minute or minimum
mm	millimetre
MSU	Michigan State University
Mt	Meticais
N	sample size
n.a.	not available or not applicable
NGO	non-governmental organisation
obs	observations
OLS	ordinary least squares
ONUMOZ	United Nations Operation in Mozambique
p.a.	per annum
p.c.	per capita
Pinto	a cotton JVC in northern Mozambique
PSU	primary sampling unit
pweight	sampling weight
Renamo	former rebel movement and largest Mozambican opposition party
RHS	right-hand side
Samo	Sociedade Algodoeira de Monapo (a JVC)
Sodan	Sociedade de Desenvolvimento Algodoeira de Namialo (a JVC)
SSS	Singh, Squire and Strauss model (1986)
st err	standard error
UNDP	United Nations Development Programme

Chapter 1: Introduction

1.1 Research Objective

The objective of this thesis is to analyse how poor farm households in developing countries cope with the legacy of internal war. This objective has three dimensions. First, the thesis will assess the usefulness of standard models of farm household behaviour in the post-war context. Second, it will explore the economic nature of the war legacy, examine how farm households adjust their behaviour in response to this war legacy, and evaluate how household welfare is affected by this war legacy. Third, the thesis will analyse these issues for the case of rural northern Mozambique (figures 1.1 and 1.2) using an agricultural household survey and regression techniques. Empirical evidence will thus be used to test the predictions derived from the theoretical analysis of war and of post-war household behaviour. The survey data will also be used to estimate the scale of various war effects on household behaviour and household welfare, contrasting these estimates with those obtained from other studies of Mozambique which do not account for the role of war explicitly. The results are informative for other poor economies emerging from war where similar reconstruction choices have to be made (Brück et al 2000).

1.2 Research Motivation

The main contribution of this study is the combined analysis of war and rural development. This is important as war is a likely cause of much social and economic suffering and underdevelopment in many low income countries. Yet war and the economic effects of war have only rarely been analysed explicitly, in particular from a micro-economic perspective. The analysis presented here is thus motivated by a desire to improve the understanding of the economic effects of war at the household level, which may lead to more effective government and donor policies targeted at war-affected rural households.

The focus of the analysis is the post-war period for policy and empirical reasons. First, most donors and aid agencies are more interested in engaging in what is seen as "development aid" after the end of fighting, thus making a detailed understanding of the war legacy an important basis for effective post-war policy design. Second, the effects of war include the absence of high quality data, especially of high quality household surveys, and the high option value of not undertaking fieldwork in acutely war-affected areas. Yet much can be learned about the economic nature of wars by studying their long-term, post-war effects (termed "war legacy" here). Thus the analysis of the post-war period is dictated by policy considerations, by data needs and safety concerns, and by the ability to

extrapolate backwards some post-war trends thus learning much about the war economy itself.

1.3 Research Scope

Post-war Mozambique is facing a daunting development challenge involving a broad range of issues. While this analysis recognises that there are important complementary policy and analytical issues which may also relate to the war legacy, not all of these issues can be analysed in great detail. These complementary issues include the economics of rural trade beyond the farm household, the legacy of socialism and privatisation, the financial sector, the government's fiscal and macro-economic management, government and donor policies, the political implications of the end of the war, the political economy of the post-war period, and the causes of the war in Mozambique.

The role of socialism in particular will not be discussed in detail as it will be argued that as a result of the war rural households had little interaction with the government in the late war period in northern Mozambique. The war induced a substantial degree of subsistence and autarky on households, and also weakened the state capacity to intervene in markets or to generally affect rural households in many ways. In addition, the government had started liberalising the economy since the mid-1980s thus reducing the degree of government control over farm households.

There are a number of complementary fields of economic analysis which contribute to the understanding of war, and some of these will be discussed in more detail below. They include the literature on farm and peasant household models and extreme forms of household subsistence behaviour (which relates to the discussion of chapter 2), the literature on empirical evidence and policy issues pertinent to the case of Mozambique (chapters 3 to 7), the literature on land access (chapter 4) and land tenure (chapter 5), the literature on disaster coping strategies and general risk, saving and investment strategies (chapter 6), the literature on the determinants of household welfare, income and consumption smoothing (chapter 7), the emerging literature on the economic effects of conflict on development (which is relevant to all chapters of this thesis), and a broad literature on econometric and statistical models suitable to the analysis of these models (chapters 3 to 7). Different chapters thus explore different aspects of the overall objective, bringing together different strands of development economics relevant for the analysis of post-war farm household behaviour in developing countries.

It will be argued that the nature of the war had a strong impact on the nature of the war legacy and thus on the economic processes of the post-war period. All of the discussion in

this thesis thus applies to the case of northern Mozambique and any other developing economy with relatively abundant and productive land and a long-term devastating internal war aimed at weakening government services and terrorising the civilian population. Countries which may benefit from this analysis could thus include Nicaragua, Angola, Sierra Leone and East Timor. Yet the analysis may not be generalised to international or very short wars, to developing economies with an acute land shortage or serious ecological constraints, or to middle or high income economies. In fact, some of the implications of this analysis may not be valid for southern or central Mozambique, which form separate economies from the north in many regards.

1.4 Methodological Considerations

Some studies of the economic effects of war derive their conclusions from the comparison of aggregated empirical indicators across countries or across time. This study chose instead to use a detailed cross-sectional survey of farm households from northern Mozambique from 1994-96 as one of its primary data sources. The dataset was kindly made available by the joint Food Security Project (FSP) of the Michigan State University (MSU) and the Mozambican Ministry of Agriculture (MAP). This approach was chosen for several reasons.

First, such survey data allows the study of the micro-level transition processes which would not become apparent in international comparisons of highly aggregated indicators such as output or inflation.

Second, the main concern of this analysis is not the estimation of total GDP losses caused by war but an improved understanding of the economic processes induced by war. This also encourages the use of micro-level data.

Third, the analysis of post-war household decisions is a more novel way of analysis, usefully complementing some international comparisons of war-affected economies with each other and with peace-time economies.

Fourth, macro-economic data for war-affected economies is often poor. By using household survey data, more control over the quality of the data and more internal consistency of the dataset can be achieved as there are often several ways of constructing a variable of interest in a household survey.

Fifth, this study does not make a comparison of the experience of northern Mozambique with either another war economy or a similar economy not experiencing peace. While this may be a useful method for the investigation of other research objectives, the strong micro-economic focus of this work and the nature of the data used imply that there cannot be a

region which is truly comparable to the that of the survey sample area. Instead, this household survey data allows to control for a variety of location-specific effects which should help to generalise the conclusions of the survey in a broad sense as discussed above.

1.5 Main Findings

This thesis will show that rural households in northern Mozambique have to cope with a substantial war legacy even many years after the end of the conflict. The war encouraged households to use land for subsistence survival activities but the war legacy also prevents households from intensifying production, thus creating the apparent paradox of an overall land surplus coexisting with household-level land constraints. This suggests that land abundance can be a household-level concept, which is a new view of land abundance in the literature.

The analysis of the role of land in the post-war period also suggests an extension to the theoretical framework by specifying possible endogeneities between land access, land tenure insecurity and land investment and testing these relationships explicitly. Other studies of African land systems may have underestimated the degrees of endogeneity and inter-temporal dependencies in these relationships.

The thesis will also uncover the coping strategies pursued by war-affected households and the determinants of these choices. This analysis thus extends the literature on coping strategies by addressing both post-disaster and war-related coping strategies. The way in which war-time peasant households had to specialise in subsistence activities will be shown, together with how households diversified their coping strategies in the post-war period. As with land choices, the indirect war legacies will be shown to have a strong effect on coping choices, which in turn may lead to market failure at the household or commodity level. Social exchange will be shown to be affected by similar determinants to market exchange, thus limiting the benefits poor households can derive from social exchange activities.

The thesis will also illustrate how the war legacy continues to depress household welfare many years after the ceasefire and how the war created poverty traps from which households cannot easily escape without external help. In contrast with other studies of Mozambique and by modelling explicitly endogenous household activity choices, this research will find that education plays only a small role in post-war reconstruction and poverty alleviation and that cotton adoption may even have negative welfare effects. However, the area farmed per household does affect welfare significantly.

The empirical case studies (using post-war household survey data from northern Mozambique) will validate a basic peasant household model of production for land

abundant tropical areas as a good starting point for the analysis of post-war reconstruction at the household level. However, the war changes some of the transmission mechanisms within the model. Most importantly, the concept of a gradual transition from one equilibrium to another may be damaged by war and is difficult to reconstruct post-war. However, peasant household behaviour under war and post-war conditions will be shown to be an analytically tractable and rational phenomenon.

The empirical analysis will demonstrate that the effects of war in Mozambique are varied and significant. They include changes to household labour and the valuation of labour, a reduction in the planning horizon, lower physical and social asset endowments, damaged market institutions and an apparently higher land abundance on average. It will be illustrated how the reversibility of the war effects determines the speed of post-war reconstruction and poverty alleviation, at both the household and the aggregate levels.

Important implications of these findings are that successful post-war reconstruction must account for the weak role of markets, the role of public goods in enabling such markets, and the varying effects of war by location, thus requiring some degree of decentralised reconstruction policy. Finally, the thesis will show how the distinctions between emergency and development policies, the investment choices between human and physical capital choices, and the promotion of cash crop market participation at the expense of subsistence crop activities were not conducive to fast poverty alleviation in the post-war period in northern Mozambique. Instead, it will be argued that an integrated approach to rural development is essential in a post-conflict situation, especially given the devastating nature of the Mozambican war.

1.6 Structure of the Thesis

This thesis has eight chapters which include an introduction to the main literature, some background to the case study and data used, and four main empirical results chapters. Thus chapter 2 defines some key terms of the peasant household literature, reviews two standard peasant household models, and discusses the effects of war in one such model. Chapter 2 also compares the predictions of the Binswanger and McIntire (BM) model and the predictions of the war analysis. The chapter concludes with a discussion of the key expected effects of war on household behaviour. Appendix A.1 outlines some key mathematical relationships of the basic BM model, unlike the original BM model which is only developed verbally.

Chapter 3 provides the background necessary for the empirical and econometric analysis of the effects of war in Mozambique. It reviews briefly some key events in Mozambique's

history and characterises the nature of the internal war. It then summarises some macro-economic indicators which show the slow pace and limited success of national post-war reconstruction and the severity of the war-induced constraints for the government and the donors.

The following section discusses the nature of markets in northern Mozambique. This justifies some of the assumptions made in the theoretical model and which in turn provides further propositions about the expected effects of war at the household level. The last two sections of chapter 3 introduce the main primary data sources (the FSP household survey and the qualitative interview evidence collected during two field visits in 1995 and 1999) and discuss some econometric and statistical techniques appropriate for the analysis of the household survey data.

Chapters 4 and 5 jointly discuss the themes of household land access, land tenure and land investment in the post-war economy. Each chapter will first analyse how war affected each of the variables land access, land tenure security and land investment, which data and techniques are available to study these issues, and what the expected signs of the coefficients are likely to be. The next sections in both chapters will then discuss the main findings of the econometric analysis of the dependent variables cultivated area, land tenure security, and land investment per household. Appendix A.2 will review a complementary discussion of changes of and inequalities in land endowments over time using data from other Mozambican household surveys.

Chapter 6 discusses household activity choices, especially the choices between on-farm and off-farm activities, subsistence versus market activities, food crop versus cash crop adoption, and indices of income, plot and social exchange diversification. The chapter reviews some standard determinants of activity diversification and then proposes a simple model of diversification which can account for the effects of war. One section addresses data and econometric considerations which lead to the discussion of the empirical determinants of the various diversification indicators. Appendix A.3 summarises the theoretical model in its algebraic form.

The determinants of household welfare as measured by household income, consumption and food consumption are analysed in chapter 7. The opening section discusses how war can affect peasant household welfare focusing on household endowments, household technology, social capital and village level markets and institutions. The next section describes the available data and derives an econometric specification. The main results section addresses the key determinants of household welfare by the main groups of independent variables. In addition, chapter 7 brings together the results of the preceding

chapters by discussing the welfare effects of land access and activity choices, resulting in some unexpected and highly policy-relevant insights. Appendices A.4 and A.5 discuss some auxiliary results concerning income and consumption smoothing and the inequality of welfare and asset endowments.

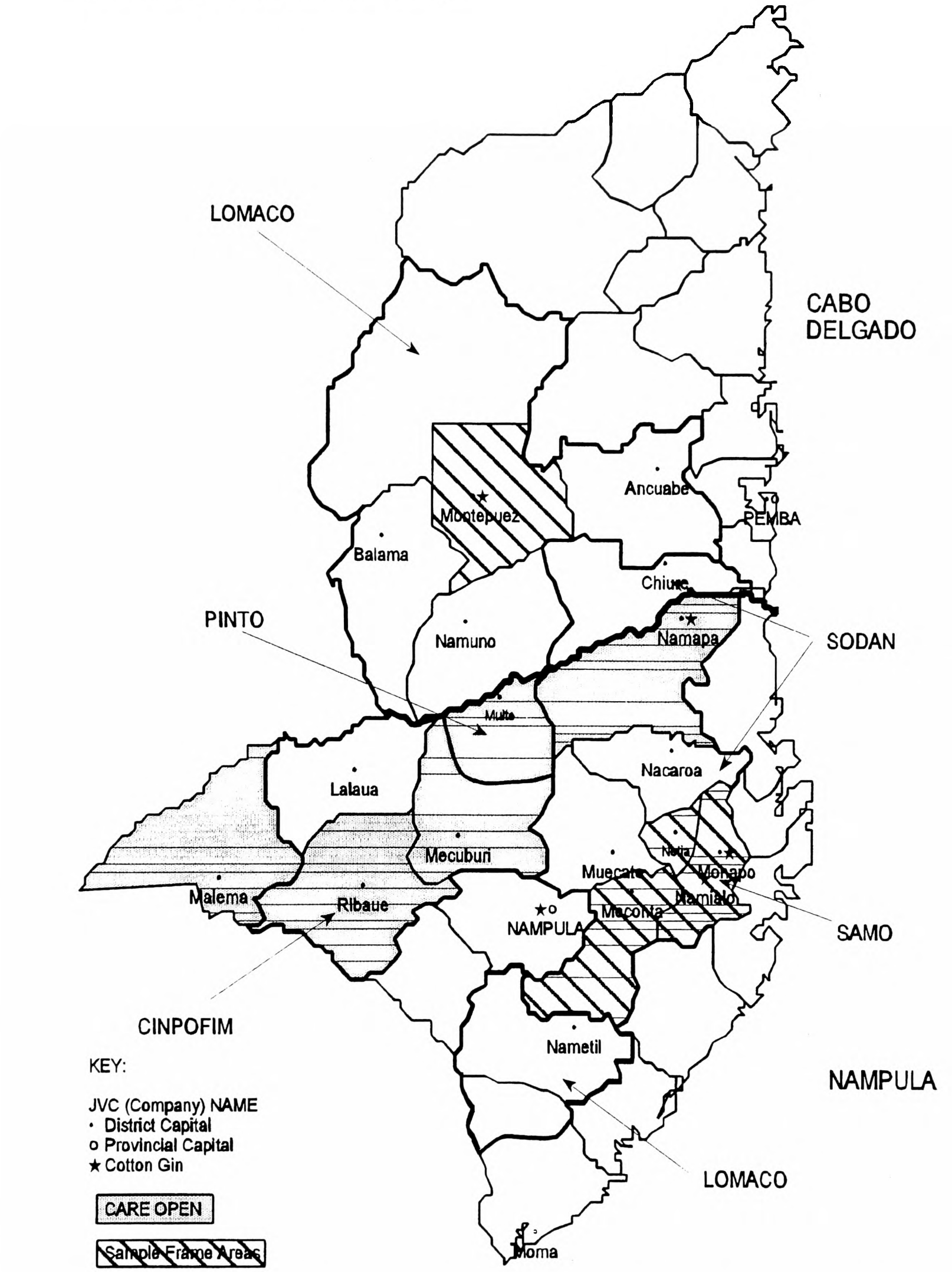
Chapter 8 concludes the analysis, discussing the broader implications from the empirical findings and relating these back to the theory and the literature. In particular, the final chapter will discuss the implications of the research for the analysis of peasant household behaviour affected by war, will assess the nature of this war legacy, and will derive some policy implications for the case of rural northern Mozambique.

Figure 1.1: Map of Mozambique



Source: United Nations (1998).

Figure 1.2: Map of Northern Mozambique



This map shows all districts in Nampula and Cabo Delgado. The diagonally shaded areas indicate the FSP sample zone while the grey shaded areas indicate the operational boundaries of Care Mozambique. The areas of influence of the monopsonistic cotton joint venture companies (JVCs) are also shown. The FSP sample design and the institutional arrangements of the cotton sector are discussed in more detail in chapter 3. The map is not drawn to scale.

Source: MAP/MSU Research Team (1996: 19).

Chapter 2: Peasant Households in the Post-War Period

2.1 Introduction

This chapter outlines a framework for the analysis of peasant households in the post-war period. Two representative farm and peasant household models will be considered and their suitability for the analysis of households affected by war will be discussed.

The emphasis will be on outlining some of the micro-economic transmission mechanisms of war and how the war legacy can persist for many years even after the end of the conflict. The war legacy is defined as the various effects of war on household characteristics, technologies, endowments, institutions and markets which persist beyond the ceasefire. These effects will be defined and considered later in this chapter. War will thus not be treated as a unitary shock akin to a natural disaster. Instead, its many and varied effects will be found to influence household endowments and decisions profoundly and yet indirectly, especially in the post-war period.

2.2 Peasant Household Models

Defining the Peasant Household

This section will briefly define the term peasant household and discuss some of the implications of that definition, especially concerning the relation between households and markets, the importance of household composition for household decisions and the degree of rationality practiced by peasant households. The next section will discuss the main exogenous constraints facing peasant households.

A household is a group of agents closely bound by choice, custom or law to make and execute many shared production and consumption decisions (Dasgupta 1993: 221). In this study and in the FSP dataset analysed below, a household is defined as all persons typically sharing their meals. This excludes non-resident household members who may make important contributions to the household's income generating or decision making process.[1]

While households size may even be endogenous in the long-term, it is assumed here that household size and most aspects of its composition are exogenous in any given year, as the gender balance rarely changes strongly or suddenly, ageing is a very gradual process, and

---

[1] Some data on non-resident household members was collected as part of the FSP survey analysed in this study and the number of non-residents (as a share of all resident household members) who occasionally share household meals is very small (1.5%) thus making number of household residents and their composition the main determinants of household labour endowments and consumption requirements.

births do not significantly alter either the consumption or production potential of the household within a given year. Only sudden deaths of productive household members change the consumption-production balance significantly within a very short period. In this study, variables capturing household size and composition refer to the status at the start of the agricultural year thus aligning the household structure with the annual production decisions.

In addition, a household is often treated as if it were a unitary agent itself (cf. Alderman et al 1995, Bergstrom 1997, Strauss and Thomas 1995). This view disregards important intra-household bargaining, for example between male and female, young and old, family and non-family members of the household, or between other coalitions of agents within the household. In this study, the household composition variables account for some of the intra-household bargaining that may affect production decisions. However, given the limitations of the available data, it is not possible to account for differences in the intra-household allocation of resources. As discussed in more detail in later chapters, variables thus measure outcomes per household or per capita per household, thus capturing only household-level effects but not those at the individual level.

Peasant households derive their livelihood mainly from agriculture, utilise mainly family labour in farm production, farm relatively small areas[2], and are characterised by partial engagement in input and output markets which are often imperfect or incomplete (Ellis 1993: 13, Low 1986). The term peasant household will thus be used interchangeably with the term smallholder household. It is their joint characteristics concerning their assets and bargaining power and their large share of the population and labour force which make them an important unit of analysis and which will be reflected in the analysis of household production and market participation decisions below.

From the point of view of peasant households, markets may fail to exist when a household faces a higher disutility than utility from conducting a market transaction as a buyer or a seller and consequently the household does not use the market for conducting this exchange but invokes non-market institutions (e.g. social exchange within the extended family) or does not conduct the transaction at all (de Janvry et al 1991, Key et al 2000). If this applies to all commodities for a household, then that household lives in complete economic isolation, or autarky.

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[2] One household with a cultivated area of 35 hectares or more in the whole FSP sample period has hence been excluded from the analysis.

More commonly, market failure is household- and commodity-specific so that each household in an area can be a market participant for some products but not for others. The divergence between disutility and utility of market participation for a given commodity increases with transport costs, search costs, enforcement costs, price risks, availability risks for the product, other transaction costs, and general equilibrium effects. The latter are particularly pronounced in agriculture where for instance a good harvest will lower the product price and thus reduce the incentive for households to sell their produce.

Peasant households thus produce at least some of their own inputs and consume parts of their own output, not participating in as many markets as other farm households facing lower market transaction costs. This characteristic has five main implications.

First, peasant households in the extreme depend only on their own household labour supply for production and either have no opportunity to hire-in or hire-out extra labour resources or they find it unprofitable to do so. Furthermore, the effective own household supply will be determined by the internal consumption-production ratios as discussed by Chayanov and in the model outlined below.[3]

Second, the decision making process in the peasant household must differ from that of a fully market-oriented farm business or a perfectly competitive firm. In the extreme, a peasant household engages entirely in subsistence (i.e. home-produced and home-consumed) production. For such households, the composition of the peasant household and its internal relationships are important determinants of its behaviour. These aspects are discussed in the subsequent two sections in greater detail.

Third, the extent of such subsistence may be determined endogenously by the household in the presence of land, labour, credit and output markets. Alternatively, a peasant household may be forced into subsistence activities against its preferences in the absence of some or all of such markets. Given the nature of the rural Mozambican economy during and after the war, it is likely that peasant households faced such constraints for many years. Much of the analysis below will thus be concerned with assessing the mechanisms which bring about such subsistence situation and how households deal with these constraints, which themselves can be expected to change with the end of the war.

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[3] The Chayanov model of peasant household production has for example been summarised by Ellis (1993) and Levi and Havinden (1982), extended by Mellor (1963), Millar (1970) and Sen (1966), and applied by Hunt (1979) and Shapiro (1990).

Fourth and to the extent that a household finds itself forced into peasant household production, this may be an inefficient allocation of resources given the household's comparative advantage. Peasant household production may occur involuntarily at the early stages of the development process where the modern sector still provides few employment or marketing opportunities and the subsistence economy dominates as in the early phases of the Lewis model (Lewis 1994) or where an unequal distribution of assets forces some households into accepting suboptimal contractual relationships (as for some sharecropping tenants). The peasant household is thus characterised by a lack of opportunity and by a lack of market power, even in the presence of markets. A corollary is that peasant households are not able to influence market prices, especially for outputs (Singh et al 1986a: 8). Most of the analysis below will hence assume that peasant households are price takers in all markets.

Finally, the existence of thin markets and the poverty of peasant households lead to a situation of household vulnerability. This is defined as a high exposure to risk, shocks and stress, and a proneness to food insecurity which may all combine to cause destitution (Ellis 1998: 14). In other words, peasant households are vulnerable if they experience a combination of a high variance of income and a low level of income.

Lipton asks whether peasant households maximise their objective (profit) function, as postulated by Schultz, or whether they act as if they maximised that function (Behrman and Deolalikar 1988: 638). A profit maximising peasant household produces efficiently and in the absence of binding constraints. Yet Lipton argues that there are many binding constraints facing peasant households. These include legal, cultural, environmental, or individual conventions and they exist for several reasons.

First, risk aversion may make these practices appear desirable or necessary. A risk averse household may opt into formal or cultural institutions which restrict choices but which ensure a minimum income even in the face of disaster. Some households may have to participate in such schemes even if they are suboptimal, either for a lack of an alternative or due to a household's lack of political or bargaining power.

Second, non-economic determinants of economic decisions are less uniform in poorer societies and thus have more influence, especially for the poorest members of these societies. The caste system in India, for example, shows how household choices can be restricted in the extreme. This will motivate an explicit incorporation of social institutions as independent variables in the analysis below.

Third, there may exist vicious circles of poverty whereby low consumption, low investment, low income and high risk reinforce each other. Instances of such poverty traps

will be analysed below in more detail. Overall, these three effects restrict the behaviour of peasant households.

According to Lipton, the assumption of "as if" profit maximisation is valid as long as researchers and policy makers also identify which constraints are binding for peasant households. Bardhan and Udry (1999: 3) support this view by interpreting the "as if" assumption as an evolutionary process. In the long-run, only "as if" maximisers survive natural selection and economic competition for resources. The theoretical and empirical analysis of peasant households neither has to make the unrealistically stringent assumption of profit maximising actors nor to consider randomly behaving households. Instead, the assumption of households acting as if they maximised profits takes into account the relevant restrictions while still permitting a systematic analysis. The analytical and regression analyses presented in subsequent chapters will thus include variables which can capture some exogenous constraints on household behaviour.

This section has defined the peasant household as a unitary economic agent which faces imperfect or even no markets. The household as a whole pursues a rational strategy which is a form of or resembles profit maximising behaviour. Peasant households are thus characterised by the incomplete markets surrounding them and which are partly the result of very significant exogenous constraints. These are discussed in more detail in the subsequent section.

Exogenous Constraints Facing the Peasant Household

A typical peasant household thus faces a set of exogenous constraints which co-determine its behaviour (Binswanger and McIntire 1987: 75, Dasgupta 1993: 243-4). This section will introduce these constraints while the subsequent chapter will discuss the exact nature of these constraints for the case of northern Mozambique. The empirical analysis in later chapters will attempt to capture some of these constraints through the inclusion of appropriate variables. These exogenous constraints will thus be shown to affect land and activity choices and household welfare.

Rural Mozambican peasant households face variable rainfall, a short growing season, little irrigation infrastructure, animal diseases limiting cattle herding and hence large uncertainty concerning the intra- and inter-year and intra- and inter-regional availability of food and cash crops. These agricultural risks are highly correlated among households and villages thus undermining credit systems. Such geographically correlated risks are called covariant risks.

Land in northern Mozambique is relatively abundant but of varying quality. Thus a system of shifting cultivation and mixed cropping is practised to avoid soil exhaustion. This technology is thus endogenously chosen, given the exogenous constraints. Fertiliser inputs are not typically required with shifting cultivation. Land is allocated at least in part by traditional institutions which do not result in European-style property rights for individual households. This implies that there is no formal market for land, that land cannot be used as collateral, that there is no land tenancy, and that there are few landless households. Rather, relatives working in urban or formal activities and local communities may provide credit, provide collateral, and help insure against the risk of crop failure. Further insurance can be derived from spreading crops across several smaller plots. Individual households, however, have little incentive to invest in the quality of their land.

The population density in Mozambique is low and transport and information costs are hence high. This, and the difficulty of obtaining credit, makes hiring in and supervising labour costly and thus reduces the size of the rural labour market. Small plot sizes, the system of shifting cultivation, the practice of migrant male labour in some areas, and the existence of tsetse flies imply that fieldwork is generally carried out by women who work with hoes, rather than with ploughs. The harvest is stored by individual households to avoid problems of moral hazard and pooled risks of pests. Stored crops are, however, a risky asset which pays no dividend. Instead, households may wish to invest in human resources. However, especially before the ceasefire there are only few functioning primary schools which offer a low quality education. As will be shown later, the demand for education is also very low during and after the war.

These climate, land, and population constraints, which cannot be changed by households or policy makers in the short-term, thus have strong implications for the resulting household choice set. The list of constraints also shows how many missing markets in rural areas of developing countries are not absent for exogenous reasons as is often assumed in the literature of the implications of absent markets. Instead, their absence is endogenously determined by the joint presence of a given set of material and behavioural elements in rural agriculture (Binswanger and Rosenzweig 1986: 504). It is such a framework that will be assumed to affect household behaviour in this analysis.

The Singh, Squire and Strauss Farm Household Model

This section briefly reviews the benchmark neoclassical farm household model summarised by Singh, Squire and Strauss (SSS) and applicable in many developing country contexts (1986a). An understanding of the SSS model and its limitations will define the key characteristics required of a realistic agricultural household model.

The typical farm household engages in input markets (e.g. for hiring-in labour) and in output markets (e.g. for selling maize) to earn its farm income. Income refers to positively valued goods, services and cash obtained by the household through farm production, off-farm work or as gifts (Ellis 1998: 4). Items obtained through non-market institutions (such as government services) may be considered part of a household's livelihood, which includes income and social institutions and relations relevant to a household's existence and well-being.

For a given set of exogenous constraints governing the climate, land, technology and information and for given prices, the household will act as if it aimed to maximise its utility, subject to budget and time constraints. The household will then equate the marginal revenue product with the wage rate which determines first the production allocation, then the consumption and labour supply allocations and finally the welfare of the household. The farm profit hence affects household income and subsequently consumption and labour supply decisions. This is called the profit effect (Singh et al 1986a).

It is thus the choice of land and labour inputs based on prices and land characteristics, not the household's endowments or preferences, which determines profits and thus consumption and utility. This is the separation property of the farm household model (Bardhan and Udry 1999: 9).

Further assumptions underlying this model include the perfect substitutability between own and hired labour, the absence of price differentials between hired-in and hired-out labour and between purchased and marketed crops, the absence of other production inputs such as fertilisers and of outputs other than main staple crop, and finally the absence of risk from production. The separability of production and consumption decisions by the household is thus dependent on (almost) complete markets.

Even if one of the market assumptions of the basic model does not hold, the separability of production and consumption decisions in the peasant household still holds (Bardhan and Udry 1999: 10). Thus a household facing no land market but a labour market chooses its labour input for its given endowment of land independent from household preferences or labour endowment. Yet if the labour market also breaks down, then the joint land and labour endowment of the household as well as its preferences will determine household choices. This case is then closer to the Chayanov household model (see references above).

There are two types of interactions between peasant households and other agents on the rural economy which are captured in this basic model, namely the non-agricultural sector and policy interventions affecting peasant households.

The demand for non-agricultural consumer goods is a function of prices and income in this model. The origins of these goods will affect how much of a demand change will translate, for example, into rural employment changes. Furthermore, the responses of the demand for these goods to changes in prices or incomes may differ between different types of agricultural households. An increase in non-agricultural output prices, which normally would negatively affect net consumers of such output, may hence cause positive spill-over effects for some households engaged in the production of non-agricultural commodities. The analysis in this study will thus address the difference between different household categories by dominant household type.

An Evaluation of the SSS Farm Household Model

There are strong theoretical grounds to believe that the SSS model does not hold in most circumstances. The behavioural relationships of any such model are bound to simplify a more complex reality. It is the purpose of modelling to propose a theoretical relationship between variables which may be tested and modified using empirical evidence. An initially simplistic model may, after some testing, finally yield a realistic approximation to the true, underlying relationship between two sets of variables.

More importantly, the assumptions underlying the basic model are quite restrictive and may not hold in reality. The assumption of separability in the decision making process depends on the necessary assumption of households being price-takers in all markets. This assumption may not hold because markets may not exist or they may be so thin, especially in the post-war period, that an individual household can significantly affect the outcomes of a very thin market (chapter 6).

In addition, non-separability may occur when sales and purchase prices differ, for example as a result of transport costs, commodity heterogeneity, and supervision costs to avoid moral hazard problems in employment, or when households face risk. The latter case implies that markets (e.g. for credit) are imperfect and may lead to outcomes considered inefficient under certainty. For instance, in the case of credit rationing the amount and the price of the credit supplied may be a function of the amount still outstanding, so that the household does not face a given price in this market, thus introducing non-separability into the analysis.

Non-separability may also result from the interdependence of household decisions, for example in the field of household health production, with gender-related differentiation of intra-household activities, or with a corner solution where a household consumes all that it produces of one commodity. In the latter case the commodity's shadow price is a function

of the household's preferences and the production technology which are also interdependent on other household choices.

Empirically, there is little evidence suggesting that the separation property holds (Bardhan and Udry 1999: 11-3). For example, if the property held and there were constant returns to scale, there would be little variation among farms with respect to key characteristics such as size, labour input, productivity and yields. Yet in practice, there is much variation among farms. This suggests that a realistic model of peasant household must incorporate some more imperfections to generate valid predictions.

The SSS model also suffers from a lack of a discussion of saving and investment. The model does not specify how households build up their capital stock or which factors influence these decisions. Increases in non-farm income only increase the household's consumption in this model, they cannot be re-invested to increase future productivity (Ellis 1998: 15). Related aspects include the lack of a dynamic perspective and the absence of risk and uncertainty from the basic model. To overcome these weaknesses, some studies have added one of these dimensions at a time (cf. Singh et al 1986a) but the resulting models often end up loosing resemblance to reality in order stay analytically tractable.

Thus separable models are analytically much more tractable but they require certain restrictive assumptions. By initially postulating the basic model, one is forced to specify the ways in which the observed economy differs from the original model and how this may alter the previously expected conclusions. When assessing empirical evidence, these considerations help to evaluate the nature of the markets studied.

The SSS model of the farm household is particularly relevant where the integration of smallholder farmers in rural markets is a dominant feature of the economy. More specifically, the model is useful if market-derived farm profits provide a high share of household income. This occurs when peasants are faced with well functioning markets for agricultural inputs and outputs and for consumption goods, when marketed crops provide a higher share of household income than retained production, wage labour or non-farm entrepreneurial activities, and when there are significant linkages.

The model is also useful if the profit effect is likely to dominate the income and substitution effects of traditional firm analysis. The role of the profit effect is higher for goods with a higher elasticity of demand with respect to income. As this elasticity tends to be lower for agricultural goods than for non-agricultural goods, the latter is more sensitive to larger profit effects.

Assessing the relevance of the two conditions above is then a good test of whether the SSS model is a useful model for the analysis of post-war Mozambique. As the next chapters will show, in post-war Mozambique the majority of rural household income is not earned in market activities but in subsistence food crop activities. Households in northern Mozambique are thus not well integrated into markets and the profit effect is likely to be small. Furthermore, the external constraints reviewed above are not well incorporated into the SSS model, thus requiring some adjustment to the analysis to explain a larger share of the observed variation in household choices and welfare outcomes (Binswanger et al 1995: 2735).

The Foundations of the Binswanger and McIntire Model

The SSS model of peasant household behaviour is analytically tractable but inapplicable to war-affected Sub-Saharan Africa. The Binswanger and McIntire (BM) model introduced here complicates the analysis in an attempt at making the model more realistic (Binswanger and McIntire 1987). In the original paper, it does so verbally (instead of geometrically or algebraically) as to emphasise the broader implications of its hypotheses while recognising the possible lack of internal consistency between the assumptions and the predictions. This thesis extends the BM model to the case of a war economy and also develops these arguments both geometrically and mathematically.

The BM model pre-supposes a low population density, missing rural markets and a risky environment. While the model does not explicitly address the issue of the economic effects of war, many of its variables are key transmission mechanisms of economic war effects, as will be shown below. The BM model thus provides a useful model with which to analyse market and non-market choices of farm households in post-war Northern Mozambique.

A community without animal traction, without public goods, without external exploitation or taxation, and without output markets has been analysed by Meillassoux (1981: 35-7). Such communities primarily interact with similar communities, through social or market exchange. They rarely have substantial interactions with structurally different communities which could lead to a change in the nature of the community's production and exchange relations.

In equilibrium, the products of insubstantial interactions with outsiders are absorbed into the community by using these products akin to those already in circulation. Instead of property (and its associated individual rights), Meillassoux considers patrimony, i.e. a communal use and sharing of resources, to be a key feature of the domestic economy. Such communities therefore need not be autarkic but are characterised by pre-capitalist forms of

social organisation and exchange which are all dependent on the external constraints of production.

Such economic system, and particularly its underlying characteristics, is summarised in more neoclassical terms by Binswanger and McIntire (1987), who also build on Binswanger and Rosenzweig (1986), Boserup (1965), and Low (1986). The BM model includes peasant households which have the objective of income maximisation while aiming to smooth income and consumption over time, avoiding risks and disasters, and providing for the negative effects of future shocks for given technological, environmental and informational constraints. Specifically, the BM model is characterised by the following set of assumptions.

Households are assumed to dislike effort but to derive utility from both consumption and from a low variation in consumption, especially a low negative deviation from what each household considers to be its minimum calorie requirements. Such a preference (i.e. for food consumption not to fall significantly and not to fall below a certain threshold for long periods of time) is defined as food security by risk averse households (chapter 7). This creates incentives for households to seek insurance against risks (see below and Binswanger and Sillers 1983).

In the absence of war, the BM model assumes that households only enter into voluntary labour contracts in exchange for money, goods or other labour services, so that there is no slavery. Households produce one good, for example a staple food crop. Chapters 4 and 5 expand on this discussion by considering trade-offs in the labour allocation between area farmed, land investment and land tenure perception. Chapter 6 considers a labour allocation choice between different goods and different markets, including social exchange. The BM model does not concern itself directly with issues of the home production of z-goods (Becker 1965) though the demographic composition of the household (which might affect the z-good production, too) does have significant effects on food crop production as seen below.

Assets are resources that can be accessed and commanded by the household while social capital are those intangible assets which improve access to other resources and, more generally, give capabilities to people to be and to do (Bebbington 1999, Sen 1997). In the BM model, there are six primary factors of production (other than secondary, or short-term, factors such as fertilisers or seeds): workers, management skills, land, trees, machines, and animals. The first two are human capital and the last four are physical assets. Management skills may also be dependent on social capital, as farm management also involves the negotiation of social relations, even if there are no formal markets. All these forms of assets will be accounted for in the regressions used in subsequent chapters.

The population density is taken to be low (as is the case in many parts of Sub-Saharan Africa) which implies that there is land abundance and no land market as land is immobile. There are traditional land allocation mechanisms and no externally imposed property rights. There are also high transport, travel and information costs thus creating economic isolation. Households conducting market transactions can use and gain information in the process but due to spatial distribution of agriculture, these opportunities are limited in the BM model. Yet relative to the cost of moving bulky crops, the travel costs of individuals are low thus social networks can exist. The analysis of land use in such agricultural system will be the focus of chapters 4 and 5.

Simple, hand-tool technology and low economies of scale dominate in agriculture and coexist with some hunting and gathering by smallholders. The low level of technology employed extends to storage techniques, so that storage losses can account for 10% to 25% of farm output in Sub-Saharan Africa (Dasgupta 1993: 205). Given such low level of technology, the risk aversion of households and the lack of markets, the BM model predicts that animal husbandry is a likely income and risk diversification strategy.

Risk in the BM Model

A situation of perfect certainty is one in which all future events can be predicted without mistake by all economic agents, that is perfect foresight exists. However, events are impossible to predict accurately in practice. Risk is thus the subjective probability agents attach to the occurrence of a future event. This means that micro-economic variables will not be deterministic but rather have probability distributions of occurrence, which agents try to estimate based on their personal knowledge, experience and expectation-generating mechanism. This includes agents' expectations of their own death thus requiring modification to their objective functions.

Uncertainty on the other hand refers to the experience of a variety of risks at the macro level of the economy. Expectations tend to be defined relative to some optimal value (such as the optimal capital stock). Information availability and processing will thus be crucial to the ex ante and ex post risk coping behaviour. In fact, the expectations formation process itself may be damaged or affected by shocks hence further increasing uncertainty.

Several sources of risk can be identified in the agricultural context of developing countries (Binswanger and Rosenzweig 1986, Ellis 1993). They include economic, political, social, and natural sources and can be experienced at the individual, household, village or macro levels. The agricultural risks derive from the weather, seasonality and the absence of irrigation, and other crop and storage risks which can be highly covariant within small areas. Examples of these risks are shown in figure 2.1. The empirical analysis below can

account for the majority of risks shown in the figure. War as a source of risk will be discussed in more detail later in this and in chapter 6.

Figure 2.1: Sources and Levels of Risks in the Rural Economy

	Sources of Risk				
Levels of Risk	**Economy**	**Politics**	**Social Environment**	**Natural Environment**	**War**
Individual				**illness**, death of individual	conscription, **dislocation**, war death
Household	bargaining power in incomplete markets	**land access**	**illness** and death of relatives, **land access**	**crop growth, field pests and diseases, storage pests**	**asset destruction, migration**
Village	**prices,** market failure	change of power, policy decisions		**climatic variations, crop pests**	information transmission, **social infrastructure**
Province	**prices**, market failure	change of power, policy decisions, aid		**natural disaster**	inflation, political change

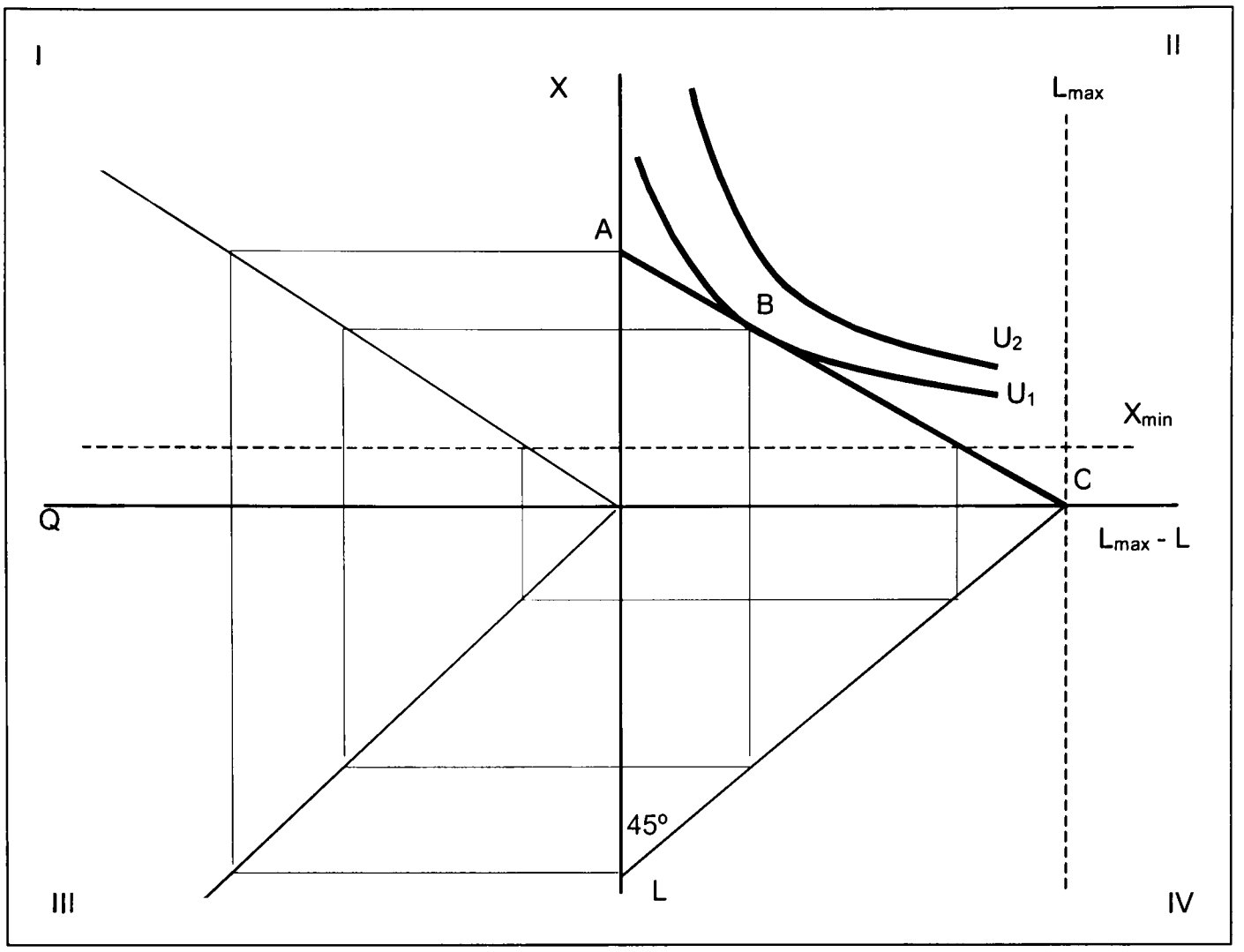
Risks shown in bold in the table indicate risks which are captured in various ways in the FSP dataset.

Sources: Adapted from Brück (1996) and Ellis (1993: 82-5).

The existence of risk can allow markets for insurance to develop by providing insurers with a profitable opportunity for the diversification of imperfectly correlated risks (Bardhan and Udry 1999). The provision of fair insurance would permit savings and production decisions to be made by agents regardless of the risks being faced. Instances of insurable risk could include fire, accident, crop failure, long, short or no further life, and ill health. Yet frequently insurance markets break down. This can be due to either moral hazard or adverse selection problems, so that an informal provision of insurance (e.g. through interlocked markets or non-market institutions) may be more efficient as long as the risks are imperfectly correlated among different members of the relevant group.

Empirical studies have never found a case where such full risk pooling is practiced. In two studies in Northern Nigeria and Southern India, the proportion of idiosyncratic risk in the variance of total household income was found to be over 75% (Dasgupta 1993: 206, Udry 1990). Another study found that over half of all yield variation in a semi-arid area of Burkina Faso was due to idiosyncratic household risk, not aggregate risk (Carter 1997). Thus all agricultural households in developing countries will experience both idiosyncratic risks and aggregate, covariate risks. Even with imperfect insurance markets or institutions, there should be much scope for household risk spreading and intra-village risk pooling and hence welfare improvement. In other words, with poor infrastructure, the opportunities and the benefits from risk sharing are potentially huge but very hard to realise in practice.

Figure 2.2: The Peace-Time Peasant Household Model



The BM model extends the analysis of the unitary household behaviour of the SSS model by incorporating a set of further assumptions which are typical of some African countries. These assumptions include land abundance, imperfect or missing input and output markets in rural areas, and a variety of sources of risk.

A Graphic Representation of the BM Model

The BM model is summarised graphically in figure 2.2. Note that appendix A.1 formalises this graphic representation of the model. Quadrant IV converts leisure (L_{max} - L) into labour supply (L), quadrant III depicts the production function, and quadrant I shows the storage function. In quadrant II, the technological constraints on production are indicated by the upper boundary ABC (which is akin to the income constraint of the neoclassical model) of the production set where a production set is the set of all possible input-output combinations (Gravelle and Rees 1992: 195). Note that the segment of ABC below X_{min} is not feasible in practice as the household would not have enough calories to live and work.

The household's preference for higher utility is indicated by the shape of the indifference curves U_1 and U_2. The indifference curves will approach the horizontal axis at the bottom-right of the second quadrant as no more leisure can compensate for a further loss of output (and hence consumption). Similarly, though perhaps less importantly, the other end of the indifference curves approach the axis at the top-left corner of the second quadrant as output will be an increasingly imperfect substitute for leisure. The slope of the indifference

curves represents the subjective wage level of the household, measured in leisure foregone per unit of stored output.

The household maximises (or acts as if it maximised, as discussed above) household utility. The maximisation is constrained by the material determinants of output and storage, by the household's given labour supply and its minimum consumption requirements. Household preferences between leisure and consumed output are such that there is diminishing marginal utility from either input. In a static and deterministic environment, the household then chooses its labour supply so that it maximises its utility.

For simplicity, assume that the constraint ABC in figure 2.2 is binding. Equilibrium is established at point b, where the highest possible indifference curve U_1 is tangential to the upper boundary of the production set. An improvement of, for example, the technology of production would permit the household to reach a higher utility. Yet such change would have an indeterminate effect on the amount of labour supplied and leisure consumed as the standard income and substitution effects of neoclassical theory apply here as well. Better production technology could lead to a reduction of the labour supply.

Key Results of the BM Model

The BM model implies several key results (Binswanger and McIntire 1987), all of which apply to the case of northern Mozambique and thus increase the model's suitability as a framework for the current analysis. First, with the low population density and low barriers to land acquisition it is always profitable for households to engage in some cultivation. The costs of labour hiring and supervision and the absence of economies of scale and gains from specialisation also prevent households from offering significant wage labour to other households.

Consequently, it is cheaper for a household to expand the area cultivated with own household labour rather than to hire-in labour. This proposition does not preclude households from performing certain tasks in groups outside the key sowing and weeding seasons, which are short, unpredictable and very synchronic within small areas. This reduces labour demand and prevents active labour markets from establishing itself.

Third, in the very long-term the hiring and supervision costs of off-farm labour, the diminishing returns based on seasonality, and the low marginal utility to effort lead to household size being endogenous. With no gains from specialisation, no economies of scale, no risk, and no capital accumulation there would be atomistic households, i.e. each adult would cultivate his own land. Relaxing the assumption of no gains from

specialisation, people form households to exploit intra-household comparative advantages which may be based on actual or perceived differences in ability, motivation and status.

Beyond these nuclear households, people may form vertically or horizontally extended households, where multiple nuclear households join together based on age or sibling-relations, respectively. These extended households, which may share crop cultivation, storage and food preparation, may be formed as an insurance policy against individual, non-covariant risk (e.g. accident) or in response to a given or optimal asset distribution (e.g. controlled by the household head in exchange for labour services). Long-term household structure, asset accumulation and social institutions are thus related in the absence of technology, property rights, and insurance markets (Meillassoux 1981: 41). However, the regression analysis carried out below only applies to one year, making the time frame too short to consider household size as an endogenous variable.

The BM model can thus account for some key features of land abundant, poor areas, including the predominance of subsistence agriculture, the near absence of household wage labour, and the endogenous role of household structure and social relations. Chapter 3 will illustrate how appropriate the BM assumptions are for the case of post-war northern Mozambique while appendix A.1 will formalise these arguments in a model of peasant household behaviour under land abundance.

An Evaluation of the BM Peasant Household Model

The BM model differs from neoclassical models of peasant household choice by not including any input or output markets and hence no explicit or market prices. Output is thus all consumed (or wasted) by the household and the labour supply decision directly determines output levels. Leisure and output are thus not independent consumption bundles and production and consumption decisions are not independent as in the SSS model. Unlike neoclassical models with input and output models, the BM model results in varying marginal products of labour across households, especially as a result of life-cycle constraints and preferences. This model also does not contain a profit effect (Singh et al 1986a: 7), as there are no exogenous prices.

Even though the BM model shares some features with the Chayanov-style models, they differ in a few key regards. In particular, the BM model does not include output markets. In practice this may be a limiting assumption just as the assumption of nearly perfect markets was limiting in the SSS model.

The BM model is not a fixed-income target model but explicitly permits a trade-off between output and leisure beyond the minimum output threshold. Yet it is likely that in

the absence of consumer good markets there is a low marginal utility from increasing output except to the extent that production and storage themselves are very risky. This does not apply if a household is very close to its survival constraint, where the marginal utility of output is large and positive (Gersovitz 1983). On balance, the BM model presented here appears to be a useful starting point for the analysis of a rural developing economy emerging from war, in which poor, isolated and war-affected peasant households are slowly entering input and output markets.

2.3 The Peasant Household Model in the Post-War Period

The remaining sections of this chapter will be used to assess the nature and the likely effects of the war legacy on the assumptions of the BM model and on the key variables used in the BM model. In particular, this section will address the peasant household objectives, peasant household characteristics, farm technology and asset endowments, rural social capital, and rural markets in the post-war period.

Understanding the long-lasting effects of war will help to understand post-war reconstruction, as war strongly shapes the initial economic conditions from which post-war reconstruction must start. In addition, understanding the effects of war is important for understanding the nature and especially the persistence of the war legacy in the post-war economy.

This analysis will prepare for later extensions into the analysis of land access, activity choices and household welfare in the post-war period. These later chapters will thus discuss the effects of war on some of the BM model outcomes, while this chapter will focus on the model itself and the inputs of agricultural production described by the model.

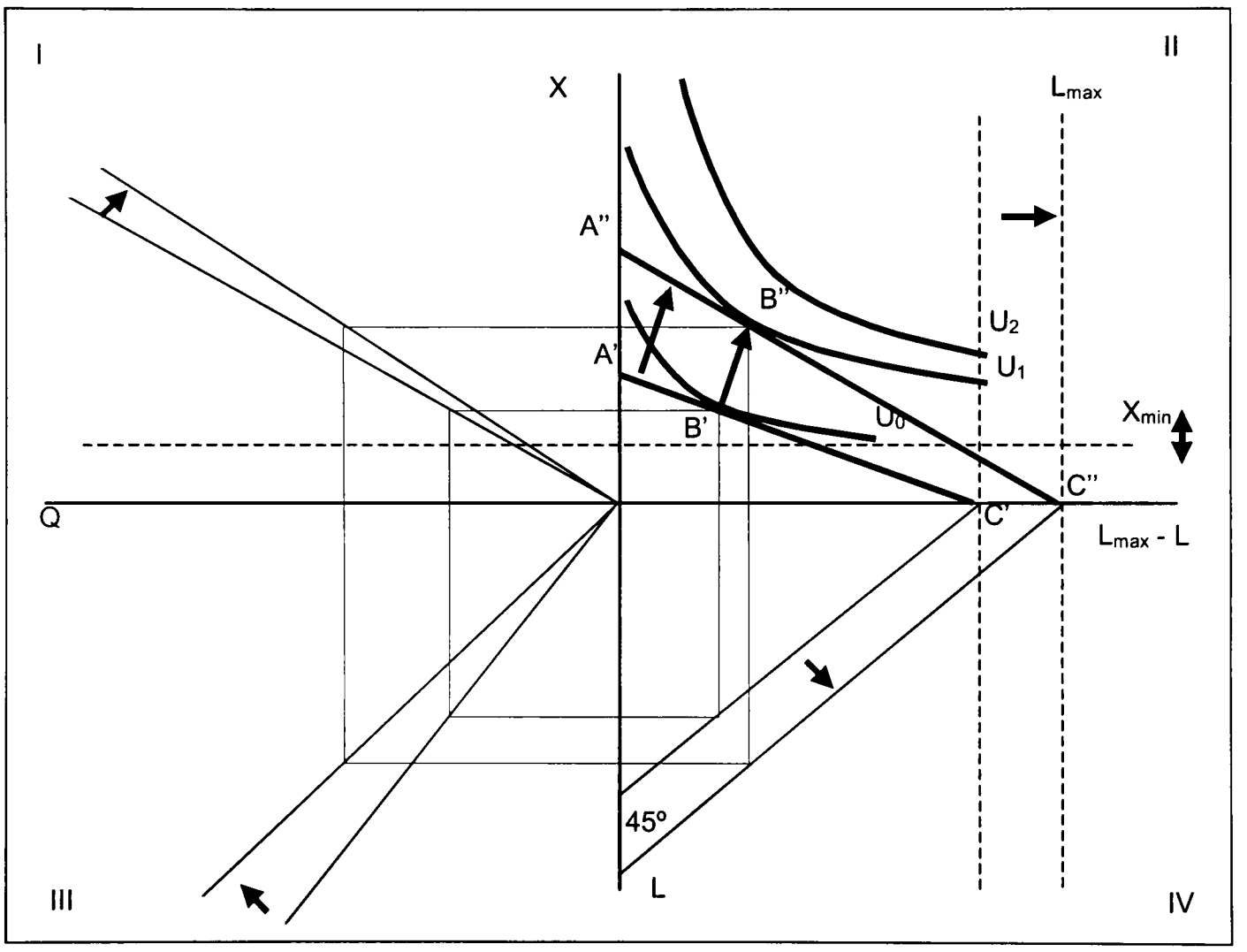
Peasant Household Objectives in the Post-War Period

A key question concerning peasant household objectives and the war legacy is whether the latter changes a household's attitude to risk. While at first sight such change may seem likely, a more realistic approximation of risk behaviour is to consider an unchanged utility function across time and to recognize that it is not people's attitudes but their endowments, actions and utility outcomes that change in response to an approaching or receding war.

That is, individuals close to the survival threshold will not become more risk averse but they will act differently in order to avoid a further deterioration of their situation (Corbett 1988, Watts 1983). Each person has an inherent contingency plan for how to behave in the face of (diminishing) disaster. The drawing closer or gradual disappearance of the disaster precipitates a pre-specified action, not a new plan.

For example, if agents' survival probability is related to their consumption level but their utility function remains unchanged, their actions would focus ever more intensely on maintaining a minimum level of consumption as they approach the survival threshold. Therefore, the utility curves U_0 to U_2 close to the survival threshold X_{min} in figure 2.3 are flat and relatively close to each other, suggesting a very low marginal utility from increased leisure and a large and positive marginal utility from increased output close to the survival threshold X_{min}. Note that in this specification X_{min} refers to the minimum bundle of goods required for physical survival. More loosely, X_{min} will also be interpreted below as a poverty line (or absolute poverty line) or as a more subjectively determined set of resources required to live free from (absolute) poverty.

Figure 2.3: The War Legacy in the Peasant Household Model



The increased marginal utility near starvation should not be mistaken for the outcome of a new, war-affected utility function. Instead, war-affected utility outcomes are the result of different production and consumption technologies, constraints and resource endowments. For example, war can affect the consumer-producer ratio of a peasant household thus changing the time preference of the household. This implies a higher utility from consumption but not a different utility function.

In addition, another exogenous event inducing a similar change in this ratio would lead to a similar change in the valuation of leisure and consumption, thus emphasising how war does not change the parameters of the utility function directly. Gersovitz (1983) and Glomm and Palumbo (1993) similarly assume that moving closer to the survival threshold itself does

not affect the utility function. Instead, they explore the effects of an endogenous survival probability for inter-temporal consumption and saving.

At the same time, the population as a whole may exhibit various risk attitudes. For example, men drafted into the army will not become more risk averse simply because they are now fighting but their personal attitude towards risk-taking is determined by their personality from the start. For convenience, this analysis assumes no population wide variation in risk attitudes. Therefore, this model treats the utility function as not being directly affected by war and uses a standard utility function as a reasonable empirical and analytically tractable representation of behaviour under uncertainty.

The assumption of an unchanged utility function may be justified on methodological grounds as otherwise a comparison of welfare between households which had been affected differently by war or between war-affected households across time would be less tractable. War affects a broad range of structural parameters and this analysis attempts to trace some of them using the best available data.

The assumption that war does not affect the utility function will be examined empirically in chapter 6. It will analyse why households close to the survival threshold may engage in very risky activities, which is consistent with a changed utility function. It will be shown instead that under the assumption of an unchanged utility function it is rational for some households to engage in very risky activities if low risk activities lead to certain death. Finally, better data might allow a more explicit test of this assumption (cf. Binswanger 1980).

Peasant Household Characteristics in the Post-War Period

The six primary factors of production (workers, management skills, land, trees, machines, and animals) are strongly and variously affected by the war and this persists into the post-war period. First, the long-term war effects on the household labour supply will be considered before discussing the effects on household assets, technology, social capital, and rural markets in subsequent sections.

At the individual level, war causes the death, disability and dislocation of household members. The dislocation can involve forced conscription, local displacement or seeking voluntary or enforced long-distance refuge from the direct effects of the war. Even for households directly unaffected by war, the expectation of possible attack and its indirect effects on rural markets imply a reduction in the effective household labour supply.

Note that these effects do not necessarily return to normality in the post-war period or that changes back to a peace-time equilibrium do not happen in a "mirror-image" fashion.

Death and disability are irreversible and even disease may have permanent effects. Conscription and dislocation may not end with the ceasefire or for all affected household members at the same time. Even for households directly unaffected by the previous war, the expectation of a resumption of hostilities or of banditry related to continued lawlessness or even demobilisation imply a continued reduction in the effective household labour supply, for example through continued sentry duties.

As the household consumption requirements may not change proportionately during or after a war, the effective, Chayanov-style subjective valuation of its own leisure (measured in leisure foregone per unit of home-produced output) may be altered significantly for years after the end of the conflict. In the post-war period, the effective household labour supply can be expected to increase by more than the household minimum consumption requirements. Note that there may be some endogenous increase in minimum household consumption requirements X_{min} after a crisis, in line with normalised calorie requirements due to increased effort, but such increase is likely to be small and finite.

The return migration of entire households, plus the diminished failure of rural markets, would slowly increase the rural population density and thus slowly reduce the case for and the conclusions of the BM model as outlined above. In addition, the post-war increase in the production-consumption ratio of the household (i.e. the increase in the subjective valuation of household leisure) would increase the maximum labour endowment L_{max} in figure 2.3 and thus cause an upward shift (for a given consumption requirement X_{min} and given production technology) of the upper boundary A'B'C' of the production set to A"B"C" and increase household utility from U_0 to U_1.

Therefore, the post-war increase in the value of leisure leads to a decrease in the on-farm household labour supply which, due to the diminishing labour requirements of the war legacy (such as sentry duty etc), permits an increased output vis-à-vis the war period. This result depends on the nature of the war, the peace settlement and the economy. With flexible markets and during an international war (e.g. during World War II) these considerations may not apply equally.

War may also change the gender balance of the household if men are predominantly involved in fighting or otherwise affected by war. However, the role of male long distance migration (Ellis 1998: 24) is relatively small in northern versus southern Mozambique (where temporary migration to South Africa is common) thus reducing the incidence of female-headed households. In addition, in a war of destabilisation aimed at the entire rural population, women as well as men may be the victims of attacks or may be forced into slavery thus weakening the war effect on the intra-household gender balance. In fact, the

use of slavery by Renamo for supplying its troops and fighting its wars can be seen in part as a cynical but rational response to the problem of low population density in Mozambique (Binswanger et al 1995: n. 8).

The effects of a war of destabilisation on human capital are very strong, as will be shown in chapter 3. Schools in rural areas were attacked or had to close for lack of teachers thus reducing the mean educational household achievement. Furthermore, less extension advice or other sources of information were available to households increasingly operating in subsistence mode during the war, so that general farm skills also depreciated over time.

In the post-war period, the increased security and the corresponding resumption of aid flows into rural areas permitted a limited rebuilding of schools and extension services. Thus human capital in the post-war period is still very low but the stock of knowledge and skills are slowly rising. Assuming there are positive effects of education on farm productivity, these post-war effects would result in a small upward shift of the production function Q in quadrant III in figure 2.3, thus increasing household utility.

Technology and Assets in the Post-War Period

Apart from the obvious human death and injury, the asset destruction caused by fighting is a key expected cost of conflict that persists beyond the end of war. Similar to the long-term effects of war on farm skills, war reinforces the perseverance of the use of low level technologies as exemplified by the dominance of hand-held tools in northern Mozambique. The war led to a depreciation of even these simple tools by reducing households' ability to buy new tools, by enforcing the substitution of better tools with poorer makes of tools, and by reducing the availability of new tools in post-war markets (Boserup 1965: 26-7). These effects were particularly significant due to the lack of local technological capacity to make or repair metal objects, which in itself may be due to a war-induced prevention of the spread of such technologies.

In addition, household storage techniques deteriorated during the war, thus increasing post-war crop losses resulting from insects, rats, fungi and other crops diseases both in the field and in the barn. This effect should have been alleviated after the war by the reduced need to conceal stored crops from rebels which prevented the use of optimal storage techniques during the war. The absence of regular post-war trading opportunities increased the importance of storage in the subsistence economy and reduced the number of modern and potentially useful storage technologies such as sheets, bags, pesticides and pest traps.

War affects household assets through erosion, destruction and reallocation. Erosion involves the loss of actual capital through transformation to a lower value and this effect

persists post-war. Reallocation is an entirely indirect concept and relates to how agents anticipate or react to war affecting their portfolio. Given an ex ante optimal capital allocation, a reallocation must reduce productivity vis-à-vis peace-times. This effect may be reversible in the post-war period to varying degrees and can help to support a peace dividend (Collier and Gunning 1995).

War also affects the physical quantity of actual or desired capital, the value of the capital stock, and the returns to capital. Reconstruction will be muted either if expectations and thus the desired capital stock are low or if the returns to capital are low, which is related to the degree of technological efficiency as discussed above.

The actual amount and value of capital can be affected by a war of destabilisation depending on the characteristics of capital, where fragile, visible, mobile and durable assets are particularly war vulnerable (Azam et al 1994). Fragility implies that an asset is easily damaged, for example animals are easily killed and the meat of animals is worth much less than live animals. Visibility clearly makes an asset more vulnerable to attack and hence to erosion or destruction. Mobility acts to increase capital's vulnerability by increasing its exposure to theft (thus keeping the capital's value unchanged but affecting its ownership). Immobility on the other hand would make an asset more subject to erosion or destruction thus reducing its value but maintaining its ownership intact. Capital cannot be both invisible and immobile. Specificity describes capital's degree of exclusiveness to an economic activity or sector. More specific capital is more vulnerable to military action in that area. Specific capital may continue to be operated even during the war but once attacked may cease to be functional. The duration of capital characterizes the economic life span or life horizon of capital. A typical distinction is between non-durable and durable goods. The longer the life horizon of a capital good, the more vulnerable it becomes to possible future wars.

Land is among the least war vulnerable assets as it is perfectly immobile and its inherent qualities are hard to destroy with the exception of land mines.[4] These qualities suggest that land should be the key asset for rural households in their attempt to reconstruct in the post-war period, as land should be the least war affected and thus most available and valuable asset. For these reasons, chapters 4 and 5 focus on the role of land in post-war reconstruction.

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[4] While arguably land mines planted in a land abundant country are more expensive than the land they destroy, their main economic cost derives from frequently maiming but not killing people, who are predominantly refugees and children, as these are least likely to know the approximate location of the mines.

In northern Mozambique, livestock used to be a key household asset (chapter 3). However, livestock is a very fragile, visible, mobile and durable asset thus making it an extremely war vulnerable asset. Irrigation equipment, tractors and modern storage assets also attracted looting rebels and were badly damaged during the war. Indirect effects of war reinforced these negative effects on assets. Poor veterinary standards, few animal markets and low household savings made restocking livestock difficult after the war, thus creating a strong and persistent war legacy in regard to low household asset endowments.

This discussion clearly indicates that post-war household coping strategies must differ substantially from the pre-war and war-time coping strategies as the war destruction of capital and its reconstruction are not symmetric. This point is elaborated in chapter 6.

The combined effects of poor production and storage technologies and destroyed or disabled assets are akin to poor human capital, and leads to a shift downwards in the production and storage functions and thus to a rotation towards the origin of the upper boundary of the production set and consequently a reduction in welfare. These effects of war on technology and assets combine to leave rural households with poor production technology and low asset endowments. This makes peasant households even more vulnerable and less likely to produce endogenously the spare resources needed to rebuild the countryside. With such low asset endowments, post-war peasant households may thus face poverty traps from which they cannot escape without substantial exogenous assistance.

The relative war vulnerabilities of different asset and activity classes then determine which of these negative effects can be overcome at which speed, thus characterising the overall pattern of reconstruction through the shift of the curves in quadrants I, III and IV and thus of the frontier A'B'C', as shown in figure 2.3. A post-war poverty trap would be indicated by a fixed frontier A'B'C', which also forces a household to operate close to the survival threshold X_{min}.

Before turning to the analysis of how peasant households behave in the post-war period and what determines their welfare, the next section will discuss rural social instititions. They could potentially help households escape the potential poverty traps, unless these institutions also have been severely damaged by war.

Rural Social Institutions in the Post-War Period

The nature of the agricultural conditions in northern Mozambique shape a variety of social and market institutions. In addition, the war may have affected these institutions. In the post-war period, such institutions have the potential to help war-affected households

escape from poverty traps. Therefore, the next two sections assess the nature of the war legacy in regard to rural social capital and market institutions.[5]

Analysing matrilineal societies such as the Macua society of northern Mozambique, Meillassoux concludes that the strong inter-household linkages of such a social model help to control and exchange labour resources beyond the immediate household, hence equipping households with a pool of reserve labour and with consumption insurance in times of unusual labour or consumption needs (1981: 25-32). In fact, Meillassoux views such social organisation as competing with alternative forms of labour control based on male dominated societies in which labour was procured through war-like raid on competing villages.

It is then ironic that the matrilineal Macua society should see a war which actually undermines many of its economic social organisations. For example, the intra-kin exchange of labour was greatly reduced during the war as travelling became more risky and costly and as information flows were reduced, making the communication of labour requirements (e.g. after the death of an important relative) more precarious and less reliable. Ultimately, the war accentuated labour shortages, prevented the equalising of labour exchange across distances, and increased the vulnerability of households to further shocks.

Another irony is that, while it has been claimed that the war in northern Mozambique in part derived from traditional discontent with local, modernist government policies (Geffray 1991), the war also undermined through its restrictions on communication, travelling and exchange of goods, the practical foundations of such traditional society and economy. Furthermore, by forcing local leaders to align themselves in many instances with either side in the conflict, many previously balanced systems of local power were dis-equilibriated. This created further post-war uncertainties at the local level in regard to land access, settling disputes, redistributing aid or government resources, and perhaps even affected the degree of war vulnerability of communities, especially to attacks by Renamo. Thus the war at the local level undermined the long-term enforcement of property rights, increased transaction costs and further encouraged subsistence activities.

A more general conclusion from this discussion is that while households with low asset stocks and weak market access increasingly require non-market forms of social insurance especially across long distances (Binswanger and McIntire 1987: 79), the use of social

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[5] The interpretations of the role of social institutions presented here derive from the analysis of interviews with a range of local actors, including many farmers, conducted during fieldwork in Mozambique in mid-

institutions is also seriously undermined by the preceding conflict and the gap between the increased demand for and the reduced supply of social exchange is much increased.

In other words, less war affected areas and households may have been in a better position to invest in and benefit from social relations, even though they were also less in need of such arrangements. This confirms that network-based substitutes for self-insurance or market-based insurance are less effective for worse-off households and may instead correlate with increased off-farm market activities by better-off households (cf. Coate and Ravallion 1993, Colletta and Cullen 2000, Fafchamps 1992b).

This type of war legacy has a number of less direct effects in the BM model. First, it reduces (vis-à-vis the peace-time) the effectiveness of labour, as weaker social institutions would for example reduce the scope for group labour, an effective way of harvesting a field.

Second, more socially isolated households in the post-war period could not call on relatives to help with key labour chores thus reducing the size of the social labour market (i.e. of potential labour available for on-farm work L_{max} in figure 2.3). As discussed above, this is why the rebels enforced slave labour during the war.

Third, weaker social institutions also reduce the choice of activities available to the household. This is partly reflected in the position of A'B'C' in figure 2.3. For example, consider X to consist of n activities contributing x output each. If m of these n activities are social activities which are not possible to pursue during or after a war (where $m < n$), then only nx-mx total output (where $nx-mx < X$) is still feasible during the war.

Fourth, some social exchange is intended as an insurance against unexpected crop shortfall, so that being able to fall back on social exchange effectively reduces the on-farm minimum production level X_{min} in figure 2.3. With less social exchange, the household has to focus more intensely on producing at least X_{min}, thus indirectly changing the production mix and labour allocation further. The net effect on X_{min} in the post-war period thus depends on the direction and scale of the changes in social institutions in the post-war period and X_{min} has not been shown to make a net shift in the post-war period in figure 2.3.

Combining these effects demonstrates how the negative effects of war induce long lasting social isolation at the household level. War thus forces households to start the post-war period from a position of subsistence, vulnerability, a small choice set, and low utility. In

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1995 and in early 1999 (chapter 3).

addition, the war-induced destruction and dislocation of social institutions may inhibit post-war reconstruction if these negative war effects are not easily reversible after the end of fighting.

Rural Markets in the Post-War Period

War has a strong negative effect on the density and even on the feasibility of rural market transactions. In part, this depends on the nature of war, with internal wars of destabilisation causing particularly high domestic transaction costs. These make market participation less profitable for each household trading a commodity (as argued above) and may thus lead to wide-spread market failure, affecting many households and many commodities over large geographic areas and for long periods of time.

This section will argue how such market failure is made more acute under conditions of war. This section will consider the case of credit though similar arguments will apply to other markets. In addition, this section will show how there are only few substitutes for credit markets and how the resulting economic environment may cause post-war poverty traps for some households.[6]

Rural households may require credit to finance the seasonal agricultural production process or to smooth consumption (Bardhan and Udry 1999: 76-7). The latter case is particularly important where insurance markets are imperfect and where savings are low (cf. appendix A.4). Poorer households may require more credit than wealthier households as liquidity constraints will be tighter and as households will be closer to the survival threshold thus increasing the marginal utility of consumption.

There are several reasons why credit markets can fail. First, restrictive and inefficient government regulations may reduce the incentive to lend and increase the incentive to default (moral hazard). Some such government regulations are likely to hold in the case of Mozambique (cf. Abreu and Hallam 1993, Banco de Moçambique 1997, Chidzero et al 1998), though for rural credit market failure in Mozambique these reasons seems relatively less compelling.

Second, the BM model argues that credit markets in land abundant areas fail because (i) there are few assets which could represent viable collateral, (ii) there is an absence of

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[6] This section is not predominantly concerned with the effects of risk per markets which will be discussed in chapter 6, in the context of household activity diversification. Chapter 6 will show, for instance, how war can push poor and vulnerable households to accept very risky activity choices indeed in a desperate gamble for survival.

property rights and of institutions enforcing them, (iii) land, labour and output markets complementary to credit markets are thin or non-existent, and (iv) demand for credit is low as households require only little working capital (Binswanger and McIntire 1987: 78). Given these restrictions, credit contracts will be small, short-term and mainly intended for consumption smoothing and will not involve financial intermediaries.

For example, land cannot be used as collateral for formal credit market transactions in this analysis as land itself is not part of a formal system of property rights and there are few institutions protecting property rights generally, undermining the potential value of the collateral to the creditor. Similarly, it would be difficult to recoup a loan through forced labour if local institutions do not support such enforcement, if debtors can escape the creditor in a sparsely populated area with far-reaching social support systems, and if there are few legal employment opportunities for such bonded labour (e.g. few plantations). The key features of the BM model therefore undermine the value of assets as collateral and undermine formal credit markets.

Third, the economic effects of war further undermine credit markets both by reinforcing economic isolation, which is also the foundation of the BM model, and by other, war-specific effects. Most importantly, war creates highly covariant risks so that financial intermediaries cannot pool the risk of their lending portfolio if they only operate within the war zone. War also reduces the mean profitability of investment projects thus making repayment more risky. Similarly, war increases the cost of obtaining information about borrowers and their projects, increasing adverse selection. Moreover, war undermines the legitimacy and the efficiency of the state in enforcing property rights and creates opportunities for evading creditors (Kandori 1992).

War also reduces the availability of lending funds and the value of collateral through the war-induced destruction or reallocation (especially abroad) of savings. The characteristics which make for example livestock, housing or jewellery useful collateral (i.e. that they durable, have a high value, and reduce moral hazard, cf. Bardhan and Udry 1999: 83) also mean that collateral is highly war vulnerable during a war of destabilisation. Group lending (Besley 1995a, Besley and Coate 1995) is less likely during a war especially with local political differences over the war aim and the high risk of displacement that make the formation of coherent and stable groups difficult. Most of these effects of war on credit markets do not end with the war, hence also preventing credit markets in the post-war period.

One response to the problem of imperfect collateral can be the emergence of interlinked transactions, so that a credit contract is linked with another contract (say for the purchase

of inputs) thereby revealing further information about the loan applicant and improving the probability that he will be able to repay his loan (Dorward et al 1998). This, however, presupposes that additional markets are operational in which such additional contract can be made. As in the case of credit markets, isolated and war-affected areas generally have fewer markets thus reducing the scope for interlocked transactions.

In fact, there is little historical or recent evidence for voluntary interlinked transactions in northern Mozambique (Govereh et al 1999). The emergence of monopsonistic cotton joint venture companies in northern Mozambique in the 1990s (chapter 3) has not helped to overcome this problem as the companies themselves do not find it profitable to provide much of the tangible and intangible infrastructure necessary to improve transaction costs and enforce interlinked transactions.

If all of the above obstacles to credit markets apply, then households reduce the frequency and the size of their loans, with no credit being provided in the extreme. This implies that dissaving becomes an ex post option for buffering negative income shocks (Bardhan and Udry 1999: 102-3, Deaton 1991). Households with no remaining assets to dissave from thus experience much higher consumption variability and thus much lower welfare. In the extreme, successive negative income shocks can leave people with such few assets that even a small negative income shock can lead to starvation. This consequence of a breakdown of credit markets may even occur after the war itself has concluded.

Furthermore, if these assets are also used in the production process (e.g. livestock), then small current income shocks can have significant future effects on households' welfare by changing the capital-labour ratio and reducing household productivity (Fafchamps et al 1998, Rosenzweig and Wolpin 1993, Udry 1995). Such households respond to income shocks by designating priorities of assets used for consumption smoothing, with non-productive assets being used first. Only after their depletion might a household resort to using productive assets to smooth consumption.

These asset effects in turn are likely to have negative effects on post-war reconstruction. In fact, negative asset shocks are likely to have a larger absolute income effect than positive asset shocks thus making positive income growth more difficult to achieve than negative income growth even with zero-mean shocks (Morduch 1994, 1995). The effectively de-capitalised post-war rural economy may not produce enough of a surplus to start investing in new activities or more efficient technologies, thus creating a war-induced and asset-related rural poverty trap.

These considerations suggest that the apparent lack of markets in post-war Mozambique has strong effects for household coping strategies, both in regard to the use of land and

activity choices, and for household welfare. The war destruction of collateral and markets may thus further re-enforce the shift of household production and welfare to the war-time equilibrium B' and may slow down the shift from B' to B" (figure 2.3).

Post-war institutions and markets are thus central to the understanding of how households survive and rebuild their livelihoods in Mozambique and of why they may remain stuck in war-induced poverty traps for many years after the end of the fighting. Therefore, the war effects on households, assets and institutions and household decisions involving these factors will be analysed in more detail in chapters 4 (land access), 5 (land use), 6 (coping strategies), and 7 (household welfare).

2.4 Summary

Contrasting the Peace-Time and the War-Time Models

The discussion above concerning the effects of the war legacy on peasant households suggests a large degree of congruency between the predictions of the BM model and those of a model appropriate for the analysis of peasant household behaviour recently affected by war.

First, the BM model predicted that household formation in the long-term would be endogenous as larger households may be better able to deal with the adverse effects of land abundance. Similarly, war encourages individuals to form households to overcome some of its adverse effects (which can include effective land abundance). A household affected by war thus has the purpose to physically protect its members and to overcome moral hazard and transaction cost problems accentuated by the war. The occasion for the formation of the household unit differs between a land abundant and a war economy but the effects are similar in this regard.[7]

Second, peasant households in the BM model are expected to use mainly own-farm labour in production, thus resulting in the subsistence model of figure 2.2. Again, there is a large degree of similarity between this prediction and that derived from the war analysis. In the BM model, this effect results from the high degree of hiring and supervision costs with land abundance. With a war-affected rural economy, hiring-in labour is also rarely profitable due to supervision costs (as war causes de facto land abundance) but also

[7] The issue of household formation will not be directly analysed using empirical evidence as the available data does not cover a period long enough to trace these effects satisfactory. In fact, it will be shown below that in the FSP dataset household size can be considered an exogenous variable for the period of observation.

because the gains from specialisation are so low while markets face high war-induced transaction costs and as labour productivity is very low with poor tools and few assets.

When households do use non-household labour, it is mainly to overcome other war effects, for example to share tools where new tools cannot be purchased or to gain some technical advantage from planting a field within a short time frame rather than over several days. Households thus aim to increase the productivity of their war-affected subsistence production in the absence of variable inputs such as fertilisers or improved seeds. The use of group labour is thus structurally different from the hiring-in of wage labour for the purpose of increasing production intended for market sale, as is common in the SSS model.

Third, due to land abundance the BM model predicts that peasant households will focus on on-farm subsistence agriculture production. In a war-affected economy, households are also pushed into subsistence survival activities. However, the reason can be quite different as war-affected households will base their activity decisions primarily on the war vulnerability of their labour and asset endowments and on the war vulnerability of market and non-market transactions. With a rural war of destabilisation this will imply that households specialise in subsistence activities. The motivation for this conclusion differs quite strongly from that of the BM model thus indicating a key difference in emphasis not so much in the predictions but in the reasoning provided for the prediction.

Finally, the BM model, while not framed mathematically in its original version, could in principle be solved mathematically as it assumes that exogenous parameters change only slowly over time, for example due to emerging population pressure. In the war economy, however, market parameters such as prices and institutions may be affected by the war in ways that are hard to predict and calculate, making the explicit modelling of household behaviour in a war-affected economy less useful and less feasible. Peasant households in times of war may face a large number of individually different constrains, making the optimisation of a representative household less informative and computationally awkward. The emphasis in the analysis in subsequent chapters will therefore be on the qualitative and long-term effects of the war on household behaviour, not on the estimation of specific parameters of household behaviour.

Overall, the BM model is a useful starting point for the analysis of households emerging from a significant rural conflict. However, as households move into a more peaceful and market-led environment, some of the effects predicted by the war-modified BM model may cease to be relevant and Chayanov-style or indeed SSS-style household models may be more appropriate for the analysis.

Initial Predictions and a Preview of Themes

From the analysis above, some initial a priori predictions of how the war affects post-war peasant household behaviour can be formulated which will be re-visited and tested empirically in later chapters. These predictions concern the nature of household land access (chapter 4), land tenure and land investments (chapter 5), household activity choices especially between on-farm and off-farm activities, between subsistence and market activities and between food and cash crops (chapter 6), and the determinants of household welfare including the welfare effects of land access and activity choices (chapter 7). Not all of the expected effects outlined here are directly testable with household survey data but the empirical analysis will indicate evidence of these propositions wherever feasible.

Generally, war appears to affect the ability of economic agents to form expectations and to process information more generally, as economic signals cannot be interpreted as easily and the general economic framework is less clear to war-affected agents. War has an obvious direct impact on households and markets but the indirect effects of war as well as the ability of households to cope with the non-war risks may be significantly altered by war.

War can change the mode of rural economic production (see above) so that the separability effect of the SSS model no longer applies and instead household preferences (e.g. about time preference) and endowments determine household behaviour. For example, war enhances Chayanov-style life-cycle effects concerning the supply of effective household labour and the subjective valuation of labour and leisure. This effect will be a key explanation in the subsequent empirical analysis.

With regard to land, war is expected a priori to affect endogenously the degree of land abundance in the rural economy which is a key reason to use a variant of the BM model for the analysis of household production decisions. Furthermore, the use of land, land access, and land institutions are likely to be war-affected, particularly as land is the least war vulnerable asset (chapter 4). Rural households with otherwise low resource endowments may thus turn to land to rebuild their assets and livelihoods. Yet if war also affects land access, this route to post-war reconstruction may be blocked for some households thus creating another rural poverty trap. Alternatively, with many households turning towards land in the post-war period, access to land may become competitive, land abundance may diminish, and inequalities of land access may lead to inequalities of asset accumulation and household welfare.

Asset endowments and distributions are likely to be strongly war affected especially as many rural assets are highly war vulnerable. This is expected to be a key determinant of household activity choices in the post-war period. War appears to force households into

subsistence production or even market autarky. The accumulation of assets depleted during the war is a very slow process for households operating near the survival constraint in the post-war period.

While for less war-affected households, only some markets may become unprofitable to participate in, all forms of market participation may eventually be unprofitable for more war-affected households. In the extreme, there are reasons to believe a priori that beyond a degree of subsistence production in the rural economy, market failure for a whole village or region can become endogenous. That is, the remaining market-participating households may be forced into subsistence despite them individually facing relatively low transaction costs. Location-specific effects on household behaviour and welfare will thus also be analysed in more detail.

The apparent resilience of northern Mozambique's Macua society to war might imply that households use social capital to rebuild their livelihoods in the post-war period. Forms of non-market exchange are expected to provide alternatives to war-affected markets suffering from high transaction costs. If transaction costs for social exchange increase dramatically due to the war as well, households may have to choose autarkic coping strategies, i.e. coping strategies which do not depend on other households. Activity diversification into several crops or across several fields may be such examples (chapter 6).

The discontinuities and barriers to information exchange in the war-affected economy hence induce market failure at the crop, household and location levels. In addition, household activity decisions may endogenously affect household welfare, as the separability effect of the SSS model does not hold post-war. These war legacies are expected to create significant poverty traps which in turn may require exogenous interventions. The determinants, nature and duration of the welfare effects of war will be discussed in chapter 7.

In conclusion, this chapter has outlined a framework for the analysis of post-war peasant households affected by war. It first considered two representative farm and peasant household models and then discussed their suitability for the analysis of households affected by war. It concluded by comparing the suitability of the BM model with the effects predicted by war, finding that the BM model is a useful starting point for the subsequent analysis of war-affected household choices. It also outlined some initial theoretical propositions about how war will affect household behaviour especially in regard to land access, activity choices and household welfare. The third theme of this study is to assess the actual effects of war on these issues, which will be continued throughout the remainder of the thesis.

Chapter 3: Background, Data Sources and Methods

3.1 Introduction and Overview

While the focus of this thesis is on choices and outcomes at the household level, households are also affected by meso- and macro-economic and non-economic constraints. Therefore, this chapter outlines some historical, geographic, and macro-economic developments in Mozambique. In addition, it provides the background information necessary to understand the choice of assumptions and constraints in the models and in the empirical analysis of the remaining chapters.

Sections 3.2 and 3.3 will summarise key aspects of the political and war history of Mozambique, which indicate that some of the war-time and post-war constraints are indeed historical structural features of the economy northern Mozambique. These include the dominance of only a few cash crops for export, the absence of much rural trading and communication infrastructure and the weak political and state institutions.

Section 3.4 will outline some features of the recent economic history of Mozambique which show how the war further weakened the state through the collapse of tax revenue and export earning and the massive growth of debt and aid, of which little reached rural northern Mozambique. That section will also discuss the small scale and slow speed of the macro-economic post-war peace dividend, which provides interesting pointers to the nature and speed of the peace dividend at the rural household level.

Section 3.5 summarises key aspects of the geography, climate, markets and social institutions of northern Mozambique which define the potential production opportunities for peasant households. For example, the degree of land abundance in rural areas will be illustrated and markets will be shown to be have been restricted or destroyed entirely by the war in rural northern Mozambique. The likely scale of some variables (e.g. total rural food production) and the set of available options (e.g. the number of cash crops) will be identified. Appropriate data from Mozambique will be used to illustrate the discussion throughout this chapter.

Section 3.6 will explain in detail the main primary data sources used in the empirical analysis of this chapter, namely the agricultural household survey data collected by the Food Security Project (FSP) of the Mozambican Ministry of Agriculture in 1994-96 and the qualitative peasant household interviews which I conducted in various districts of Nampula province in 1995 and 1999.

The main analytical themes of this thesis are difficult to test rigorously given that one cost of war is the paucity of reliable data sources. Ideally, this analysis would require a

household panel dataset covering the war and post-war years and war-affected and non-war-affected households. However, there does not appear to be a household survey from any country which includes contemporarily war-affected households. The potentially misguided policy bias of many governments and donors towards providing emergency aid in the immediate aftermath of conflict also prevented the collection of reliable household-level data in that period.

The collection of the FSP dataset, which started tracing households two years after the end of fighting, is thus a unique and encouraging step towards understanding peasant household behaviour recently affected by war. The quality and comprehensiveness of the data, as argued below, help to make this a valuable tool for the analysis of the issues addressed here. Nevertheless, not all proposed hypotheses and all potential econometric tests are feasible even with this reasonably high quality dataset. It may thus be worthwhile in the future to collect a genuine panel dataset to take the quality of the analysis beyond that of this study.

Finally, section 3.7 will review the key statistical and econometric methods used in later chapters, such as OLS and 2SLS regression techniques and associated specification tests. This section will serve as a reference point for later chapters which will employ variants of the techniques introduced here.

3.2 A Historical Overview

Many current economic institutions and policies in Mozambique are strongly shaped by the region's long history of colonial rule, international trade and conflict.[8] Around 800AD, the town of Sofala (today Beira) emerged as a Muslim-ruled port, integrated into African and Indian Ocean trading networks. Portuguese involvement in Mozambique started with Vasco da Gama's arrival via the Cape of Good Hope in 1498. Owing to the shortage of Portuguese capital, Mozambique was never developed as a settler economy. Instead, several trading companies were granted long licences to run virtually separate states within Mozambique, even issuing their own currency and overseeing forced labour on cash crop plantations.

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[8] The political history of Mozambique is reviewed by Barnes (1998), Hall and Young (1997), MacQueen (1997), Newitt (1995), Schafer (1999) and Synge (1997) while the economic history of Mozambique is discussed by Arndt, Jensen and Tarp (2000), Brück (1996, 2000), Cravinho (1995), Hanlon (1996), Isaacman (1996), Tibana (1997), and World Bank (1985).

In response to territorial claims on southern Mozambique, the colonial administration moved in 1902 from Mozambique Island (near present-day Nacala) in what is now called Nampula province to what is now called Maputo in the South of the country. Maputo provided essential port and rail facilities and cheap labour for the fast-growing Johannesburg area. The development of northern Mozambique was not linked to these changes and the north remained thinly populated and agrarian in its outlook.

The Portuguese military coup of 1926 led to the establishment of a fascist dictatorship lasting till 1974. Economic policy was geared towards integrating Portugal with its colonies but protecting them from world trade and prices. The uncompromising view of the fascist leadership towards independence of the African colonies led to the start of the war of independence in 1964 in Northern Mozambique led by the left-wing Mozambican Liberation Front (Frelimo).

The independence war came to an unexpected end with the military coup in Portugal in April 1974. In September of that year the Lusaka Accord arranged the transfer of political power from Lisbon to Maputo within nine months but failed to resolve many economic or legal aspects of the changeover. This resulted in an ill-prepared Frelimo leadership and an economically and politically uncertain future for independent Mozambique.

As South Africa's president from 1978, P.W. Botha introduced the South African policy of destabilisation aimed at weakening left-leaning, black-ruled frontline states, including Mozambique. Rhodesia helped to set up the rebel group Renamo as a mercenary movement launching strikes against Mozambican and pro-Zimbabwean targets. The Zimbabwean independence in 1979 ended the costly Mozambican participation in the embargo of Rhodesia and induced South Africa to take over from Rhodesia its support for Renamo. Afonso Dhlakama assumed the leadership of Renamo in 1980 and continues to hold it in early 2001. The start of the Mozambican internal war is disputed but it is safe to assume that by 1980 at the latest it had become a serious security threat for Mozambique.

Despite Frelimo's earlier decision to convert itself to a communist party, Mozambique's application for entry into the Comecon trading bloc was rejected in 1981. This induced the Mozambican government in 1982 to apply for membership of the International Monetary Fund, which it joined in 1984. Mozambique is thus the first country to undergo both a transition from socialism and a set of structural adjustment programmes. Mozambique experienced a severe drought from 1981 to 1983. In 1984 South Africa and Mozambique signed the Nkomati Accord in which they pledge mutual non-aggression. It is widely believed that South Africa's defence forces continued to support Renamo tacitly.

The Mozambican president Samora Machel died in a plane crash in 1986 and was succeeded by Joaquim Chissano, who is still Mozambique's president in early 2001. The first IMF structural adjustment programme was introduced in Mozambique in 1987. Subsequently almost all state-owned enterprises (including state farms and financial companies) were privatised in one of the most comprehensive privatisation programmes ever to take place in Africa. In 1990, peace negotiations between the Mozambican government and Renamo convened in Rome and led to a partial ceasefire in the Zimbabwean-Mozambican railway corridors. In the following two years Southern Africa experienced another severe drought, threatening over three million Mozambicans with starvation.

Frelimo and Renamo signed a ceasefire agreement in October 1992 in Rome which led to the UN peacekeeping forces (ONUMOZ) arriving in Mozambique from March 1993. The first free parliamentary and presidential elections were held under UN supervision in October 1994. Frelimo won by a narrow majority in parliament with 44% of the vote versus Renamo's 38%. The incumbent president Joaquim Chissano of the Frelimo party was elected with 53% of the vote while the Renamo candidate Afonso Dhlakama polled 34%. The ONUMOZ mandate ended in December 1994.

Since these elections, Mozambique has been a parliamentary democracy with the president appointing provincial and district governors, except in the largest 13 municipalities. For these, free local elections were held in thirteen cities and municipalities in 1998. As Renamo was boycotting the elections, Frelimo and independent candidates won the vote. In December 1999, the second free parliamentary and presidential elections were held. Frelimo maintained its majority in parliament with 133 seats versus 117 seats held by the Renamo-led opposition coalition. President Chissano was re-elected with 52% of the vote while the Renamo candidate Dhlakama polled 48%. Renamo did not accept the result of the election in its post-election speeches and occasional political violence has since increased across the country. Large-scale floods especially in southern Mozambique caused significant damages in early 2000.

These historical developments affect the analysis presented in this thesis in several ways. First, Portuguese colonialism left a legacy of weak economic institutions with monopolistic cash crop traders, highly contested rural political institutions, and forced agricultural labour up to independence.

Second, the absence of a human capital base at independence and the haste of the independence process led to a serious weakening of central political institutions.

Furthermore, these often either misunderstood or were unable to influence directly rural economic developments.

Third, the range of international opponents of the Frelimo regime successfully destabilised the national economy in that there was no integration of different regions within the country and an unbalanced integration of the national economy in international trading systems. The integration instead occurred with landlocked industrial (in southern Mozambique), settler (in central Mozambique), or rural economies (in northern Mozambique). An appreciation of the historic origin of these constraints on current development in Mozambique will thus help to focus the analysis presented below.

The thesis concerns itself with economic aspects of the post-war period. From a legal point of view, the post-war period entails at least the period from the signing of the ceasefire in October 1992 to the end of the ONUMOZ mandate in December 1994, a period of factual UN occupation. Given the strength and duration of the war legacy, however, the term "post-war period" should also include the whole term of the first freely elected government, that is from October 1992 to December 1999. Finally, given the type of data used below, the period of analysis covered by this thesis is October 1992 to early 1996, when the FSP survey ends. This thesis therefore analyses the early and mid-post-war period in Mozambique.

3.3 The Nature of the War

The post-independence war in Mozambique had external and internal causes.[9] The former were reviewed above and include the end of apartheid and the cold war and the international community's desire to assist the victims of the 1991-92 drought. The latter include a failure of Frelimo to understand rural issues and to persuade large sections of the rural population and their traditional leadership of Frelimo's case for change. For example, large scale village resettlement and collective village programmes failed as they did not address the underlying causes of underdevelopment and as villagers were not in control of these programmes. Frelimo thus placed itself on many occasions in the position of the hated colonial authorities, creating a climate which fostered implicit or even outright support for Renamo.

Yet Renamo did not possess a viable alternative strategy for rural development. Instead, its aim was the destruction of government infrastructure and thus the demonstration of

Frelimo's lack of power. For example, by the end of the war Renamo did not control a single Mozambican city or town as it was both unable to sustain a major attack and uninterested in territorial gain. Such aim of destruction required little direct fighting and little central coordination, making the rebels unpredictable, a characteristic also of their behaviour in the post-war, demobilisation period. Given its original war aim, Renamo's war effort was supremely effective though at a massive cost to the whole country.

With the relative lack of easily extractable natural assets in Mozambique (compared to, for example, Angola or Liberia) the end of war was endogenously determined (Brück 2001). Both the government and Renamo were unable to sustain the fighting financially and the drought of 1991-93 finally forced a settlement. Diplomatically, the war was ended as a draw but politically the Frelimo government had to compromise little of its initial stance. The fact that politically Mozambique was a very different country at the end of the war owed less to Renamo's political philosophy or bargaining strength and more to the ability of the Frelimo party to re-invent itself over decades, most recently as a largely pro-business party, while being led by a virtually unchanged group of politicians.

From an economic point of view, the key characteristics of the war were thus a high level of uncertainty and a large destruction of assets and infrastructure. These were caused by Renamo's war strategy, an absence of clearly defined battle lines, a high risk of attack for rural households and rural infrastructure (most towns were reasonably protected by the government army), and a long time horizon.[10] These characteristics of the war strongly shape the expected effects of the war on various variables. For example, due to the constant risk of attack in rural areas farmers had to look out for or flee from attacks thus strongly reducing their effective labour supply.

3.4 Macro-Economic Trends in the Post-War Period

At the end of the war in 1992, Mozambique was very poor even by African standards (figure 3.1).[11] There was hope that the economy would realise a peace dividend, that is an increase in output and an improvement in the fiscal position as a result of the end of the war. Yet by late 1995, only small progress had been made and expectations of future growth were much reduced.

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[9] For discussions of the nature of the war in Mozambique see Finnegan (1992), Geffray (1991), Hume (1994), McGregor (1998), Saul (1999), and Vines (1996).

[10] These issues are elaborated in Brück (1996).

[11] Figures presenting empirical results are grouped at the end of the corresponding chapters.

One objective of this thesis is to understand why the aggregate supply response in rural areas in northern Mozambique (and indeed national GDP growth) was so muted in the early post-war period (cf. figure 3.2). The main hypothesis is that the effects of the war had been underestimated in 1992 and that they had a long-lasting negative effect on agricultural growth (both of food and cash crops) throughout most of the 1990s.[12]

As a result of decolonisation and the war, Mozambican output in 1987 had dropped to less than one fifth of the mean level of all Sub-Saharan African countries (figure 3.1). Output in the period 1987-89 rose by 5% p.a. due to the increased levels of foreign aid and structural adjustment. During the next two years, growth was below 2% p.a. as aid flows diminished, the war intensifies and a drought adversely affected Southern Africa. In 1992, the economy shrunk by 1.4% while the population growth was still high despite the war. These pressures led to the peace agreement thus permitting a resumption of high inflows of humanitarian aid.

The partial economic recovery of the early 1990s can be explained by the end of capital destruction and of high levels of uncertainty caused by the war, a credible peace agreement and peace process, the high inflow of resources with the factual two-year UN occupation of the country, the return of large number of displaced people, related increases in the total land cultivated, favourable weather conditions, continued high levels of aid, continually improved macroeconomic management, increased competition in many markets, and increasing inflows of foreign direct investment.

Persistent constraints in the early 1990s included the low levels of physical infrastructure, the fragility of civil and state infrastructures, the subsequent high levels of transaction costs as well as the geographic, economic and social isolation of many peasant households, their low agricultural productivity, the poor domestic and regional integration of the economy, the continued high levels of foreign debt, the high budget deficit, the balance of payments disequilibrium, the correspondingly overvalued exchange rate, high real interest rates, and still low levels of government policy making capacity.

The start of IMF stabilisation programme raised the consumer price index (CPI) of Maputo dramatically in 1987 and led to continued urban inflation until after the departure of ONUMOZ (figure 3.5).[13] With a normalisation of the security situation and of the

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[12] For a more detailed analysis of the limited macro-economic peace dividend in Mozambique, see Brück, FitzGerald and Grigsby (2000).

[13] Until the late 1990s, the Maputo CPI was the only price index calculated for Mozambique.

macroeconomic policy management, urban inflation fell for the first time to below 20% in 1996. Maputo prices are strongly determined by southern Mozambican food prices and by the Metical-Rand exchange rate, as South Africa is (southern) Mozambique's main trading partner. However, in the mid-1990s prices were mainly determined by market forces, not by government controls as was the case for 70% of legal market transactions in 1986 (Andersson and Sjöö 1998: 11).

There is no reliable data in Mozambique on rural-urban relative prices and thus on the internal terms of trade. Estimates by Arndt, Jensen and Tarp suggest that increased international trade in cash crops led to reduced marketing margins for cash crops and to increased marketing margins for food crops in the period 1991-96, therefore encouraging the production of food crops by smallholders (2000: 304). This analysis suggests that the lifting of domestic price controls or their non-enforcement, the increasingly liberalised exchange rate mechanism, and the liberalisation of foreign trade sent proper market signals to producers, especially from the mid-1990s onwards (Tschirley and Santos 1999). Leakages of food aid may have had a depressing effect on some agricultural producer prices at the height of the 1991-92 famine but this effect is unlikely to have been as significant in 1995 (Tschirley et al 1996). The net effects of the war on the price mechanism per se and on rural-urban prices is thus likely to have occurred through the significantly raised transaction costs as discussed in more details below.

The stabilisation programme also led to an increase in investment from 1987 (figure 3.5). However, the official estimate of investment is likely to be far too high (Cruz 1999) so that it is difficult to infer much about the effects of the war and of the peace agreement on changes in investment. Foreign direct investment (FDI) on the other hand increased dramatically with the end of the war (figure 3.6). The figure shows total approved annual FDI in all sectors except minerals and commerce at about US$ 30 million during 1985-93. This low value must have been due, at least partly, to the war. In comparison, in the immediate post-war period, mid-1993 to end-1994, US$ 443 million of FDI were approved by the Mozambican government under new investment legislation. Furthermore, 9.6 billion US$ worth of FDI was under consideration or being committed in 1999, mainly in very large projects in heavy industries, natural resource extraction and commerce (Brück et al 2000: 101, Muchine 1999).

The key macro indicators were therefore only slowly improving by the end of the war. Consequently, the output response to the end of war (i.e. the production peace dividend) was quite slow in the first post-war years (figure 3.2). Food production per capita increased by almost 9% per annum in the period 1993-96 but this was from a historically low base so

that by 1996 the pre-war level of food production per capita had not yet been attained. The productivity of exports, expressed in exports per capita in figure 3.2, was even more damaged by 1992 relative to its pre-war level and it had not yet reached the pre-war level by 1998. Figure 3.2 also shows how structural adjustment policies helped to raise export earnings in the late 1980s but failed to affect significantly the supply response of farm households. The dual policy challenge of the post-war was therefore to identify and remove the constraints to rural development and export performance in order to achieve a long-term, peace-time economic equilibrium. Part of the analysis presented below aims to identify these constraints to rural development and to assess the role of war in shaping these constraints.

Figure 3.3 summarises the implications of such a weak export performance for the external equilibrium. Western aid and trade liberalisation in the 1980s as well as the ONUMOZ mandate in the early 1990s increased imports by 140% in the period 1985-94 thus raising the trade deficit from 10% to 61% of GDP in the same period. With the departure of ONUMOZ the trade deficit fell significantly but it remained above war-time levels throughout the post-war period. This led the government and donors to support both large scale foreign direct investment (FDI) and the adoption of cash crops such as cotton. Yet both policies remain contentious in Mozambique. Even if such policy aim was accepted, there is no broad consensus as to how cash crop exports can be increased most effectively and which consequences this may have for rural development and poverty alleviation.

In addition to the low level of realised output there has also been a strong inequality in distribution of growth across sectors and space. In 1996 agriculture contributed 28% to total GDP while manufacturing and construction accounted for 21% and services for 51% of GDP (UNDP 1999: 38). The large size of the tertiary sector is in part caused by the large inflow of foreign aid and the related presence of many donors in Maputo.

In fact, the economic development of Maputo still drives a large part of the economic growth of Mozambique, with the city of Maputo accounting for 34% of total GDP in 1996-98 but only for 6% of the population in 1999 (figure 3.4).[14] The north of the country accounts for 21% of total GDP and 33% of total population with Nampula province (which contains the city of Nampula) being the largest province in that region. In the central region it is worth noting that Beira, the capital of Sofala, is the second largest city in

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[14] The regional GDP data cited in this paragraph were first calculated and published by UNDP (1999: 35-43). These are the earliest estimates of regionally disaggregated GDP figures for Mozambique known at the time of writing.

the country and the origin of the Beira corridor linking Harare and Lusaka with their nearest port. Mozambique is thus characterised by large regional and rural-urban inequalities which mask even deeper poverty than the already low GDP per capita figures indicate.

The scope for raising productive government spending in response to the end of war (i.e. the government finance peace dividend) was quite small in the first post-war years (figure 3.7). Total government spending as a share of GDP actually fell from 52% in 1990 to 34% in 1996, partly as a result of a fall in military spending after the ONUMOZ departure. However, this fall was limited and post-war spending on health and education stayed below its peak of 5.1% of GDP. The dominant cause of the falling expenditure and continually low social spending was the low government revenue which resulted in a mean fiscal deficit of 26% of GDP in the war-period 1987-92 and of 21% of GDP in the post-war period 1993-97.

The Mozambican government has two main sources to help fund this dramatic fiscal deficit, namely external debt (figure 3.8) and foreign aid (figure 3.9). External debt reached its historical high value of 406% of GDP in the last year of the war, which in part accounts for the end of the war in that year. Even though the value of the external debt stock started to fall in the post-war period, it still accounted for 262% of GDP in 1998.

The other important source of finance for the government and indeed the whole Mozambican economy is foreign aid. Aid from the OECD countries started to increase strongly from 1987 and peaked at 118% of GDP in 1992. With the receding humanitarian disaster and the departure of ONUMOZ aid then fell rapidly in the post-war period and "only" accounted for 39% of GDP in 1997. Nevertheless, foreign aid was still worth more than twice as much as government revenues in 1997, thus continuing to exert a strong Dutch disease effect on the competitiveness of Mozambican exports (Brück et al 2000).

Similar to output, foreign aid was not distributed evenly across Mozambique or across sectors. UNDP calculated that aid per capita in the period 1995-97 was spent disproportionately in Maputo city and province (figure 3.10). Furthermore, only 9% of all foreign aid spent in 1995-97 was allocated to agricultural projects, with 19% being committed to humanitarian and food aid, 24% to economic management and administration, and the remainder to a range of smaller sectoral programmes (UNDP 1998a: 19).

This evidence suggests that the peace dividend in Mozambique had not started to materialise by 1995, that the capacity of the state to initiate development projects was very weak, and that aid resources were available to help lift the supply constraint but that these

resources were not geared towards northern Mozambique or agricultural projects. The average peasant households in northern Mozambique was hence virtually unconnected with post-war government or donor economic activity or indeed post-war output growth.

3.5 Geography, Markets and Institutions in Northern Mozambique

Geography of Northern Mozambique

The majority of the data analysed in this thesis derive from the FSP survey. The analysis covers the three districts Montepuez, Meconta and Monapo in the two provinces Cabo Delgado and Nampula in northern Mozambique (figures 1.1 and 1.2). This is often considered the most agriculturally productive part of the country and has long been an area for cotton cultivation. The soil conditions of coastal districts such as Moma, Angoche or Nacala are more suited to cassava, rice, cashew and coconut, while intermediate districts such as Monapo, Meconta or Montepuez grow predominantly maize, cassava, sorghum, cotton and some cashew. The interior districts of Nampula such as Ribaué or Lalaua also have favourable conditions for maize and tobacco and grow some cotton but no cashew.

The main transport corridor (the so-called Nacala corridor) connects the port of Nacala with the provincial capital Nampula and then with Niassa province and finally Malawi by road and, potentially, by train. The rail infrastructure was badly damaged by the war with the national stock of operational locomotives declining from 222 in 1982 to 158 in 1989 (Brück 1996: 61). A main road also connects Nampula to Pemba, the capital of Cabo Delgado province. There is little overland traffic or trade with southern Tanzania due to poor infrastructure, the low population density in the border region, and the large river Rovuma dividing the countries. The road connecting Nampula with southern Mozambique was poorly maintained for most of the post-war period.

Nampula city, with about 206,00 inhabitants in 1994, is the third largest town in the country and is the main urban centre of northern Mozambique (Comissão Provincial do Plano de Nampula 1995). Overall, Nampula, Cabo Delgado and Niassa provinces had about 5.17 million inhabitants in 1995, representing 32.7% of Mozambique's total population (UNDP 1998b: t. 7). Portuguese is the only official language of Mozambique but only 6% of the population speak Portuguese fluently while in the FSP sample area Macua is the dominant local language (UNDP 1998b: t. 29).

The climatic and topographical conditions of northern Mozambique are suitable for rain-fed agriculture, though conditions are variable both across space and time. The interior districts generally have higher rainfall and better soil conditions compared to the coastal

areas. Environmental factors in the north differ significantly to those in the south of the country, suggesting potentially large gains from domestic agricultural trade.

The mean rainfall in the period 1985-94 in the FSP sample areas Montepuez and Meconta was 922 mm and 1024 mm, respectively, which is sufficient on average for rain-fed agriculture (Strasberg 1997: 71). The agricultural year 1994-95 received about 82% of that level of rainfall and can thus be considered broadly in line with historical expectations. In Nampula city, 1042 mm and 1188 mm of rainfall were recorded in 1995 and in 1996, respectively, suggesting that in both years normal climatic conditions dominated. The FSP survey did not record rainfall data but asked households about their perception of rainfall on a per-plot basis. Households in Montepuez, Meconta and Monapo reported a perceived shortage of rainfall on 46%, 24% and 10% of their cultivated land in 1994-95, respectively (RAIN4).

The main rainy season in the north is between December and March when about 90% of the annual rainfall can be expected. The main land preparation and planting season for maize and cotton is September to January with the main harvest season being April and May for maize, June and July for cotton, and October to December for cashew. Crops are then sold in the month or two months subsequent to the harvest. The period leading up to the harvest is also called the hungry season. Cyclone Nadia affected Nampula in March 1994 damaging primarily crops and cashew trees (Strasberg 1997: 34). This adversely affected consumption levels in early 1995 (round 2 of the FSP survey) but not those in early 1996 (round 5).

These observations imply that agricultural conditions generally and those during the FSP sampling period in particular were favourable for rain-fed agriculture in post-war northern Mozambique. National and international trade in agricultural commodities is feasible in northern Mozambique but has been inhibited by high transport costs in the past. The degree of variation in actual climatic conditions observed at the household-level also suggests that there will be sufficient degree of variation in the dependent variables to permit a meaningful econometric analysis.

Land Markets

Northern Mozambique has a population density of 19 inhabitants per square kilometre, compared to an estimated population density of 29 inhabitants per square kilometre in the FSP sample area and 39 inhabitants per square kilometre in Nampula province. Partially as a result of this low population density, peasant households do not irrigate their land or use animal-drawn or mechanised ploughs. The use of inputs is also very low, except for some pesticide use in cotton growing.

The low population density also implies that land mines are not the biggest constraint to post-war resumption of agricultural production, though mines impose a heavy humanitarian cost especially on children and refugees who may be least aware of the distribution of mines (chapter 2.3, Andersson et al 1995, Human Rights Watch Arms Project 1994, Roberts and Williams 1995).

As will be shown more formally in chapter 4, there are no landless households in rural areas and there are only very few large, and village-based land owners. In Cabo Delgado and Nampula there are very few other large so-called private (i.e. business-like) land owners, except for a few sisal plantations which derived from colonial land concessions. It is worth noting that there are thus no land-lease, share-cropping, or other principal-agent relations as are common in Asia and other, more densely population African countries.

The key institution governing land access are the traditional (mwene and piamwene), colonial-political (regulos and cabo) and post-independence-political (secretário) authorities. These authorities emerged and were created at different times in history but continue to co-exist and represent different levels of traditional society and state authorities. A reason for the war was the dispute over the role of these authorities in rural life. This policy issue continues to generate significant debate in the post-war period. At the time of the FSP survey, in 1994-96, the role of traditional authorities depended very much on the standing of the individuals, on the war experience of the community, and on the issues under consideration. Land disputes, for example, could be resolved by low-level authorities if they involved intra-village disputes but a state authority may better resolve the relatively rare disputes between peasant households and private farmers.

Given these physical and cultural environments, peasant households typically either acquire land through inheritance via maternal or paternal families (note that the Macua are a matrilineal society) or are allocated new land by traditional authorities.[15] Such new land can often be genuinely new (virgin) land or it may be land previously abandoned (which implies a degree of disowning exceeding that of fallow land) by other households. The total sum of all agricultural land in northern Mozambique is thus defined by cultivated plus fallow plus abandoned plus new or virgin land.

Peasant households in Mozambique could not claim full statutory property rights on land in the mid-1990s as the government formally owned all land. The Mozambican

government was reviewing this land tenure legislation throughout this period, finally drafting an innovative land law which today grants the right to secure land tenure to entire communities but not to individual peasant households (figure 3.16). However, large-scale, private land owners were always able to obtain de facto full property rights. A high degree of corruption through large-scale land-grabbing has been alleged since the end of the war. Yet the provinces most affected appear to be those with the lowest population density like Niassa or those with a longer history of plantation farming, such as for sugar in the south.

No data on land transactions is available in the FSP survey but an informal survey of households in FSP sample districts found that in Monapo both men and women can inherit land and that they are allocated land without payment primarily by local or traditional authorities (UNHCR and UNDP 1997b: 4). Two thirds of households in Monapo occupied land previously owned by other households while one third of households used virgin land. In Meconta, land is allocated mainly to men through traditional authorities and no payment is made for land, either (UNHCR and UNDP 1997a: 4-5). In that district, 20% of all households farm land which has previously been farmed while 60% of households occupy previously virgin land.

These observations suggest that many peasant households face a large supply of land or even land abundance. More formal tests of this hypothesis and the implications of this hypothesis are the subject of chapter 4. In addition, these observations suggest that the effects of formal property rights at the local level are minimal and that, at least during the FSP sample period, the war and traditional society were the major influences on peasant household land institutions and allocation decisions. There is hence no formal land market in rural northern Mozambique and households do not use land as collateral in credit transactions (see also chapters 4 and 5).

Labour Markets

The war reduced the mean annual population growth rate of Mozambique from 2.5% in 1970-80 to 1.7% in 1980-97.[16] However, this figure masks very variable mortality and fertility rates, which are both particularly high in the north. In Nampula province, for example, the total fertility rate in 1997 was 6.3. During the war, mortality rates were even

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[15] Land institutions in Mozambique are reviewed by Carrilho (1991), Gengenbach (1998), Kloeck-Jenson (1997, 1998), Marule (1998: 64-78), McGregor (1997), MOA/MSU Research Team (1994), Myers (1994), O'Laughlin (1995), Pössinger (1968), Tique (1997), and West and Myers (1996).

[16] All data cited in the first two paragraphs are derived from UNDP (1999: statistical appendix).

more variable. Figure 3.11 shows that while the mortality rates fell over time to about 1.6% in the late 1980s, civilians living in war zones had mortality rates of up to 14% per year.

Other health indicators for 1997 are low, too, with 96% of the population in northern Mozambique having no access to piped water, 78% having no access to health services, and 39% of all children under 3 years of age being moderately or severely underweight. The life expectancy at birth in the north was 41 years in 1997. Interestingly, the gender structure of the northern population was quite balanced (with 50.7% of all residents being female in 1997), probably due to the equal effect of the terrorising war on the civilian population and due to the high share of very young people who were not directly affected by the war anymore.

The adult literacy rate was 28% in 1996, a figure which was directly war-related as the rebels specifically targeted schools and teachers in rural areas. In the period 1983-92, 58% of all primary schools were destroyed through fighting or had to close due to the high level of insecurity (Ministério da Educação 1994: 7-8).

In addition to these quantitative and qualitative constraints to the factor labour, rural labour markets in northern Mozambique were very fragmented, weak and disrupted by the war (figure 3.16).[17] There were few agricultural or non-agricultural employment opportunities and few migrant workers, unlike in southern Mozambique. For example, only 11% of all rural households occasionally or regularly employed agricultural labour (UNDP 1999: t. 38). The Macua culture, the main ethnic group of the FSP sample area, has strong customs regulating the hiring-in of casual labour and the mutual exchange of group labour. Although this may not reduce the level of labour market transactions, it adds an additional layer of meaning to the hiring-in or -out of household labour (chapter 6).

An important feature of the war- and immediate post-war labour markets was the extreme degree of displacement induced by the war of destabilisation. Approximately half of all Mozambican households were local, national or international refugees by the end of the war (figure 3.12). This indicates that most other household coping strategies failed given the severity of the war and that a large number of households must have been extremely close to the survival threshold to invoke such drastic coping strategies. Furthermore, the scale of migration to government-held areas during the war indicated some trust in the government and its allied NGOs by a large majority of the population of rural areas. This is

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[17] These issues are discussed by Cramer and Pontara (1998, 1999), Melamed (1999), O'Laughlin (1996), and Pitcher (1999).

in stark contrast to the extreme atrocities committed in the rural areas throughout the war (figure 3.13).

These indicators suggest that the rural Mozambican labour force in the mid-1990s had extremely poor health and education, was very dependent on own-farm income due to the lack of large scale labour markets, and had experienced traumatic, life- and livelihood threatening displacement until the very end of the war. In fact, these indicators may even suggest that both land and labour markets did not strictly speaking exist in rural northern Mozambique as would be expected in more developed or more densely populated areas. These factors can be expected to have had strong implications for the type of agricultural activities households were interested in or capable of pursuing. Furthermore, the economic models used to approximate such behaviour may have to be adjusted to reflect these fundamentally different circumstances, as was discussed in chapter 2.

Output Markets

Agricultural production and the rural infrastructure were severely damaged and destroyed during the war (figure 3.14). Facilities in smaller localities or with a higher degree of immobility or visibility endured proportionately more war damage, making some forms of rural production virtually impossible. For example, the number of cattle in Mozambique declined from over 1.3 million in 1982 to 0.25 million in 1992 as rebels looted and killed livestock and rural veterinary services and livestock markets collapsed (Ministério da Agricultura 1994).

In addition to threats to production, marketing structures were also severely damaged. The number of private shops, which often are the only rural providers of key goods such as tools, salt, soap and frequently act as purchasers of agricultural crops as well, fell by 39% while the number of Agricom posts, the agricultural marketing board, fell by 74% in the period 1982-88 (World Bank 1990: 142).

Transport costs of export crops increased due to the cost of protection for the convoys travelling form rural areas to the ports and due to the inability of the state to maintain rural roads in times of already large fiscal deficits and of high levels of insecurity on these roads (figure 3.15). Nevertheless in the post-war period, crop markets appear to have become increasingly integrated at the national level (figure 3.16, MOA/MSU Research Team 1997, Tschirley 1998, Tschirley et al 1996), though this did not appear to prevent large, isolated rural areas from being poorly integrated into the post-war distribution and pricing of food crops. This is also confirmed by the large variability shown in particular by food crop prices (PRICEV3) versus consumer prices as recorded by the FSP survey (figure 3.20).

The marketing of tools was very difficult in the post-war period leading to regular shortages of high quality, hand-held tools. This was accentuated by the lack of blacksmiths in rural areas, a phenomenon which may be related to negative cultural perceptions of blacksmiths.

These figures show that the war destroyed assets and institutions in a deliberate and significant way. These war-affected tangible and intangible institutions (Ensminger 1992, North 1990) then led to strongly rising transaction costs as illustrated by figure 3.15. Many peasant households thus ceased to produce large quantities of cash crops or to sell food crops. For example, Mozambican cashew output accounted for 43% of world cashew production in 1969-71 but only for 5% in 1989-91 (Cramer 1999, UNDP 1998b: 65). Cotton production in Cabo Delgado and Nampula declined from 83,000 metric tons in 1973 to 19,000 metric tons in 1988 (Fok 1995).

The war-induced isolation of households in rural Mozambique implied that most households were nearly self-sufficient in most commodities and that commerce was mainly limited to low weight, low volume, non-perishable and essential items such as salt, soap, dried fish, batteries, and t-shirts (Brück et al 2000: 90-1). The high covariance of output fluctuations reduced opportunities for profitable inter-household exchange (trade across space) within a given area. In fact, the value-share of purchased food in total food consumption in the FSP sample was only 22% in 1995 (own calculations).[18]

It was also not profitable for households to hold significant stocks of crops beyond those required for expected own consumption in the hungry season. The storage costs and losses would outweigh the expected benefit of such trade across time. There were hence few regular, annual agricultural output markets within homogenous agricultural areas, thus confirming a key hypothesis of the Binswanger and McIntire analysis for land abundant tropical agriculture (1987: 77).

Overall, the effects of war were both direct and indirect and the cumulative effect on the capacity for growth in the whole economy was debilitating. Rural peasant households were forced by the war into an extreme form of subsistence and even autarky. The factors which induce households to return to market-based activities such as selling food crops or producing cash crops will be addressed in chapter 6.

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[18] Details of any of the author's own calculations or of regression output not shown are available from the author upon request.

Other Rural Institutions

A key sector in many rural development programmes is the rural finance sector, which includes savings associations, rural development banks, and money lenders. However, in virtually no rural areas in northern Mozambique was it possible to find such institutions, which was a result of the effects of the war and the related, extreme poverty. In interviews, households confirmed that the only sources of credit were informal consumption loans among farmers, often in times of ill health to attend hospital. Given the paucity of data on loans even in the FSP survey (due to a large extent to the absence of credit rather than to systematic under-recording), there is no explicit analysis of financial borrowing, lending and saving behaviour in this thesis.

Another key rural institutions are the three cotton joint venture companies (JVCs) Lomaco, Sodan and Samo which were set up in 1990 by the government and by British (Lonhro) and Portuguese (JFS and Entreposto) enterprises.[19] In a set-up not dissimilar to the colonial period, each JVC was allocated an exclusive area of influence and thus monopsony rights for cotton at prices set each season by the government in line with world cotton prices. Of the areas analysed in the FSP sample, Lomaco operates in Montepuez, Sodan in Meconta and Monapo and Samo in Monapo. These spatial monopsonies were intended to help overcome the large costs and uncertainties associated with purchasing cotton in a low-density and insecure area. In return, JVCs had to provide inputs, extension advice and other services to farmers. In addition, the government annually set a minimum cotton price to protect smallholder interests against the JVCs and from changing world prices (figure 3.16).

In 1994-95, about 81,000 peasant households participated in this scheme with these JVCs (Strasberg 1997: 12). In practice, many of the functions envisaged for the JVCs were never carried out by these companies, in part because the costs of operating in post-war rural areas had been overestimated ex ante. Pesticides were allocated to most cotton growers but little extension advice and no fertilisers or other cash or food crop seeds were provided.

Finally, it is important to note that almost no surveyed FSP household would have had access to electricity, telecommunications, postal services, or regular public transport unless the household lived near a main inter-provincial transport corridor. Some sample areas

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[19] Reviews of the cotton sector in Mozambique include Pitcher (1996a, 1996b), Fok (1995), Isaacman (1996), MOA/MSU/UA Research Team (1992a), Strasberg (1997), and Tschirley and Weber (1994).

were able to receive a state radio station so that owning a radio was a source of information and key status symbol in rural areas in 1995.

3.6 Primary Data Sources and Description of Variables

This section will provide a brief overview over the main primary sources of data used in this thesis. First, the FSP household survey will be described, with an emphasis on sample selection, questionnaire content and enumeration management. Second, my own interviews in Mozambique especially with a range of Nampulan farmers will be described as their responses have assisted in the interpretation of the quantitative results.

FSP Household Survey

The agricultural household survey from northern Mozambique analysed in this thesis was organised by the Food Security Project (FSP) at the Ministry of Agriculture (MAP) in Maputo with the assistance of the Michigan State University (MSU) and the Land Tenure Centre (LTC) at the University of Wisconsin-Madison.[20] The FSP conducted a first round of data collection in June 1994. However, subsequent changes to the sampling strategy make the results from this round incompatible with later data. The analysis in this thesis thus focuses on rounds two to five, which took place in January, May and September 1995 and January 1996 and so cover the period mid 1994 to early 1996. The total sample size is 371 farm households. There appeared to be virtually no attrition from the sample over this period. This corresponds with the low degree of household mobility seen since the end of the ONUMOZ mandate.

The FSP questionnaire is summarised in figure 3.21 by round of data collection and by the various questionnaire modules. These modules include information on individual residents (e.g. age, gender, position in the household, education, health, time use), on the overall household characteristics (e.g. the relation of the household to local political authorities, household refugee and migration history, gender of the head), on field-level characteristics (e.g. field size, soil characteristics, crop use, land tenure status), on production and storage tool and technologies (e.g. number of tools, types of tools, crop storage pests, local crop mill availability), on agricultural production and marketing activities (e.g. food crops, cash

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[20] The data and sampling strategy are explained by MAP/MSU Research Team (1996) and Strasberg (1997). I also interviewed several FSP staff members in Nampula and Maputo in 1995 and in 1999 and discussed the research methods on these occasions.

crops, trees, fruit, vegetable, livestock), and on monetary and in-kind transactions (e.g. food expenditure, non-durable expenditure, durable expenditure, remittances, gifts).[21]

The sample area includes seven villages in Montepuez district in Cabo Delgado province, five villages in Monapo district and four villages in Meconta district, both in Nampula province (figure 1.2). The sampling area includes 16 villages, which are the primary sampling units (PSUs) in the survey design. These villages are not densely populated clusters of settlements but rather describe an administrative unit below the district level, where each village can stretch over several square kilometres.

The FSP survey is stratified by cotton growing status of each household, with four mutually exclusive categories. Households either farm no cotton, or they farm cotton in one of three different institutional frameworks. Each of the three joint venture companies (JVCs) trading cotton in northern Mozambique during the sample period offered farmers the opportunity either to grow cotton individually on their own farm ("dispersed" growing) or to utilise land in a "block" of adjacent fields, therefore in principle easing the delivery of inputs. In Montepuez, Lomaco offered a variant of this scheme where farmers can grow both cotton and maize in such a block. Thus the four survey strata (captured by the variable CATEG1) are non-growers, dispersed, block and Lomaco-block growers of cotton (figure 3.17).[22]

Only villages where at least twenty households grew cotton in 1992 were selected. Both villages and households were selected randomly given these sampling constraints. This makes the FSP sample statistically representative of potential cotton growing areas in the relatively accessible parts of Nampula and Cabo Delgado. Broadly speaking, the findings of the survey should be applicable to the more accessible parts of northern Mozambique but not to central and southern Mozambique, which have different cultural, social, geographic and economic conditions.

Enumerators were local extension workers fluent in Portuguese and Macua and resident during the survey work in the sampling villages. To enumerate consumption and income components of the questionnaire, households were visited twice within a week during each survey round. Other questions included longer recall periods, either over the previous four months (i.e. since the last round) or since the end of the war (e.g. to assess end of war asset

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[21] A copy of the questionnaire used by the FSP is available from the author on request.

[22] Parallel to the FSP data and in conjunction with the same research team, the NGO Care collected further data in Nampula province. As this data is not directly comparable in scope, survey design, as well as temporal, spatial and thematic coverage it was excluded from the current analysis.

endowments). These recall periods seemed appropriate for the issues questioned and are unlikely to have introduced serious measurement error (cf. Deaton 1997: 24-5, von Braun and Puetz 1993).

The same enumerators interviewed both the head of the household and, as appropriate, the person in charge of food storage and preparation in repeated visits. Some modules of the questionnaire were repeated in subsequent visits to track changes in household endowments. While the FSP survey is not a panel, it provides very accurate endowment, production and expenditure data as a result of the repeated household visits.

Given the relative isolation of households during the war, "survey fatigue" did not appear to be a significant problem, with interviewees being keen to share their information. The data was checked in the field with survey supervisors (enabling return visits if necessary) and in the survey offices in Nampula and Maputo. The data was entered into SPSS and the data files later converted using Stat/Transfer 5 for analysis in Stata 6.

The Definition of the FSP Variables

This section will summarise some key independent variables (especially how they were constructed and what they represent) and discuss the quality of the FSP data. The dependent variables used in the analysis below are discussed there in more detail. The focus in this section is on unusual or non-self-explanatory variables. Most of the variables used in this thesis have been calculated from the basic FSP dataset and have been cleaned further, though no major data inconsistencies emerged during this cleaning process. The main reference period of the FSP dataset is 1994-96 (as discussed above) but some key data is only available for 1995. The FSP dataset contains variables calculated per adult consumption equivalent (ACE), which are defined in figure 3.18. These ACE conversion factors correspond to those factors used by other researchers analysing the FSP dataset (Marule 1998: 115, Strasberg 1997: ch. 4) and thus maintain some degree of comparability of results.[23] Finally, note that all the FSP variables used in the data analysis are summarised in figure 3.19.[24]

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[23] For a further discussion of equivalence scales, see Atkinson (1991), De Vos and Zaidi (1997), and Deaton and Muellbauer (1986).

[24] Note that variables are printed in capital letters in the text (e.g. HHSIZE2). An X in a variable name generally denotes that this is a series of related variables (e.g. HHSIZEX encompasses all variables measuring household size from HHSIZE2 to HHSIZE7). Some variables have corresponding variables which express their squares or natural logs and these variables are denoted by almost identical variable names (e.g. HHSIZE3 is the square of HHSIZE2). Further non-linearities may exist in the determinants but the small sample size and the lack of panel data prevented more than quadratic terms to be included (Strauss and Thomas 1995: 1901-7).

Household Characteristics

There are several variables of household size, including the total number of resident household members (HHSIZE2), the total number of resident non-dependent and dependent household members (MEMND01 and MEMD01), and the total number of male and female household members (MALE1 and FEMALE1). Residency is defined through regularly eating in the household while dependent household members are those aged below 10 or above 65 years.

The household size (HHSIZE2 and HHSIZE5) and dependency ratios (DEPEND94 and DEPEND95) are fairly static between the rounds of the surveys, suggesting that household sizes and composition are indeed exogenous and have been measured accurately by the enumerators. Note that each household headed by a wife of a polygamous husband was counted as a separate household, which is consistent with the theoretical definition of a peasant household.

The variable REFUGEE1 indicates households which were displaced during the war and recognised for this displacement by the government (e.g. by having fled to safe, government-held urban areas). As is discussed in later chapters, there are significant measurement problems with this variable, as not all displaced households were recognised as such and as some displaced households did not return to rural areas after the war. In theory, this variable is expected to have a strong negative effect in many circumstances. In practice, the unusual de facto definition explains the surprising coefficients of REFUGEE1.

The variables TIME01 and TIME02 summarise the number of hours per month the wife, principal woman or female head spent collecting wood in the hungry season and in the harvest season in 1995, respectively. The variables TIME03 and TIME04 are equivalent measures for water collection. All four variables are intended to capture environmental resource constraints which are likely to reduce significantly the available household labour supply.

While the level of educational achievements in the sample is very low (e.g. EDUHEAD1), the majority of all household heads had some education hence generating enough variation in the data to permit the inclusion of household education variables.

In the EDINFRAX variables, various education variables have been interacted with 1-INFRA4 (where INFRA4 measures if a village perceives significant infrastructural problems), so that the coefficient on that variable measures the effect of education in more accessible areas.

The EDUMAX3, EDUMAX4 and EDUMUMX variables include an adjustment for household members who did not attend school but are literate. This was considered equivalent to two years of primary education. Unfortunately, no data was collected on the ability of the household head to speak Portuguese which is conceivably an important determinant of market participation and cotton adoption.

Land Characteristics

Some land characteristics (especially the size of land holdings) were enumerated on a plot-level basis but plots were not actually measured individually. Hill tests whether smallholders are actually providing accurate estimates of plot sizes under this methodology (1995). He compares the results of a 1993 DEA household survey with a sub sample of that survey for which the interviewers had measured the size of the landholdings. His study concluded that the difference in reported to measured land holdings is not statistically significant. A later analysis of the FSP data, which also involved measuring a sub sample of the fields, similarly found that farmers reported land sizes accurately (Marule 1998: 60). The accuracy of the land area variables thus appears high.

The correlation coefficient between total land endowment per household in 1994-95 and 1995-96 is large (0.78) and highly significant compared to a smaller but also significant coefficient for cultivated area per capita (0.53). This suggests that total land endowments are indeed exogenous in the medium term and that households primarily adjust the area cultivated between agricultural years. Note that the analysis excludes abandoned land over which households may have residual land rights and which are likely to explain the small difference between the total land endowments of the two agricultural years.

Most other land characteristics are either explained in more detail in the chapters above or are self-explanatory. Note that the soil quality characteristics of household land (AREAFERX) are based on field level observations by the households and have been weighted by the area of each cultivated field. The distance to the field (DISTANCX) and rainfall (RAINX) variables have been weighted similarly.

Figure 3.22 summarises by village the share of land with a lack of rain (in % of total cultivated land). That share varies from a mean of 1% in Nacololo (Monapo) to 76% in 25 Setembro-Lomaco (Montepuez), with the standard error in both locations being less than 1. Such small spread of values within each location indicates that neighbouring households experience similar shortfalls of rainfall, which suggests that the reported rainfall shortages are not simply proxies for household-specific productivity constraints.

Technology and Assets

The local availability of mills (MILLXX) and the degree of crop storage pests (PESTXX) are respectively considered exogenous and pre-determined indicators of household technology in a given agricultural year. The pest variables are important as in poor, rural households in Sub-Saharan Africa up to 25% of grain placed in an on-farm storage may be lost while in storage (cited in Dasgupta 1993: 205). Consequently, this effect has also been included explicitly in the model of chapter 2 (equation A.2a).

Further indicators of household technologies include the number of tools (e.g. TOOL01) and the number of types of tools per household (TOOL02). These technology variables have only low correlation coefficients with the household asset endowments (discussed below). This suggests that the tool variables behave as if they were resource endowments which are not endogenous in the current period.

The endowment with the number and the range of tools is also pre-determined in a given agricultural years as the market for tools is highly imperfect in rural Mozambique. Many households reported using the tools received during the ONUMOZ period, when many emergency NGO programmes were being implemented. Households also reported that they were unable to buy new tools easily as the trading network had not yet been fully rehabilitated and as the few existing traders generally did not trade in tools. This was confirmed by the inspection of tools in survey households and through market and shop visits in various districts. The TOOLXX variables are hence used as "pre-determined" (Glewwe 1991: 312, Maddala 1992: 357) proxies of household productivity, rather than being included in the household asset endowment.

The household asset endowment does not include livestock as the valuation of livestock seemed impractical with no data available on livestock prices. The asset variables (ASSETXX) instead simply count the number of assets such as bicycles, radios, sewing machines, tables, mattresses, wooden beds and (for some ASSETXX variables) high-value housing components such as brick walls, zinc roofs, and wooden doors per household.

The variables VASSETX value the durable goods owned by the household (i.e. excluding the household components) using estimated values reported in IAF and converting these into real 1996 US$ values (IAF 1998: 50). The real value of total household assets thus defined increased by 3.1% per annum per household in the period 1992-96. Past assets and animal stocks are significantly correlated with current assets, making past assets and animal stocks useful exogenous indicators of current household endowments.

Social Capital

The social capital variables are a set of discrete variables capturing a household's links with the village and the local political and cultural authorities. The details of the latter institutions are discussed in chapter 3. Excellent overviews over the various political institutions in Macua culture are provided by Macy (1995), Marule (1998: 64-78), and Tique (1997).

Village-Level, Price and Survey-Design Variables

A number of variables are calculated at the village level to capture location-specific effects which otherwise would have to be absorbed by the village dummies or the constant. These village level variables are thus primarily proxies or controls for unobservable village effects and their coefficients are not always of direct interest. Only a small number of these village-level controls have been included in the regressions to reduce the potential of multicollinearity among variables and to prevent an increase variance of the estimator resulting from such imperfect proxy variables (Maddala 1992: 464-8, 492-3).

Some variables discussed previously have also been aggregated at the village level thus creating control variables for local health-care facilities, population density, input, asset and output markets etc. For example, the MARKETX variables measure the density of the local crop market while the LABOURX variables measure the density of the local wage labour market. Note that the latter has no household-level equivalent expression as household time budgets and wage labour hiring were not enumerated at the household level.

The categorical variable INFRA4 codes 1 if a village is considered to have an above average degree of infrastructural problems (excluding complaints by households about prices). It thus helps to capture differences in infrastructure endowments and transaction costs which were not enumerated directly or with a community questionnaire.

The YIELD07 and YIELD08 variables measure the mean yield in kg/ha per village for monocropped maize and cotton, respectively. This data is only available for these crops as they are the only ones grown in enough monocropped fields to make such calculation viable for all villages. Note that maize yields are quite uniform at 317 to 320 kg/ha across all districts while cotton yields differ more substantially, from 552 to 711 kg/ha. This is mainly a result of different input packages available to farmers in different areas. The high value of 710 kg/ha in Montepuez district also corresponds with a very low share of cash crop income in total income, suggesting therefore that farmers could profitably expand cotton growing in that district. These yield variables can thus help to capture the effects of

random weather and agronomic differences and of varying institutional support schemes across villages.

The seasonal and spatial household-level Paasche price indices (Deaton 1997, Deaton and Muellbauer 1980: ch. 7, Deaton and Zaidi 1999: equation 4.5) for purchased food, purchased non-food, non-durable items, and for home-produced food are called PRICE1X, PRICE2X, and PRICE3X where X = 3...5 denotes early, mid, and late 1995, respectively. They are calculated at the household level but are included in the group of village-level variables as they help control for unobservable differences between households and villages (such as changes in weather and road transport costs). They are also required for the calculation of welfare indicators that are comparable across households and are thus equivalent to weights used to adjust for household composition (such as in per ACE or per capita specifications).

The variables PRICEVX express the variance of the price index across time at the household level (figure 3.20). Note that the variance in prices divides into the expected and unexpected changes in prices but these components are unknown to the analyst. For example, households in isolated areas or households experiencing a local drought might expect food prices to rise so that a high level of local prices during the hungry season would not be surprising. Yet the price variance variables may still help to control for unobserved differences in location-specific fixed effects even if the effects cannot be decomposed into expected and unexpected components.

The variables indicate the strong seasonality of prices in northern Mozambique for all product categories. The purchased food price index, for instance, dropped by 15% from the first to the second third of the year, which is the harvest season, before rising by 21% from the second to the final third of the year. The equivalent changes were -7% and 9% for non-food items and 5% and 19% for home-produced food items between these seasons.

The increase for home-produced food in the harvest season (i.e. mid-1995) likely results from the lower production in that cyclone-affected year while the very large increase in prices for those goods at the end of the year suggests that the harvest season saw very low stocks of home produced food and/or very high transaction costs for these goods thus increasing the mark-up. Note that these price indices are based on local (village) market prices reported by survey participants so that farm marketing costs are included in the prices. This will tend to overestimate household subsistence production slightly.

The dataset also contains the weights WEIGHT2 and WEIGHT3, which are based on the survey design and the population distribution in northern Mozambique. Using WEIGHT2, the survey results are broadly representative of 32,540 households or 243,000 residents in

northern Mozambique. WEIGHT3 differs from WEIGHT2 only by excluding one household which has an implausibly large value for PLOT32 which is most likely the result of a coding error (chapter 6). That household otherwise has plausible values, hence justifying its inclusion in the sample for most calculations.

The survey strata are captured by the variable CATEG1. CATEG3 summarises the four strata into just two strata, namely cotton-growers and non-growers. This variable is used for example in chapter 7 where the four strata would not permit the sub-division of the sample into income deciles. The primary sampling units (the villages) are expressed by the variable ALD. The 16 village categorical variables are named ALD111 to ALD332 and the three districts are coded by the variables DIS1 to DIS3.

Qualitative Interviews

As part of my research into the effects of war and post-war reconstruction in Mozambique I conducted a two-month field visit to Nampula and Maputo (figure 1.1) in 1995 and a three-month visit to both provinces in 1999. The main purpose of these visits was to analyse the war and the post-war economy, especially though interviews with farmers, extension workers, private sector managers, government officials, NGO and donor representatives, policy analysts, and academics. In addition, I collected a variety of data, including a copy of the FSP dataset.

In Nampula province, I visited a large range of districts and interviewed farmers and officials in each location. To gain an appreciation of the economic and geographic diversity of the region, I visited remote locations such as Lalaua, Memba and Mogincual, areas with good road transport such as Ribaué, Murrupula and Ilha de Moçambique, and the small coastal town of Angoche, famous for having been the location of the last, futile attempt by Renamo to capture a small urban area at the end of the war (figure 1.2 shows some of these locations). These districts also exhibit the full range of agro-climatic diversity typical of northern Mozambique.

The interviews with farmers were arranged with the help of local NGOs (especially Care, Concern, Cocamo and Memisa) or district departments of agriculture and were conducted with the assistance of a translator. The individual interviews followed the FSP questionnaire format but the emphasis was on elucidating qualitative responses and explanations by the farmers, which were almost always keenly provided. Some interviews were also conducted as group discussions. The results of these interviews have not been used in any quantitative analysis as a broad range of interviewees was selected non-randomly but with a view to generate a range of explanations for phenomena observed in

the data or discussed in the literature. The results of these interviews and of the fieldwork generally were instrumental in interpreting the quantitative results presented in this thesis.

3.7 General Econometric Considerations

This section will introduce the key statistical and econometric methods used in later chapters, such as OLS and 2SLS regression techniques and associated specification tests. This section will thus serve as a reference point for later chapters which will employ variants of the techniques introduced here.[25]

Chapters 4 to 7 use reduced-form models to estimate the exogenous determinants of a variety of dependent variables. These reduced form equations derive from a constrained optimisation problem as summarised in chapter 2. The reduced-form functions do not permit the analysis of structural production functions for output, health or labour supply but they summarise the total effect of exogenous changes on endogenous welfare variables for given preferences and for current stocks of household assets and characteristics (cf. Behrman and Deolalikar 1988, Glewwe 1991, Rosenzweig and Schultz 1988). This avoids some of the difficulties of assessing simultaneously determined outcomes for various activity choices and of assessing the impact of changes in various events exogenous to a household. Moreover, reduced-form functions require less data and fewer assumptions for their estimation than do systems of structural functions defining the economics of farm household decision making.

In each of the subsequent chapters there will be categorical dependent variables. These can be estimated using either logit or probit techniques, depending on the underlying distribution of the error term.[26] However, in practice there is little difference between these two techniques and the choice of technique often derives from practical, computational considerations. The logit equation has the general functional form:

$$y = (e^{\alpha + \beta x}) / (1 + e^{\alpha + \beta x}) \qquad (3.1)$$

which implies that y is constrained to the zero-one interval. The equation can be transformed into a log-odds ratio where:

$$\ln \{y / (1-y)\} = \alpha + \beta x \qquad (3.2)$$

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[25] The econometric techniques applied in this thesis are based on the basic texts by Amemiya (1990a, 1990b), Deaton (1997), Davidson and MacKinnon (1993), Johnston (1991), Kennedy (1998), Maddala (1983, 1992), and StataCorp. (1999) and on the analyses of the more specialist references provided in further footnotes.

[26] For a further discussion of discrete dependent variables and regression techniques, see Aldrich (1984), Cramer (1991), Demaris (1992), and StataCorp. (1999: logit).

so that the coefficient β of a logit regression can be converted into an odds-ratio e^{β}. Odds-ratios larger (smaller) than one thus indicate that the independent variable raises (lowers) the probability of success. Note that the "logit" command of Stata 6 tests the regression model for identification and collinearity and adjusts the specification by dropping variables and observations to permit the estimation to proceed.

As the FSP dataset is not a full panel and some variables were only enumerated in one round (e.g. household-level land tenure conflicts), the data could not be analysed as a panel or be pooled across time. However, the validity of the data pooling for all households (i.e. cross-sectional pooling) is analysed explicitly in chapter 7. Generally, the theoretical and the econometric models assume that the coefficients are constant across the entire sample (cf. Behrman and Deolalikar 1988: 648, Grootaert 1997: 172). In other words, it is assumed that all households behave identically.

On the one hand, this assumption may be true as the sample area is culturally, geographically and even economically quite homogenous. On the other hand, this assumption may not hold in practice as the war had strong differential impact across households and as some households may therefore have more assets and higher returns to assets than poorer households (Appleton 1995). Alternatively, households in different localities may face different endowments and constraints so that their behaviour, for example concerning output market participation, may differ systematically across space (Tschirley and Weber 1994).

The empirical analysis in this thesis adopts three measures to deal with these potential instances of structural differences across households. First, the regression analysis uses a larger set of control variables than has been common in the econometric analysis of Mozambican household surveys to date (even using the same FSP dataset), thus capturing some of the previously unobserved differences between households. For example, the main differences between the three sample districts derive from differences in land endowments, transaction costs and weather conditions, all of which are at least in part accounted for by the data.

Second, the regression programme Stata 6 includes commands to account explicitly for the design of household surveys by accounting for sampling weights, cluster sampling and stratification (Deaton 1997: 9-18, StataCorp. 1999: svy). Weighting results in estimators which are unbiased. Their standard errors are also affected by weights. Clustering accounts for the lack of independence between observations from within the same PSU and hence raises the estimates of standards errors and confidence intervals. Stratification on the other hand does not affect the independence of sampling and this can result in smaller estimated

standard errors.[27] All these adjustments imply that it is less likely that the analysis has to be separated across groups or districts as the survey commands of Stata 6 already account for some of these differences.

Third, the empirical analysis will test explicitly if pooling is valid (e.g. chapter 7). This will be done using the Chow test of parameter constancy or stability across subgroups of observations (Kennedy 1998: 111, 229, Maddala 1992: 170). For the case of two sub-groups, the Chow test examines the null hypothesis that the coefficients are equal in both sub-groups. The test statistic is:

$$F = \{ (RRSS - RSS_1 - RSS_2) / (k + 1) \} / \{ (RSS_1 + RSS_2) / (n - 2k - 2) \} \quad (3.3)$$

where RRSS is the restricted residual sum of squares, RSS_1 and RSS_2 are the residual sum of squares for the first and second sub-groups, respectively, n is the total sample size, and k is the number of explanatory variables. The test statistic has an F-distribution with (k + 1) and (n - 2k - 2) degrees of freedom. A large test statistic therefore suggests that the null hypothesis (which states that the sub-groups share equal coefficients) should be rejected. In other words, a large test statistic suggests that pooling is not appropriate. Note that the Chow test assumes that the error variance in both sub-groups do not differ significantly. The data analysis thus examines if this assumption holds before performing the Chow test.

The basic model outlined in equations A.1 to A.2d is recursive, that is there is a set of exogenous (or independent or explanatory) variables (called X_i) determining the outcome of the endogenous (or dependent) variable (called Y_i). This case can be summarised by the following econometric equation:

$$Y = \beta_0 + \beta_1 X + e \quad (3.4)$$

where β_j are the coefficients to be estimated and e is an error term which is distributed normally and with a zero mean. Equation 3.4 can thus be estimated using the standard ordinary least squared (OLS) technique. Note that if Y in equation 3.4 is measured in natural log form, if X takes a binary format and if β is the coefficient of X, then a change in the independent variable X induces a change of the magnitude $e^{\beta}-1$ in the dependent variable Y (Kennedy 1998: 228).

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[27] To illustrate the point empirically, consider the following example. Without any of the three survey adjustments, the estimated mean and standard error of household size in late 1995 (HHSIZE5) are 7.16 and 0.15 while the weighted and adjusted mean and standard error are 7.47 and 0.33, respectively. Accounting for survey design thus affects the empirical results significantly.

Under some circumstances a model may not be recursive so that some of the variables on the right hand side (RHS) are in turn dependent on the endogenous variable. Consider this model of simultaneous equations:

$$Y_1 = \beta_{10} + \beta_{11}Y_2 + \beta_{12}X_1 + \beta_{13}X_2 + e_1 \quad (3.5)$$

$$Y_2 = \beta_{20} + \beta_{21}Y_1 + \beta_{22}X_3 + e_2 \quad (3.6)$$

where the dual subscripts denote the equation and the coefficient, respectively, and where the error terms are now correlated with some RHS variables. This problem can be overcome by using the computationally equivalent instrumental variable (IV) or two-stage least squared (2SLS) techniques.[28] These involve finding the instrument X_3, which is correlated with Y_2 but not with the error term e_1. In the first round, all exogenous variables are then used to estimate both Y_1 and Y_2 in a reduced form system:

$$y_1 = \gamma_{10} + \gamma_{11}X_1 + \gamma_{12}X_2 + \gamma_{13}X_3 \quad (3.7)$$

$$y_2 = \gamma_{20} + \gamma_{21}X_1 + \gamma_{22}X_2 + \gamma_{23}X_3 \quad (3.8)$$

where y_1 and y_2 denote the estimated values for Y_1 and Y_2. This is possible if the system is at least exactly identified, in other words if there are at least as many instruments as explanatory variables. The first stage estimation should have a good fit and the instruments should be jointly significant to create predicted values which are of benefit in the second round.

In the second round, these predicted values y_1 and y_2 are substituted into equations 3.6 and 3.5, respectively, which are then estimated using OLS. This process yields consistent estimates of all coefficients because all y_i are uncorrelated with the error terms from the first stage regressions. Note that the estimated standard errors of the second stage are different because the second stage uses the predicted y_i values instead of the original Y_i values. For very large models with many exogenous variables the Y_i and the y_i may in fact be quite similar so that it will be instructive to compare their values. Note that the discussion so far applies to models with continuous dependent variables. There are techniques which extend these principles to limited dependent variable models and these are discussed and employed in the results chapters as necessary.[29]

In Stata 6, the IV procedure can be implemented using the "ivreg" and "svyivreg" commands for standard IV and survey IV regressions, respectively. Stata 6 also provides

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[28] For an overview over IV and 2SLS techniques, appropriate tests and their limitations, see also Bound, Jaeger and Baker (1993), Deaton (1997: 111-6), Maddala (1992: 366-77), and StataCorp. (1999: ivreg).

some tests for endogeneity such as the Hausman test (Hausman 1978, StataCorp. 1999: hausman). This test assesses if there is sufficient difference between the IV and the OLS coefficients to suggest that OLS may be inconsistent, with the null hypothesis being that the difference in coefficients is not systematic (i.e. that OLS is consistent).

Building on Davidson and MacKinnon (1993: 236-42), Stata suggests an alternative test called the augmented regression or Durbin-Wu-Hausman (DWH) test which is implemented in Stata 6 using the "dmexog" command (Cong 1999, StataCorp. 1999: ivreg, dmexog). The DWH test involves estimating the model of interest but including the predicted values of all endogenous RHS variables (as a function of all genuinely exogenous variables). The DWH then checks if the coefficients of all predicted variables are jointly equal to zero. If the null hypothesis of jointly zero coefficients cannot be rejected, then OLS appears to be consistent.

In regression models with many independent variables, there is a potential danger that some of these variables are closely related and thus introduce multicollinearity.[30] This would result in artificially large estimated coefficients or in underestimating the statistical significance of a coefficient (which in fact is related to the dependent variable). All estimated regressions have thus been inspected informally for a high correlation between the explanatory variables and for the presence of a large number of insignificant test statistics for the coefficients. In addition, the presence of multicollinearity was tested more formally by assessing variance inflation factors (VIF) using Stata 6. Individual VIFs larger than 10 or a mean VIF much larger than 1 were taken to indicate the presence of multicollinearity and the specification was improved to remove the problem.

This section concludes with a note on the procedure and nomenclature of hypothesis tests. The probability of falsely rejecting the null hypothesis is equal to α where $0 \leq \alpha \leq 1$. The significance level of statistical tests is denoted as α (which is often reported as $1-\alpha$ and then expressed as a percentage). The default for $1-\alpha$ in any hypothesis test is 0.95 and its use is indicated in figures by ** while $1-\alpha=0.99$ is denoted by *** (or by the term "highly significant") and $1-\alpha=0.90$ is denoted by *. "Statistically significant" test results hence

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[29] Simultaneous probit models and tests for endogeneity in such models are also discussed by Blundell and Smith (1989, 1994), Mallar (1977), Newey (1987), Rivers and Vuong (1988), Smith and Blundell (1986), and StataCorp. (1995: ivprob).

[30] Multicollinearity is also discussed by Chatterji and Price (1991), Maddala (1992: ch. 7), StataCorp. (1999: regression diagnostics), and Studenmund (1992: 271-83).

imply that the sampling variance is unlikely to be the cause of the discrepancy between the null hypothesis and the sample values (Maddala 1992: 29-31).

3.8 Summary

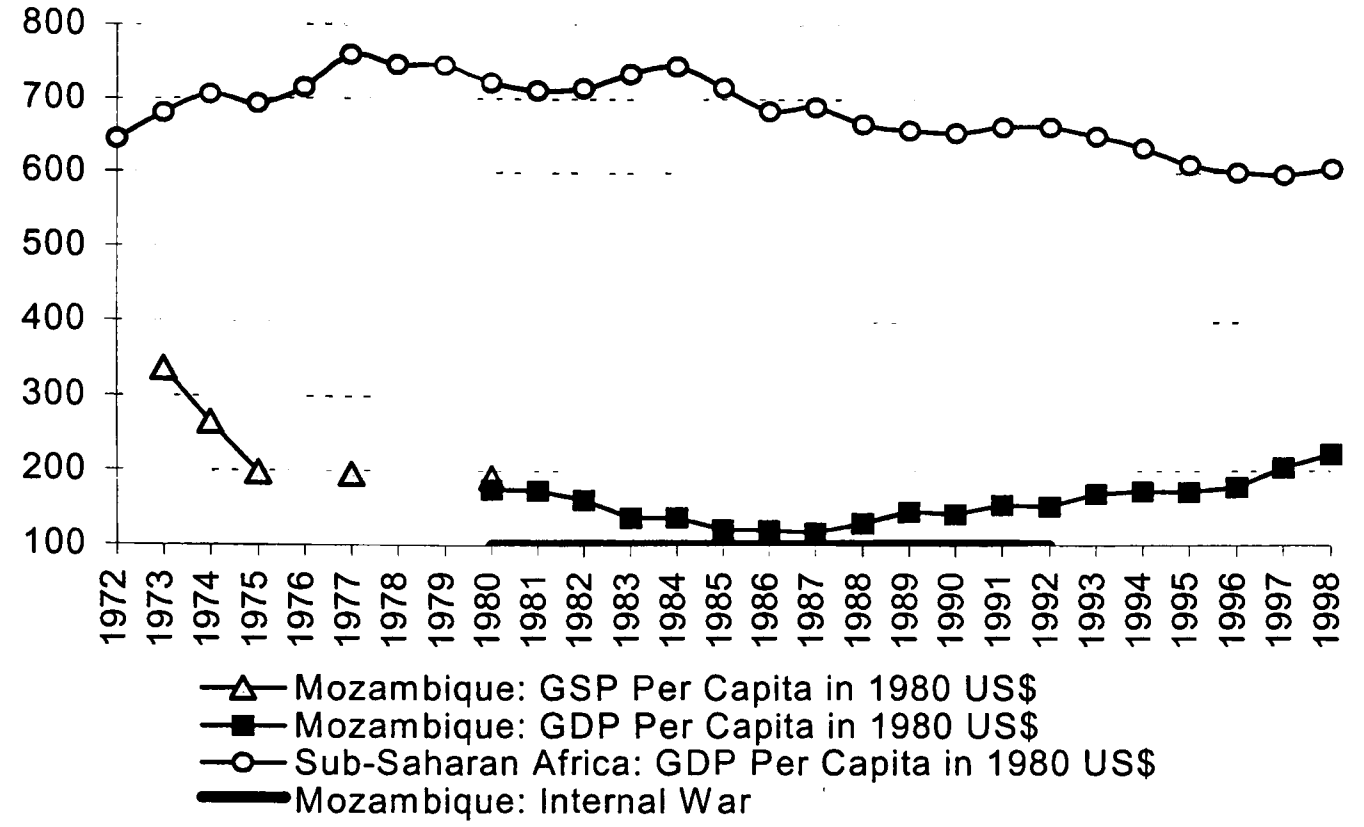
The objective of this chapter was to provide the background information necessary to motivate the choice of assumptions, constraints and the derivation of hypotheses of the previous chapter, to analyse the case of northern Mozambique generally, and to utilise and investigate the household survey data specifically.

The particular nature of the war in Mozambique accentuated the impact of fighting on peasant households through a variety of channels. The transformation from a backward colonial and later from a socialist to a market-led economy involved massive dislocations apparent in the macro-economic indicators and emphasised by the war. The transition to peace thus created an expectation of a fiscal and in particular of a production peace dividend which could not be delivered in the period of analysis, up to early 1996.

The geography and various rural markets and institutions which are relevant for an understanding of how the specific rural production peace dividend did not materialise in northern Mozambique in the period 1993-96 were considered. While peasant households generally face favourable geographic conditions, they also face very fragmented labour and output markets and very traditional land use mechanisms. The expected formation of large households, the expected focus on own household labour and on on-farm subsistence activities, and the dislocated nature of rural markets with high welfare effects of endogenous activity choices have thus been placed in an empirical framework which makes these predictions of the BM model of land abundance and of the effects of war appear more likely.

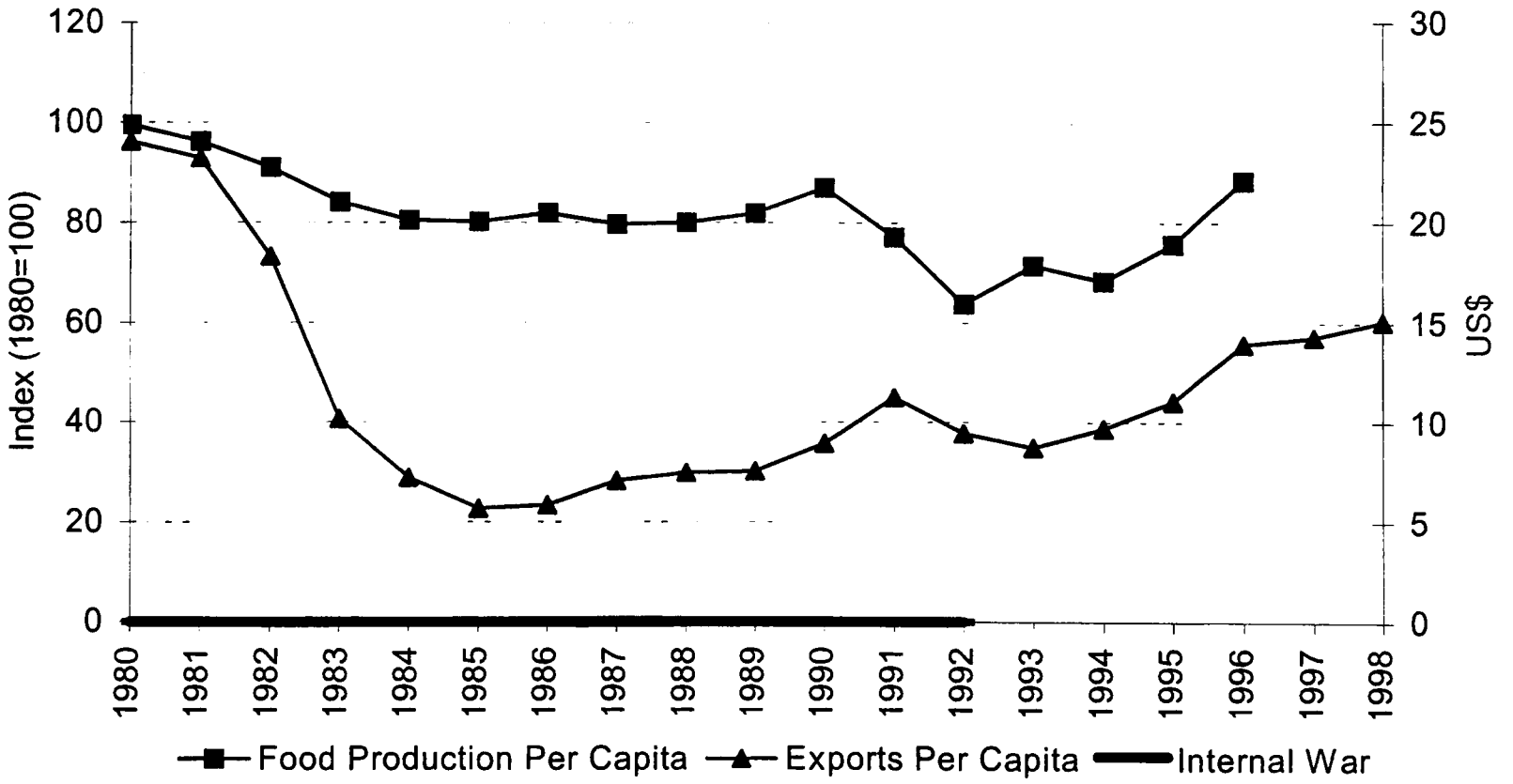
Finally, the nature of the dataset used was discussed. The data is unique for providing such insights into the economic behaviour of post-war farm households but some aspects of the data imply that not all ideal empirical issues and not all preferred econometric techniques may be applied in later chapters. However, in combination with the evidence collected in two fieldtrips to Maputo and northern Mozambique in 1995 and 1999 the FSP data is expected to yield interesting insights into the study of post-war household coping strategies under conditions of newly found peace.

Figure 3.1: Output in Mozambique and Sub-Saharan Africa



Source: Brück, FitzGerald and Grigsby (2000: 9).

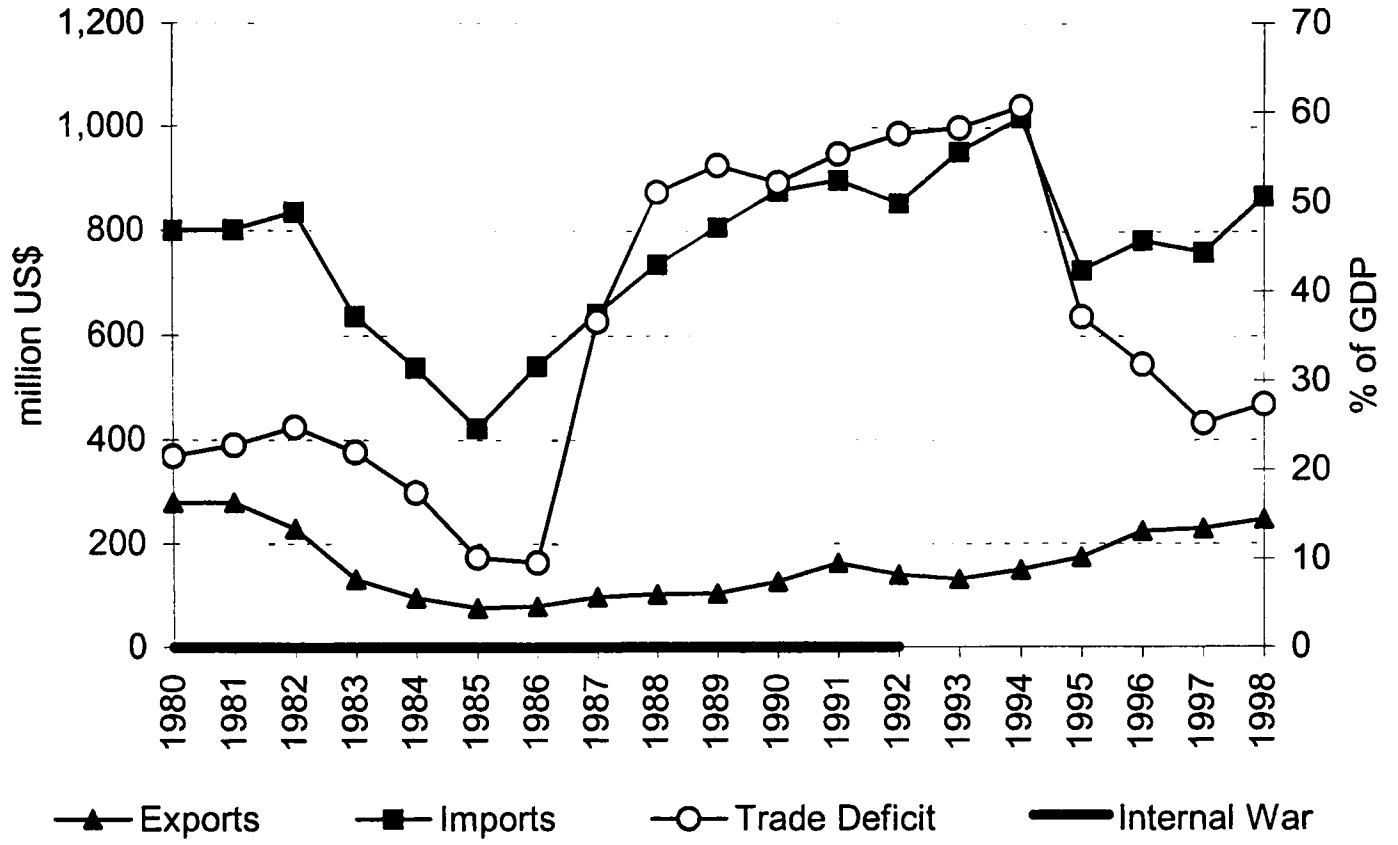
Figure 3.2: Food Production and Exports per Capita



Food production per capita is expressed as an index (with 1980 as the base year) while exports per capita are measured in current US$.

Source: Brück, FitzGerald and Grigsby (2000: 29-30).

Figure 3.3: Exports, Imports and the Trade Deficit



Exports and imports are shown in current million US$ while the trade deficit is shown as a share of GDP.

Source: Brück, FitzGerald and Grigsby (2000: 16-7).

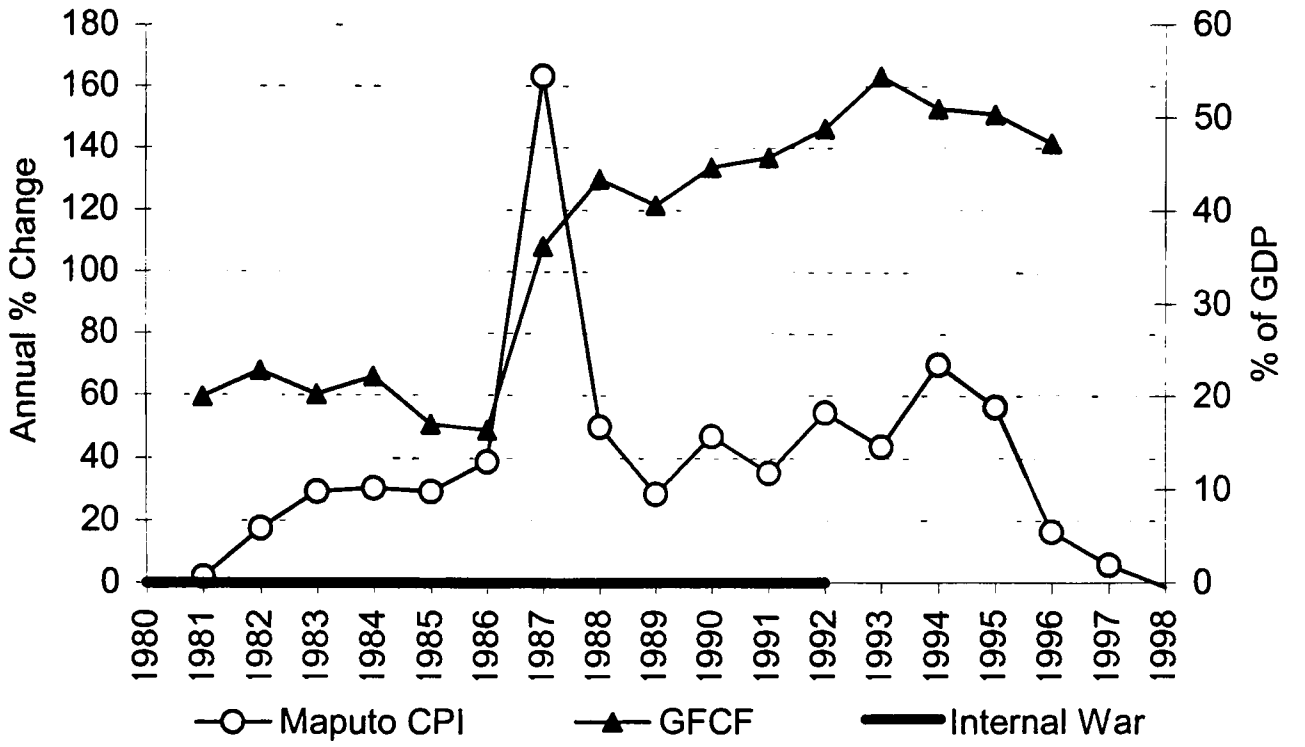
Figure 3.4: GDP per Capita by Province and Region

	US$				% of		% of
	1996	**1997**	**1998**	**Mean**	**Total**	**Population**	**Total**
Nampula	131	155	176	154	13	3,196,472	19
Cabo Delgado	113	140	152	135	5	1,436,496	9
Niassa	97	114	128	143	3	848,889	5
Sub-Total North	**121**	**145**	**162**	**143**	**21**	**5,481,857**	**33**
Zambézia	102	126	134	121	11	3,240,576	19
Tete	99	127	169	131	5	1,287,517	8
Manica	123	156	196	158	5	1,103,857	7
Sofala	248	308	326	294	11	1,424,378	8
Sub-Total Centre	**135**	**168**	**189**	**164**	**31**	**7,056,328**	**42**
Inhambane	136	165	180	161	5	1,222,219	7
Gaza	113	141	156	137	4	1,173,337	7
Maputo Province	125	150	185	153	4	899,329	5
Maputo City	1,072	1,301	1,426	1,266	34	1,007,584	6
Sub-Total South	**357**	**430**	**471**	**419**	**48**	**4,302,469**	**26**
Total Mozambique	**187**	**227**	**252**	**222**	**100**	**16,840,654**	**100**

The GDP per capita data is expressed in current US$. The regional sums have been weighted by their respective shares of the total population. The distribution of GDP refers to total GDP for the period 1996-98. The population figures are a 1999 estimate.

Source: UNDP (1999: 18, 42).

Figure 3.5: Inflation and Investment



The annual percentage change of the Maputo consumer price index (CPI) is shown on the left-hand scale. Its value in 1998 is -1.3%. Investment in Mozambique is expressed as gross fixed capital formation over GDP and this variable is shown on the right-hand scale. This is the best available estimate though it is likely to be an overestimate (Cruz 1999).

Source: Brück, FitzGerald and Grigsby (2000: 11-2).

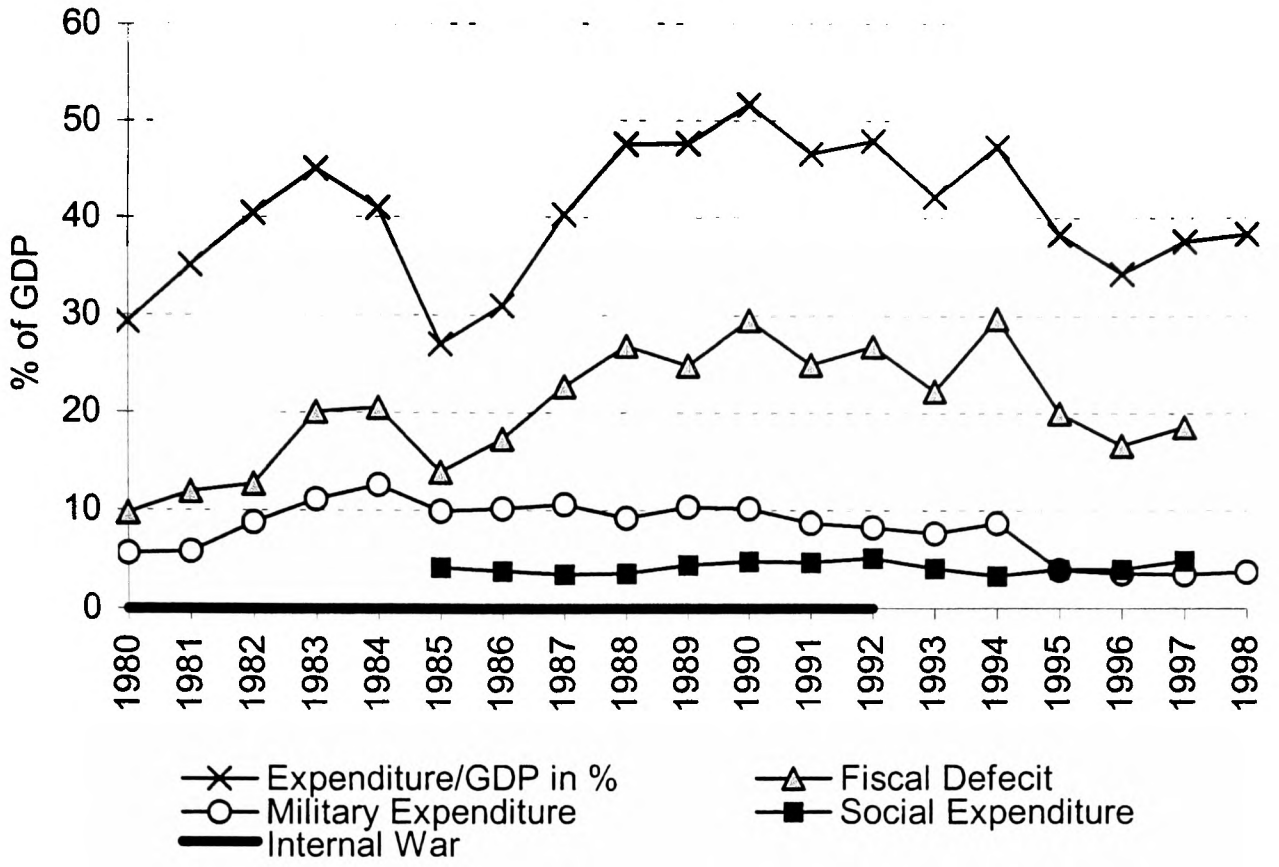
Figure 3.6: Foreign Direct Investment

	Mid-1985 to Mid-1993		Mid-1993 to Mid-1994	
FDI Project Status	**million US$**	**% of Total**	**million US$**	**% of Total**
Implementation not Started	22.5	4	158.2	36
Being Implemented	62.8	10	217.1	49
Active/Realised	165.6	27	40.0	9
Cancelled/Pending	366.5	59	27.6	6
Total Approved FDI	617.4	100	442.9	100

The data includes all economic sectors except minerals and commerce.

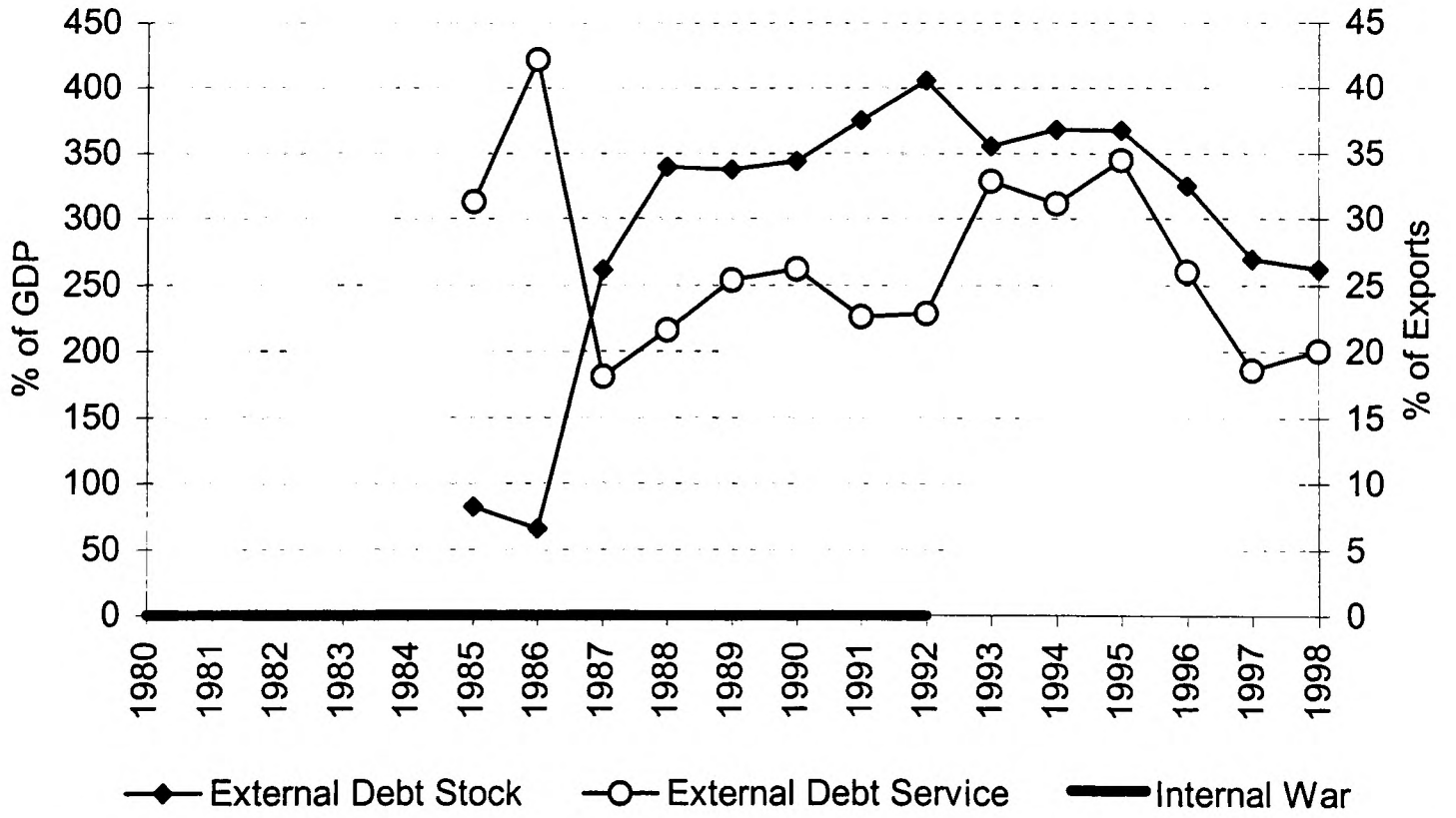
Source: Centro de Promoção do Investimento Estrangeiro (1995).

Figure 3.7: Government Expenditure and the Fiscal Deficit



Source: Brück, FitzGerald and Grigsby (2000: 10-3, 18, 20).

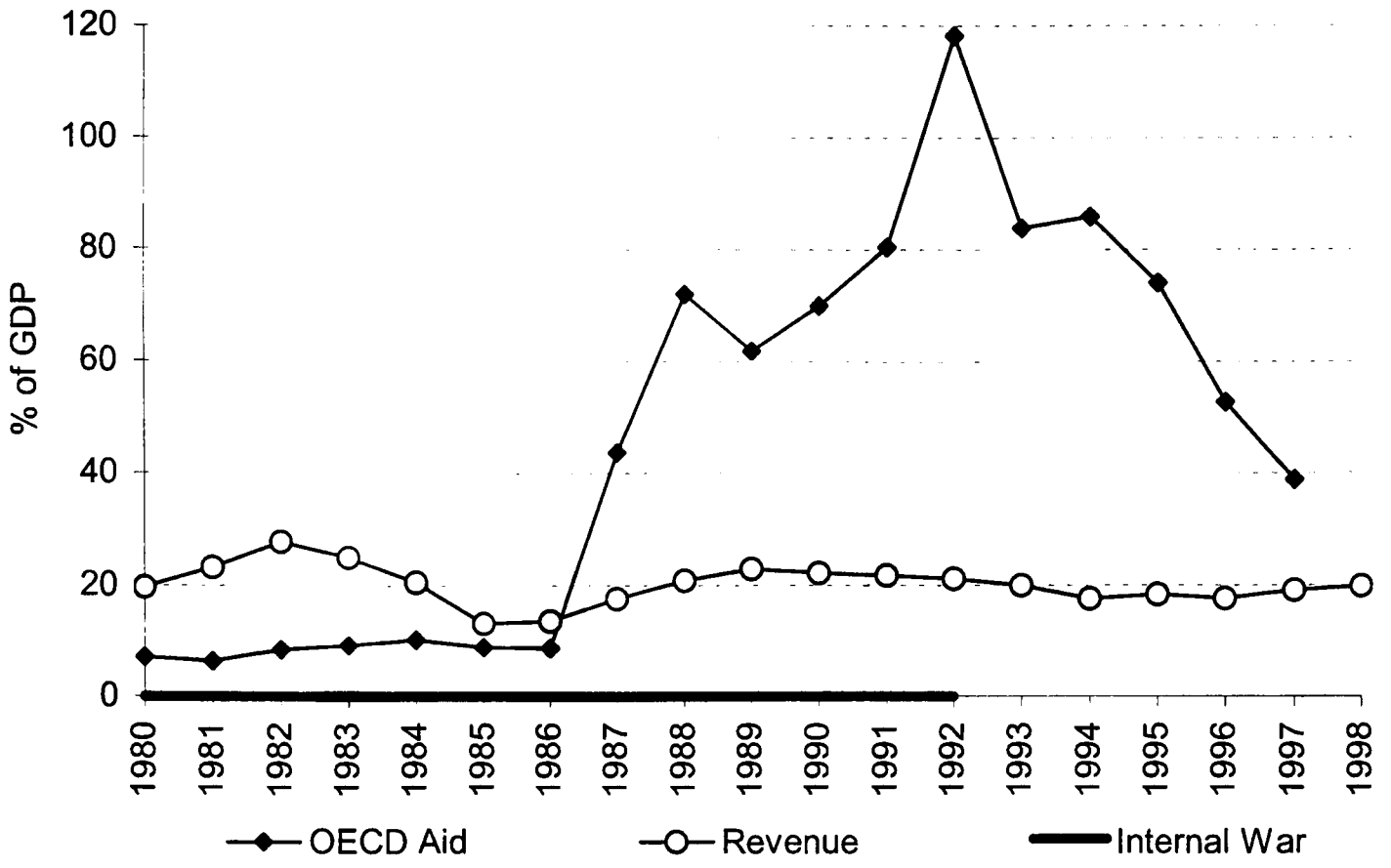
Figure 3.8: External Debt



"External Debt Stock" measures total official external debt stock as a share of GDP and "External Debt Service" measures total official external debt service as a share of exports.

Source: Brück, FitzGerald and Grigsby (2000: 25-6).

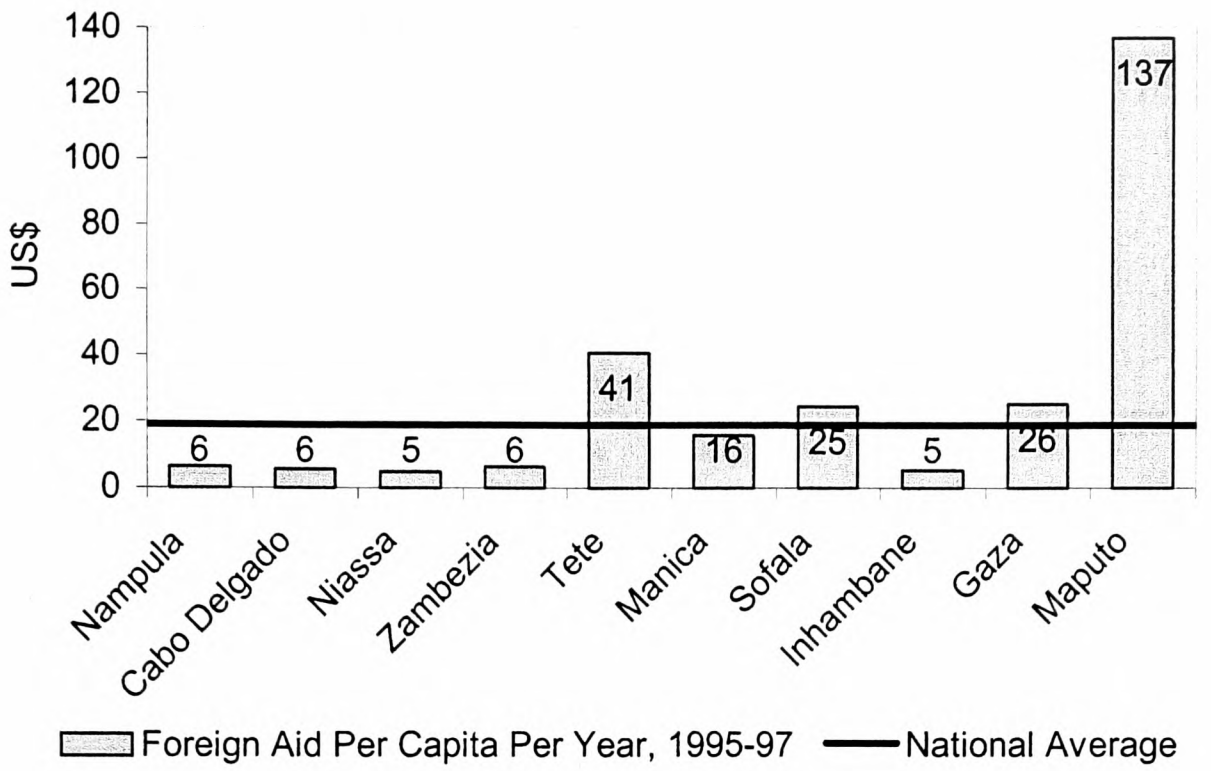
Figure 3.9: Foreign Aid and Government Revenue



"OECD Aid" measures foreign aid from OECD Countries as a share of GDP. "Revenue" measures total government revenue as a share of GDP.

Source: Brück, FitzGerald and Grigsby (2000: 18, 22).

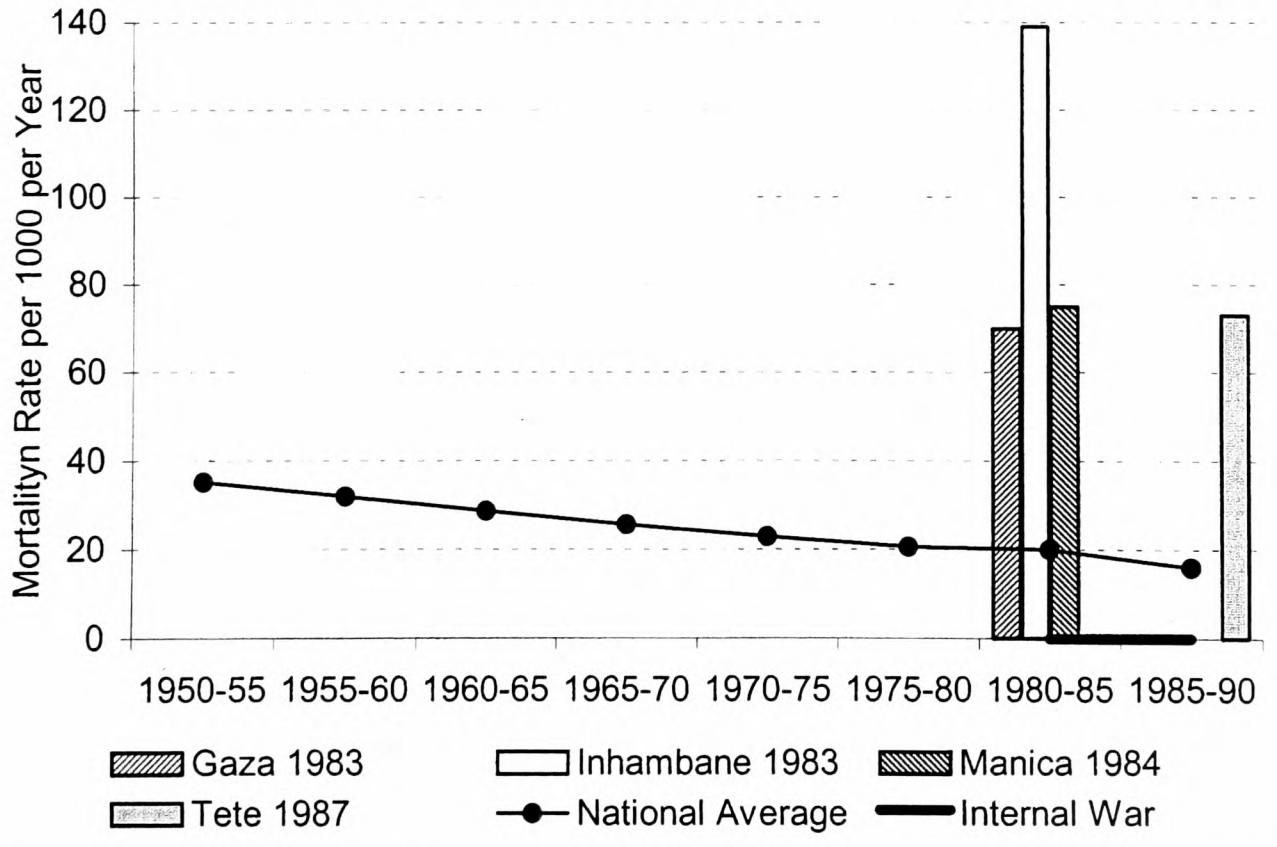
Figure 3.10: Foreign Aid by Province



The data includes all foreign aid implemented at a national or sub-national level and know to the UNDP office in Maputo. The figure for Maputo includes projects implemented in the city and the province of Maputo but not projects whose purpose was not regional development in Maputo itself. The data for Tete excludes aid for the Cahora Bassa project, which has been designated a national project for the purpose of this figure. The data shown in the figure represents 33% of all foreign aid to Mozambique in that period. The other foreign aid was not spent on projects with a regional focus (66%) or the main benefiting province could not be identified clearly (1%). The "National Average" refers to the weighted mean of the provincial figures. The weights are based on a 1999 population estimate.

Source: UNDP (1998a: 18, 1999: 18) and own calculations.

Figure 3.11: Mortality in War-Affected Areas



Source: Cliff and Noormahomed (1988: 720) and Comissão Nacional do Plano and Ministério da Saude (1993: 21-31).

Figure 3.12: Population Displacement During the War

	September 1986		Mid-1989		October 1992	
	Number	%	Number	%	Number	%
Affected	n.a.	n.a.	2,873,957	19	n.a.	n.a.
Displaced	n.a.	n.a.	1,689,492	11	3,728,000	26
Affected and Displaced	3,482,626	25	4,563,449	30	n.a.	n.a.
Refugees	250,000	2	1,000,000	7	1,390,000	10
Displaced and Refugees	n.a.	n.a.	2,689,492	18	5,118,000	36
Displaced, Affected and Refugees	3,732,626	26	5,563,449	37	n.a.	n.a.
Total Population Estimate	14,174,300	100	15,166,000	100	14,285,000	100

Affected persons are people whose homes or livelihoods have been destroyed but have not fled their general area of previous residence. Displaced persons are people who moved involuntarily within Mozambique. Data for refugees refer only to those persons living in neighbouring countries with 1986 and 1989 data restricted to Malawi, Zambia and Zimbabwe. "n.a." indicates data which is not available. Note that the rows do not represent mutually exclusive categories.

Sources: Comissão Nacional do Plano (1987), International Organisation for Migration (1994), UNOHAC (1994) and World Bank (1990).

Figure 3.13: Children's War Experiences

Type of War Experience	Share of the Sample in %
Witnessed Physical Abuse and/or Torture	88
Witnessed Killings	77
Served as Porters for Renamo	75
Were Abducted from their Families	64
Witnessed Rape or Sexual Abuse	63
Were Physically Abused or Tortured	51
Witnessed Family Members Killed	37
Were Trained for Combat	28
Admitted to Being Raped	16
Admitted to Killing	9
Suffered Permanent Physical Injury	7

The survey sample consisted of 504 children aged 6 to 15 years at the time of their war experiences, originating from 7 different provinces, all of whom had been resident in war-affected areas. The data was collected between 1989-1990.

Source: Boothby, Uptom and Sultan (1991).

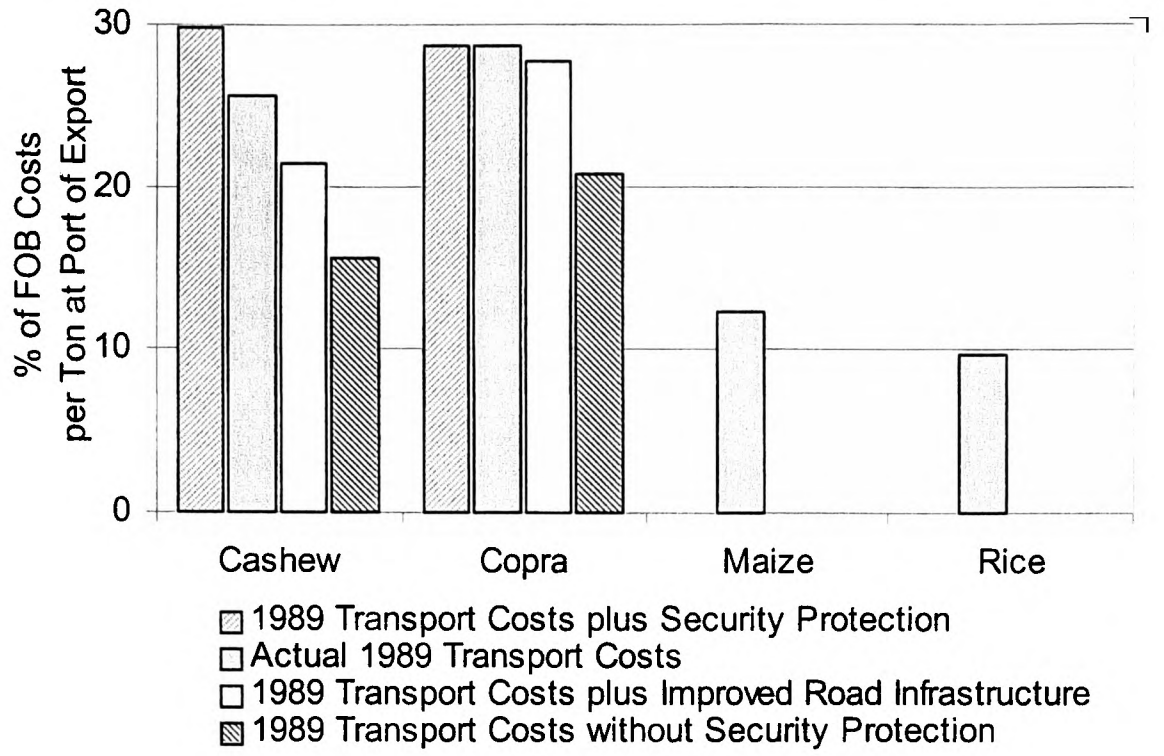
Figure 3.14: War-Damage to Agricultural and Rural Infrastructure

Immobile Capital by Sector in 1992	Operational	Inactive	Destroyed	Total	Damage (%)
Agriculture					
Irrigation Systems	118	24	7	149	**21**
Dams	122	208	57	387	**68**
Seed Production Centres	13	9	0	22	**41**
Nurseries	38	19	4	61	**38**
Tick-Cleansing Tanks	70	299	40	409	**67**
Water Supply					
Wells	3,057	1,071	138	4,266	**28**
Water Holes	1,225	530	32	1,787	**31**
Fountains	484	205	11	700	**31**
Small Water Supply Systems	96	84	29	209	**54**
Commercial Buildings					
Shops	6,664	1,318	2,381	10,363	**36**
Warehouses	369	8	40	417	**12**
Banks	144	6	4	154	**6**
Savings Posts	54	31	0	85	**36**
Communication					
Post Offices	123	8	17	148	**17**
Rural Post Offices	49	90	13	152	**68**
Public Administration Offices					
District Level	117	33	42	192	**39**
Municipal Level	99	83	120	302	**67**
Official Residences	724	474	374	1,572	**54**

"Damage" is defined as the share of infrastructure either inactive (i.e. non-operational) or destroyed over the total number of surveyed infrastructures.

Source: Comissão Nacional do Plano (1993: 21).

Figure 3.15: The Effect of War on Transport Costs



Source: World Bank (1989: 75-6).

Figure 3.16: Markets in Rural Northern Mozambique

Market	Characteristics
Land Market	no formal market for legal reasons and due to land abundance
Credit Market	not existent
Agricultural Labour Market	few wage-labour opportunities on farms or plantations
Formal Sector Labour Market	very small and access only through political connections
Agricultural Tool Market	surprisingly restricted and inefficient for not very well understood reasons
Other Agricultural Input Markets	very limited on both demand and supply sides except for some cotton pesticides provided by cotton monopsonists
Food Crop Markets	few local markets which are well integrated into regional or international trading channels though Mozambique has a relatively well functioning national food crop market (Tschirley et al 1996)
Cotton Market	most regulated market in rural Mozambique with monopsonist cotton buyers and a government-fixed cotton price
Other Cash Crop Markets	depending very strongly on the degree of remoteness of the area, the density of producers, and the type of crop

Figure 3.17: Distribution of Sample Households by PSU and Strata

		Cotton Growing Status (Strata)				
Village (PSU)	**District**	**Not Growing**	**Dispersed**	**Block**	**Montepuez-Block**	**Total**
Mararange	Montepuez	2.33	1.69	0.09	0.05	4.17
Nacuaia	Montepuez	0.90	3.20	0.00	0.06	4.16
Nacuca	Montepuez	1.26	2.27	0.26	0.10	3.89
Mondlane	Montepuez	1.61	0.32	0.22	0.00	2.15
Nacimoja	Montepuez	9.63	0.80	0.00	0.00	10.43
25 Setembro	Montepuez	7.89	0.50	0.00	0.00	8.39
Linde	Montepuez	12.55	4.33	0.00	0.00	16.88
Napipine	Meconta	2.96	1.27	0.00	0.00	4.23
Varrua	Meconta	0.09	0.27	3.15	0.00	3.51
Napita	Meconta	0.26	0.29	3.26	0.00	3.81
Mepine	Monapo	0.17	1.85	2.69	0.00	4.71
Natete	Monapo	0.75	2.66	0.00	0.00	3.41
3 Fevereiro	Monapo	0.42	9.09	0.00	0.00	9.51
Namacopa	Monapo	0.30	2.77	4.10	0.00	7.18
Nacololo	Monapo	1.47	0.52	6.24	0.00	8.23
Picadane	Monapo	0.97	4.38	0.00	0.00	5.35
Total		43.57	36.20	20.02	0.21	100.00

The cells show as a percentage the share of the households from each village-status combination as a share of the total sample. The data is weighted using WEIGHT2. The sample size is 371 households.

Source: FSP data and own calculations.

Figure 3.18: ACE Conversion Factors

Category	Conversion Factor
resident child aged 0-9 years	0.60
resident female aged 10 to 19 years	0.84
resident female aged over 19 years	0.72
resident male aged over 9 years	1.00
non-resident household member	0.00

Resident household member is defined by sharing meals with the other household members listed on the questionnaire. Where the gender, the age or both variables were not reported in the FSP survey, expected conditional values were calculated.

Sources: Marule (1998: 115) and Strasberg (1997: ch. 4).

Figure 3.19: Definitions and Summary Statistics of Key FSP Variables

Variable Name	Variable Definition	Mean	Standard Error
Income Variables			
EXP12PC	imputed, price-weighted food expenditure per capita /household in $, 1995	26.05	2.21
EXP36PC	imputed, price-weighted per capita expenditure /household in $, 1995	33.05	2.55
INCOME05	net household income per capita in $, 1995	37.13	3.61
SHAREC	share of net income derived from cash crops, 1995	0.17	0.03
SHAREE	share of net income derived from entrepreneurial activities, 1995	0.10	0.01
SHAREF	share of net income derived from food crops, 1995	0.65	0.03
SHAREW	share of net income derived from wage and social activities, 1995	0.08	0.01
Household Characteristics			
AGEHEAD1	age of household head, 7/1994	39.93	1.35
AGEHH01	average age of household, late 1994	22.11	1.00
DEPEND95	dependency ratio /household, 7/1995	0.26	0.02
EDINFRA3	maternal education (EDUMUM1) if area has few complaints about infrastructure (INFRA4), 7/1994	0.49	0.18
EDINFRA5	education of head (EDUHEAD1) if area has few complaints about infrastructure (INFRA4), 7/1994	1.02	0.28
EDUHEAD1	# of years of education by household-head, 7/1994	1.91	0.23
EDUHH1	total # of years of education /household, 7/1994	7.26	0.50
EDUMAX3	max # years of effective education /household (adjusted for literacy), 7/1994	3.58	0.21
EDUMUM1	# years of education of the household's mother (adjusted for literacy), 7/1994	0.77	0.16
FEMALE2	ratio of females over total # of people /household, 1994-96	0.47	0.01
FEMHEAD1	Female-headed household, 7/1994?	0.01	0.01
HHSIZE5	# of residents /household, late 1995	7.47	0.33
ILLDAYS2	total # days ill /household, 1995-96	21.77	2.35
MEMD11	# dependent residents /household, 7/1995	1.89	0.11
MEMND11	# non-dependent, resident members /household, 7/1995	5.57	0.33
REFUGEE1	Has household been recognised as a refugee household, 1994-96?	0.16	0.05
TIME01	# hours /month wife spent collecting firewood, hungry season 1995	7.31	0.77
TIME02	# hours /month wife spent collecting firewood, harvest season 1995	7.35	0.84
TIME03	# hours /month wife spent collecting water, hungry season 1995	15.06	1.00
TIME04	# hours /month wife spent collecting water, harvest season 1995	24.63	3.27
Land Characteristics			
AREA51	ln of hectare of cultivated area /household, 1995-96	0.71	0.05
AREA53	ln of hectare of total area /household, 1995-96	1.33	0.06
AREAC95	cultivated area /household in hectare, 1995-96	2.59	0.23
AREAF95	fallow area /household in hectare, 1995-96	1.82	0.18
AREAFER5	Very high soil quality /household (weighted), 1995?	0.41	0.05
AREAFER6	Low soil quality /household (weighted), 1995?	0.29	0.05
COTTON2	share of cultivated land with cotton /household, 1995	0.13	0.02

COTTON99	Cotton growing household, mid 1995?	0.56	0.10
DISTANC3	distance to fields in min /household (weighted), 1995	40.67	3.48
PEST01	Do most crops suffer from pests (unweighted), 1995?	0.40	0.07
RAIN4	% of cultivated area with lack of rain /household, 1994-95	0.30	0.05
TENURE1	Worried about household land tenure, 1995?	0.52	0.07
TENURE3	Very easy to get new land, 1995?	0.42	0.05
Asset and Technology			
ANIMAL1	# of large animals /household, 10/1992	0.67	0.24
ANIMAL2	# of large animals /household, 2/1996	1.42	0.29
ANIMAL5	Household has at least one large animal, 10/1992?	0.11	0.03
ANIMAL6	Household has at least one large animal, 2/1996?	0.29	0.06
CYCLONE2	Affected by cyclone Nadia in March 1994?	0.33	0.08
TOOL01	# of tools /household, 5/1995	6.17	0.24
TOOL02	# of types of tools /household, 5/1995	2.90	0.11
TREE11	# of cashew and coconut trees per capita /household, 1994	1.22	0.29
VASSET3	value of assets in real 1996 $ /household, 10/1992	166.80	23.13
VASSET4	value of assets in $ /household, 2/1996	165.31	45.11
Social Capital			
ANCEST1	Does the household have ancestors buried here, 1994-96?	0.84	0.04
AUTH11	Is household related to any authority, 1994-96?	0.48	0.06
AUTH12	Is household head in any position of authority, 1994-96?	0.07	0.01
ORIGINF1	Is this village the origin of the main woman in the household, 1994-96?	0.65	0.05
ORIGINM1	Is this village the origin of the main man in the household, 1994-96?	0.68	0.05
Village-Level Variables			
ANIMAL3	mean # of large animals /household /village, 1992	0.67	0.16
ANIMAL4	mean # large animals /household /village, 1996	1.46	0.27
ILLDAYS4	average # days ill /village, 1995-96	22.53	1.97
INFRA4	above average complaints about economic infrastructure /village, 1995	0.45	0.12
LABOUR2	# of hrs of labour hired for farm work /village, 1995	2833.92	686.86
LABOUR3	ln of # of hrs of labour hired for farm work /village, 1995	7.23	0.19
LABOUR4	# of hrs of labour hired for farm work per capita /village, 1995	6.00	1.08
LABOUR5	ln of # of hrs of labour hired for farm work per capita /village, 1995	1.40	0.18
MARKET1	mean household crop sales /village in $, 1993-94	58.02	5.74
MARKET2	mean household crop sales /village in $, 1994-95	51.61	7.79
MARKET3	mean household crop sales /village in $, 1995-96	9.74	1.24
MILL11	# of grain mills near household, mid 1995	2.24	0.31
YIELD07	yield for maize /village in kg/hectare, 1994-95	318.71	38.10
YIELD08	yield for cotton /village in kg/hectare, 1994-95	649.56	61.80
YIELDL7	ln of yield for maize /village in kg/hectare, 1994-95	5.61	0.11
YIELDL8	ln of yield for cotton /village in kg/hectare, 1994-95	6.35	0.13

Miscellaneous Variables			
ALDXXX	village categorical variables	n.a.	n.a.
CATEGX	cotton growing category /household (see chapters 3.6 and 7)	n.a.	n.a.
DIS1	Is this household resident in Montepuez district, 1994-96?	0.50	0.11
DIS2	Is this household resident in Meconta district, 1994-96?	0.12	0.06
DIS3	Is this household resident in Monapo district, 1994-96?	0.38	0.11
PRICE13	Paasche price index for purchased food /household, early 1995	1.09	0.04
PRICE14	Paasche price index for purchased food /household, mid 1995	0.93	0.04
PRICE15	Paasche price index for purchased food /household, late 1995	1.13	0.07
PRICE23	Paasche price index for purchased non-food /household, early 1995	1.05	0.06
PRICE24	Paasche price index for purchased non-food /household, mid 1995	0.98	0.05
PRICE25	Paasche price index for purchased non-food /household, late 1995	1.06	0.04
PRICE33	Paasche price index for home-produced food /household, early 1995	1.04	0.07
PRICE34	Paasche price index for home-produced food /household, mid 1995	1.10	0.05
PRICE35	Paasche price index for home-produced food /household, late 1995	1.29	0.21
PRICEV1	inter-temporal variance of the Paasche price index for purchased food /household, 1994-95	0.09	0.01
PRICEV2	inter-temporal variance of the Paasche price index for purchased non-food /household, 1994-95	0.06	0.01
PRICEV3	inter-temporal variance of the Paasche price index for home-produced food crops /household, 1994-95	0.40	0.11
WEIGHT2	sampling weight for given location and cotton growing category /household, 1994-96	194.67	36.72
WEIGHT3	as WEIGHT2 but excluding one outlier (see chapters 3.6 and 6)	194.32	36.78

The FSP dataset includes 371 observations. The data was weighted using WEIGHT2. The standard errors have been adjusted for the survey design. See section 3.6 and individual chapters for more detailed definitions and variants of these variables.
Source: FSP data and own calculations.

Figure 3.20: Price Variables by Location

	PRICEV1		PRICEV2		PRICEV3	
Village	**Estimate**	**St Err**	**Estimate**	**St Err**	**Estimate**	**St Err**
Mararange	0.0242	0.0071	0.0074	0.0010	0.0154	0.0001
Nacuaia	0.0561	0.0024	0.1535	0.0035	0.0187	0.0000
Nacuca	0.0560	0.0114	0.0220	0.0111	0.1057	0.0146
Mondlane	0.0302	0.0175	0.0108	0.0049	0.0051	0.0000
Nacimoja	0.2059	0.0189	0.0536	0.0017	0.4193	0.0000
25 Setembro	0.1027	0.0000	0.0129	0.0004	0.1586	0.0009
Linde	0.1188	0.0002	0.0376	0.0031	0.9644	0.0109
Mepine	0.0286	0.0044	0.1355	0.0366	0.0005	0.0000
Natete	0.0285	0.0013	0.0527	0.0034	0.0683	0.0000
Napipine	0.0460	0.0045	0.0920	0.0165	0.3494	0.0007
Varrua	0.0614	0.0029	0.0284	0.0017	0.0038	0.0005
Napita	0.0096	0.0014	0.0072	0.0005	0.0037	0.0000
3 Fevereiro	0.0987	0.0046	0.1690	0.0077	1.0966	0.0000
Namacopa	0.0925	0.0536	0.0086	0.0025	0.6063	0.0119
Nacololo	0.0688	0.0083	0.0463	0.0035	0.0398	0.0000
Picadane	0.0959	0.0032	0.0599	0.0118	0.1610	0.0185
Total	0.0899	0.0146	0.0578	0.0131	0.4026	0.1104

PRICEV1, PRICEV2 and PRICEV3 are defined as the inter-temporal variances of the Paasche price indices for purchased food, purchased non-food, and home-produced food crops by household in 1994-95, respectively. The total number of observation is 371. The data is adjusted for survey design. The weight is WEIGHT2.

Source: FSP data and own calculations.

Figure 3.21: Summary of FSP Questionnaire

Topic	Round 1 6/1994	Round 2 1/1995	Round 3 5/1995	Round 4 9/1995	Round 5 1/1996
Core Sections					
On-farm members demographics	X	X	X	X	X
Off-farm members and remittances	X	X	X	X	X
Land resources and crop mix,	X	X	X	X	X
Field history, soil type, location	X	X	X	X	X
Agricultural sales		X	X	X	X
Consumption		X	X	X	X
Expenditures		X	X	X	X
Household labour on land	X	X	X	X	
Off-farm income	X	X	X	X	X
Labour hired	X	X	X	X	
Agricultural inputs and instruments	X	X	X	X	
Fruit and vegetable production		X	X	X	X
Animals		X	X	X	X
Additional Modules					
Family history	X			X	
Relation with political authorities	X			X	
Relation with JVC	X		X	X	
Cotton grower market		X		X	
Agricultural production		X		X	
Food storage methods			X	X	X
Cashew management				X	
Grain milling and processing				X	
Women's time allocation					X
Land tenure and conflict					X

The survey rounds refer to the period of data enumeration. The collected data thus generally refers to the preceding four to six months. Note that some of the collected data (e.g. on total calories stored or consumed) could not be used for analysis due to enumeration or definition problems.

Source: MAP/MSU Research Team (1996: 33).

Figure 3.22: Shortfalls of Rain by Village

Village	Mean of RAIN4	Standard Error	N
25 Setembro-Lomaco	75.7	0.8	19
3 Fevereiro	15.4	0.1	26
Linde	40.6	1.4	22
Mararange	37.0	2.9	39
Mepine	21.5	8.6	20
Mondlane-Lomaco	42.4	0.7	31
Nacimoja	34.2	1.4	21
Nacololo	0.8	0.7	19
Nacuaia	57.0	2.9	21
Nacuca	33.6	8.8	44
Namacopa	3.6	0.7	22
Napipine	23.7	3.9	14
Napita	17.2	2.2	21
Natete	27.1	5.4	18
Picadane	2.8	1.7	14
Varrua	31.4	2.2	20
Total	29.6	4.9	371

RAIN4: Share of land with lack of rain per household (in % of total cultivated land). The data is weighted using WEIGHT2. N refers to the unweighted number of households.

Source: FSP data and own calculations.

Chapter 4: Land Access

4.1 Introduction

This chapter will analyse the nature of land access and quantitative land use by peasant households in the post-war period. It will be found that the area cultivated varies more strongly across households than would be expected under conditions of land abundance. However many households can freely adjust their land use to their labour supply, suggesting that the observed degree of land inequality in Mozambique is not due to a lack of land. Instead this chapter will show how household-specific effects determine the degree of land access so that land abundance can be re-defined as a household-specific concept. This holds particularly in the post-war context as the war strongly shapes the remaining land access and other production constraints and production alternatives.

The analysis will include a detailed look at land tenure arrangements. Land tenure refers to the system of rights, relations and institutions constituting the nature of property rights over agricultural land by individuals, households, kinships, villages, firms, or the state (Binswanger et al 1995: 2666-8, Feder and Feeny 1991: 136-7, Maxwell and Wiebe 1998: 4). There can be tree, grazing, gathering, hunting, water, and trespassing tenures all controlling the nature of property rights for these related aspects of agriculture. There can therefore be overlapping systems of tenure for overlapping features of the agricultural system (e.g. different households may have tenure to a field and trees which are occupying the same space, Bruce et al 1993).

A specific area of land and its use will have one of the following, mutually exclusive property rights assigned to it at any point in time: private, communal, state or no property rights (i.e. open access land). Agricultural land has one of these mutually exclusive statuses: it is either unclaimed (or new or virgin), cultivated, fallow, or abandoned land. Typically cultivated and fallow land have clear property rights while unclaimed and abandoned land may have no clear property rights defined.

Land tenure security refers to the perception, by households, of the duration of rights held, the scope of these rights, and the degree of assurance institutions provide for current and future land tenure rights (Place et al 1994: 19-21). Land tenure insecurity thus differs from land title ownership (Roth et al 1989: 211), which is more frequently analysed in empirical studies. Tenure insecurity has been measured in the FSP survey and will be analysed in detail in the next chapter.

Two methodological problems warrant some caution in the interpretation of the results. First, most of the FSP data refers to the period 1994-95 but some describes the subsequent

agricultural year so that the periods of observations are not always completely aligned. This may lead to the underestimation of some empirical observations. At times, the different periods of observation can be used to improve the quality of the analysis, for example to exclude endogeneity biases (as first period effects clearly cannot be caused by second period events).

Second, the observed link between the war legacy and post-war outcomes and behaviour is weaker or less obvious or less clearly defined by the available data than expected. The FSP dataset, for example, does not record the nature of the war legacy on labour availability, for example through disability or death. The refugee variable is also not well defined. Yet such effects (or variables) were expected to be statistically significant. This data problem may also lead to an underestimation of the link between war and household behaviour. These problems occur throughout the analysis presented in this thesis. However, given that some war effects will be found to be significant in later chapters, these words of caution may serve to suggest that the actual effects of the war legacy might be more severe still.

The chapter will start with an assessment of the importance of land in the post-war economy, which is based in part on the relatively low war vulnerability of land. These observations will suggest three broad hypotheses which in turn motivate a discussion of a standard economic model of land use and an econometric specification of that model. The expected signs of the specification are reviewed in detail in section 4.4 while the next section discusses the regression results. Section 4.6 will summarise the main findings of this chapter.

4.2 The Role of Land in the Post-War Economy

There are six reasons why land is a key input and plays a key role in the post-war economy. First, land is the least war-vulnerable factor of production, making it the central part of household war-time coping strategies. Second, the effects of war on land transactions and endowments may help to explain the paradox of parallel land inequality and land abundance observed in northern Mozambique. Third, household welfare may be directly dependent on household land endowments with imperfect land markets, an issue that will be revisited in chapter 7. Fourth, one of the most heated post-war economic policy discussions in Mozambique has concerned the reform of the land tenure legislation, without much evidence being presented in the debate. This discussion will analyse the determinants of land tenure insecurity. Fifth with agriculture playing such a dominant role in Mozambique, post-war reconstruction depends on generating endogenously an increased rate of investment. Such investment may in part occur in land assets, especially as these are

less vulnerable to war, theft and disaster. Finally, land is at the heart of the causes of the war and at the efforts to resolve the war and share the benefits of peace equitably.

Land plays a special role in the post-war rural economy. From a theoretical point of view, land should be the key component of post-war household coping strategies as the war in Mozambique had, comparatively speaking, the least effect on land. Land is the least war vulnerable factor of rural production, being immobile and not fragile. In addition, its inherent productive aspects cannot be destroyed or eroded directly, especially as its use is strongly reduced in war-affected areas.

Indirectly, land productivity is more likely to erode during a war if the productivity of the soil depends on the soil being part of a more complex and fragile eco-system or on continued investment in soil quality. War-induced deforestation may thus lead to soil erosion and reduced soil productivity. It is thus an empirical question to what extent war accelerates deforestation compared the a peace-time economy. Given the nature of the war in northern Mozambique, it seems probable that war did not have a strong direct effect on soil quality. Rather, the post-war period has seen an increase in, for example, charcoal trading activities which have been affecting the degree of forestation in northern Mozambique.

An indirect and negative effect of war on soil quality may also have occurred through the gathering of refugees in a few relatively safe, urban areas where the dramatically increased population density may have induced excessive use of land for agricultural survival activities, thus causing a rapid decline in soil quality. Given that most survey areas experienced a low degree of security during the war, such effect is unlikely to have occurred in the sample analysed.

Land can most easily be devalued through the planting of land mines. This was done frequently and widely in Mozambique. On the one hand, if the exact distribution of the mines is not certain, the planting of only a few mines will increase insecurity and uncertainty significantly and will devalue large areas of land. Returnees in particular may be unaware of mined areas and children and livestock are at a high risk of accidentally stepping on mines by leaving safe areas or passages. This suggests that the clear demarcation of possibly mined areas and public information campaigns, especially among refugees and in schools, can yield large dividends by reducing mine-induced death and disability.

On the other hand, most land mines do not kill, in particular they tend not to kill local, adult residents. This applies even more to those who did not leave their areas during the war as they may know which land remains safe. Mine victims are thus mainly post-war

returnees, children playing in unknown areas, and people attempting de-mining. This pattern suggests that a key issue in the analysis of the effects of land mines is the distribution of their costs (as well as of their perceived benefits when produced and planted).

Furthermore, in a land abundant country, reducing the supply of land is not a significant economic constraint in the immediate post-war period. It has been estimated that post-war agricultural production in the absence of land mines would have increased by only 3.6% in Mozambique versus 88% to 200% in Afghanistan and Cambodia where arable land is generally considered to be less abundant (Andersson et al 1995, Human Rights Watch Arms Project 1994).

This view was also supported by interviews in Maputo with mine-clearing staff working in Mozambique in 1995, who thought that public information and mine mapping exercises were more useful and cost effective than very large scale mine-clearing programmes. Given this balance of the costs and effects of mines in Mozambique, and noting that different types of mines, wars and environments may have different economic effects, this analysis will not concentrate on the analysis of mines on land in Mozambique.

Given the relatively low war vulnerability of land, one could expect households during the war to increase their dependency on land-based strategies and for much of the post-war reconstruction effort to depend on surpluses derived from the use of land. The analysis in this chapter will thus also motivate and explain the subsequent analysis of household activity choices in chapter 6.

From an empirical point of view, it is puzzling why northern Mozambique, with its low population density and favourable agricultural conditions, should have a relatively high degree of land inequality, which contradicts the assumptions that land is abundant and that land access is informal. The degree of land inequality will be assessed in more detail in the results section below, but one possible hypothesis explaining this puzzle is that the war changed the land allocation thus creating war beneficiaries and war losers with respect to household land endowment. Moreover, with higher post-war transaction costs for land transactions (Besley 1995b), there has been a continuing mismatch between the demand and supply of land, hence maintaining land inequalities.

Another empirical reason for analysing the role of land in post-war reconstruction is the role of land ownership in explaining household welfare outcomes (Maxwell and Wiebe 1998). In a perfectly competitive peace-time economy, the allocation of land may not affect household welfare if each household rents-in (-out) the land (not) needed for household production, in accordance with household comparative advantage and market prices. Such

an assumption has been reflected in previous empirical studies of rural household welfare in Mozambique. In fact, it may be that this assumption has driven the subsequent finding that land is not a key determinant of household welfare in rural Mozambique (see, e.g., IAF 1998).

However, household welfare depends on the exogenous distribution of land if the war-induced market imperfection (including in the land market) and land inequality are significant and with land having a low degree of war vulnerability. The effects of land on household welfare will be analysed in more detail in chapter 7, which will argue that land is a key and previously undervalued determinant of household post-war welfare. This chapter will help to understand the role of land in rural agriculture, how households determine their land allocation, and how they use land.

Another reason for analysing the role of land in the post-war economy is that land policy has been one of the key policy issues in Mozambique in recent years.[31] Some analysts have argued strongly for reforming the land tenure legislation in order to enhance property rights and poverty alleviation measures. Others have seen land as being relatively less important thus stressing the role of labour, capital, infrastructure or rural markets instead. However, as little empirical analysis has been done on the role of land in the post-war context, policy analysts and policy makers are left to base their claims on scant evidence.

Investment in land is a key component of post-war reconstruction and rural poverty alleviation, especially with 71% of the Mozambican population living in rural areas and 81% of the national labour force working in agriculture (Brück et al 2000). With the severe destruction of rural assets in the war (chapter 3), rural households must increase their level of agricultural investments to increase production yet they have few resources to do so. Land investments, area farmed and perhaps even tenure insecurity may thus be simultaneously determined processes, which may jointly affect household welfare. The nature of this issue of simultaneity and endogeneity will thus also be analysed in more detail in the sections below.[32]

Land also matters in the post-war economy because land issues were at the heart of the nature of the war in Mozambique (chapter 3). While the first military actions in the post-independence war did not originate from within Mozambican society, the duration and

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[31] See the references cited in chapter 3.

[32] This analysis will thus build directly on the discussion of the endogeneity of tenure status and land investment in Besley (1995b), Foltz, Larson and Lopez (2000), and Place and Hazell (1993).

intensity of the war can only be accounted for if endogenous Mozambican issues are also seen to contribute to the causes of violent discontent. Past policies including the forced villagisation of households and the treatment of traditional authorities helped create disagreement with the role and direction of government policies in the 1980s in northern Mozambique (Geffray 1991).

Furthermore, the resolution of the war and the stability of the peace depend on the ability of agricultural land to support more and larger households, as demobilised soldiers and refugees (who were often landless during the war) were expected to return to their place of origin and to earn their own living as they only received limited social security benefits (Schafer 1999). Thus the causes of war and the ability of the Mozambican society to return to peace are intrinsically linked through the flexibility of its existing land tenure institutions and through the potential of land to feed the population.

These six reasons for land playing a key role in the post-war economy have strong implications which conform only in part with the predictions of the BM model. First, both the war circumstances and the BM model suggest that there are no landless households in rural areas (Binswanger and McIntire 1987: 76). As argued above, this result is even more likely to obtain during the war, in part because landless households in a high transaction cost economy have no sustainable income sources and must thus flee to safer urban areas or abroad. The dependent variable AREA45 (measuring land endowments per capita) should hence be positive for all households (as tested below).

Second, the BM model would suggest that in a land-abundant environment there is a static land-labour ratio across households after controlling for soil quality. In other words, there was no land inequality (Binswanger and McIntire 1987: 77). However, the post-war model of chapter 2 indicated that, as in the Chayanov model, individual household consumption requirements will determine the value of leisure and hence the amount of land a household will farm. Thus additional controlling factors (such as household consumption requirements, labour availability and productivity, and market access) are required for the analysis of area farmed in a post-war rural economy.

Third, the diverse effects of war and the resulting variability in the subjective value of leisure, in asset endowments and in transaction costs suggest that the area farmed will not be similar across households in the post-war period. In other words, it is hypothesised that household characteristics such as household size will be significant determinants of area farmed per capita. If such hypothesis was true, it would explain the apparent paradox of land inequality in an area with general land abundance.

More generally, the many long-lasting effects of war are expected to strongly affect the economic development process for rural smallholders in northern Mozambique. The war legacy is therefore an important determinant of household behaviour as will be shown for the case of land access in this chapter and for land tenure insecurity and land investment in the subsequent chapter.

4.3 Data and Econometric Considerations

These issues may be tested more formally by considering a variant of the post-war model proposed in chapter 2. This variant is also the standard framework with which the agricultural economics literature describes the determinants of land access and land use and was first proposed by Place and Hazell (1993: 10-1).[33] The Place and Hazell (PH) model is useful for focusing on the nature and direction of causality of the key land variables (e.g. between land access and land tenure insecurity) and for providing an explicit framework from which to derive econometric specifications. This chapter will outline the first part of this model (which explains land access) while chapter 5 will continue to develop the model for the determinants of land tenure insecurity and land investment.

Specifically, consider the utility maximisation problem of a peasant household where utility is a function of output and leisure and where the household can determine area cultivated (A_i), investments in land (I_i) and their tenure perception (T_i). This approach effectively expands the production side of the BM model (i.e. the conversion of labour resources into output Q) as introduced in chapter 2 and adds the three interdependent aspects of peasant household production area farmed, land investment and land tenure perception. Labour resources are allocated to these factors which in turn determine final output Q.

Assuming that the underlying functions have desirable properties and that an internal maximum can be obtained, then the constrained maximisation of preferences will yield a set of reduced form equations (Baland et al 1999: 14, 27, Behrman and Deolalikar 1988: 646), with the additional constraint that the employed labour supply may not exceed the household labour endowment. Note that all exogenous, predetermined and some lagged variables can enter the reduced form equations (chapter 3).

Given the above discussions of the role of household characteristics and endowments in determining post-war production choices, the cultivated area per household (A_i) is then determined by household labour ($\mathbf{L}_{Ai}$) endowments, field characteristics ($\mathbf{F}_{Ai}$), asset

endowments ($\mathbf{K}_{Ai}$), village level constraints ($\mathbf{V}_{Ai}$), investments in land (I_i), and the perception of land tenure insecurity (T_i). This suggests the following hypothesised structural model:

$$A_i = f(\mathbf{L}_{Ai}, \mathbf{F}_{Ai}, \mathbf{K}_{Ai}, \mathbf{V}_{Ai}, I_i, T_i) \quad (4.1a)$$

where the subscripts i and A respectively denote the households i = 1...N and the area-specific variables for each of the vectors **L**, **F**, **K**, and **V**. Land investments per household (I_i) and household tenure insecurity (T_i) have been included in this specification as they may endogenously determine the area cultivated (A_i). For example, households may face a trade-off between extending the quantity of area farmed and improving the quality of that area as both require labour and asset inputs. Furthermore, households experiencing a high degree of tenure insecurity may prefer to seek more off-farm income opportunities thus reducing the area farmed. The specifications of the equations for I_i and T_i will be briefly summarised here, to assist in the derivation of the reduced form equation for cultivated area. Their detailed specifications will be discussed in the subsequent sections.

Tenure insecurity is a function of a set of exogenous household endowments, field characteristics, asset endowments and village-level constraints, as well as area farmed and investment in land:

$$T_i = f(\mathbf{L}_{Ti}, \mathbf{F}_{Ti}, \mathbf{K}_{Ti}, \mathbf{V}_{Ti}, A_i, I_i) \quad (4.2a)$$

where the subscripts i and T respectively denote the households i = 1...N and the tenure-specific variables for each of the vectors **L**, **F**, **K**, and **V**. Land investment is in turn a function of a set of exogenous household endowments, field characteristics, asset endowments and village-level constraints, as well as area farmed and tenure insecurity:

$$I_i = f(\mathbf{L}_{Ii}, \mathbf{F}_{Ii}, \mathbf{K}_{Ii}, \mathbf{V}_{Ii}, A_i, T_i) \quad (4.3a)$$

where the where the subscripts i and I respectively denote the households i = 1...N and the investment-specific variables for each of the vectors **L**, **F**, **K**, and **V**. This set-up deliberately does not specify credit or yield equations. Chapter 3 argued that there are virtually no formal or recorded credit transactions in northern Mozambique unlike in other economies where secure land is used as collateral to obtain credit (cf. Besley 1995b, Feder 1987). A yield equation has been omitted as no suitable data for plot-level yields is available in the FSP dataset. This is mainly the result of households practicing intercropping for all crops except cotton (which is not grown by all households).

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[33] See for example Baland et al (1999), Foltz, Larson and Lopez (2000: 6-7), Hayes, Roth and Zepeda (1997: 370-1), and Place, Roth and Hazell (1994: 29).

If the exogenous determinants are not identical across all three equations above, then substituting for A_i, T_i and I_i using these different exogenous instruments will yield a set of reduced form specifications which summarise the joint effects of demand- and supply-side factors on household land decisions (cf. Place et al 1994: 28-9):

$$A_i = g(\mathbf{L}_{Ai}, \mathbf{F}_{Ai}, \mathbf{K}_{Ai}, \mathbf{V}_{Ai}, \mathbf{Z}_{Ii}, \mathbf{Z}_{Ti}) \quad (4.1b)$$

$$T_i = g(\mathbf{L}_{Ti}, \mathbf{F}_{Ti}, \mathbf{K}_{Ti}, \mathbf{V}_{Ti}, \mathbf{Z}_{Ai}, \mathbf{Z}_{Ii}) \quad (4.2b)$$

$$I_i = g(\mathbf{L}_{Ii}, \mathbf{F}_{Ii}, \mathbf{K}_{Ii}, \mathbf{V}_{Ii}, \mathbf{Z}_{Ai}, \mathbf{Z}_{Ti}) \quad (4.3b)$$

where the vectors $\mathbf{Z}_{ji}$ denote the exogenous determinants of j for j = A, T and I such that $\mathbf{Z}_{Ai} \neq \mathbf{Z}_{Ti} \neq \mathbf{Z}_{Ii}$. Using such a reduced form model is appropriate in this context as the absence of fully functional wage labour markets makes the model non-recursive (Singh et al 1986b: 21-2). In addition, the reduced form specification requires less data, which is helpful as the FSP survey did not record wage rates, other input costs or household time allocations (chapter 3).

The specification of equations 4.1b to 4.3b thus includes a broad set of household and asset endowments and controls for differences in field characteristics and in community-level endowments and constraints. If the key hypothesis (stating that the war affected preferences and raised land transaction costs and thus induced differences in land endowments across households) is correct, then many of these variables should be significant, especially if they have been strongly affected by the war.

The FSP dataset does not include as many land tenure variables as some other datasets used in the literature cited above. In particular, the method of land acquisition is not known, and this has been a significant variable in other study contexts (Place et al 1994: 30). However, this variable is likely to be of less concern in the northern Mozambican case as the relative land abundance, the weak formal legal institutions, and the uncertainty induced by the war implied that the majority of households acquired communal land. In some districts the majority of households even acquired previously not cultivated communal land (chapter 3). This means that the institutional history of each plot is less likely to determine current land investment and tenure perception and that the variation in that institutional history across plots is likely to be very small.

Furthermore, the FSP dataset includes a variety of social capital variables which will identify the social position of each household in the village. This in turn will control for a household's past land tenure position and prevent the current land tenure perception to be influenced by an otherwise unobserved past process of self-selection where, for example, more powerful households choose more fertile or more secure land (Place et al 1994: 27-8). Another way to control for such effects would have been to collect multiple observations

per plot and per household but the nature of the FSP dataset does not allow such panel data techniques.

These considerations suggest the following econometric specification for equation 4.1b:

$$A_i = \alpha_0 + \alpha_1 \mathbf{L}_{Ai} + \alpha_2 \mathbf{F}_{Ai} + \alpha_3 \mathbf{K}_{Ai} + \alpha_4 \mathbf{V}_{Ai} + \alpha_5 \mathbf{Z}_{Ii} + \alpha_6 \mathbf{Z}_{Ti} + e_{Ai} \quad (4.1c)$$

where e_{Ai} is an error term which is not correlated with the exogenous variables thus yielding unbiased and consistent estimates for the vectors of coefficients α_h. The RHS variables in 4.1c take a linear or log-linear form as defined for the case of each variable in chapter 3. Furthermore, some variables may be entered both in their linear and in their quadratic forms if non-linear effects are suspected a priori. Indeed, for the case of household size the analysis below will address the difference between the log and quadratic specifications. The final variables used will be discussed in more detail in the results section below.

Using OLS on such a reduced form specification generally incurs some loss of statistical efficiency but not of consistency thus making OLS a useful technique (Singh et al 1986b: 22). In Stata 6, this can be implemented with the 2SLS technique using the "svyivreg" command (StataCorp. 1999: svyivreg). In a model with a good $\mathbf{Z}_{ji}$ vector, the predicted and the actual values for T_i or I_i may be very close, thus OLS and 2SLS will result in similar coefficients. While the endogeneity of A_i, T_i, and I_i is suspected as argued above, exogeneity will be tested explicitly in the results section below. The final econometric specification may thus result in zero coefficients for α_5 or α_6 in equation 4.1c.

4.4 Expected Signs of the Determinants

This section will review the expected signs of the determinants of land access at the household level. It will focus on household characteristics as a test of the post-war land abundance hypothesis. The section will also review the effects on land access of household asset and technology endowments, social capital, and community-level variables.

Testing the Post-War Land Abundance Hypothesis

In figure 4.1, the joint labour supply and consumption effects (also discussed in chapter 2) are simulated for the life cycle of a standard peasant household. The household comes into existence with a single 20-year old man and grows through marriage and the birth of children thus first increasing consumption requirements X_{min} and later also labour availability L_{max}. The couple's children (of which there are 5 in this example) over time set up their own households and only the old couple remain. The key result is that there will be a period of low valuation of leisure (peaking when the household head is aged 35 years in

this example) while the children are young, inducing the parents to increase their on-farm labour supply.

With the war having reduced the scope for profitable off-farm income opportunities, increasing the effective on-farm labour supply results in an increase in area farmed. The effective labour supply is thus related to two measures. With land abundance, more household labour and an equi-proportionate increase in household consumption requirements should leave the household land-labour ratio unaffected (disregarding economies of scale, the transaction costs of clearing new land, and the effects of seasonality). However, for a given household labour endowment with increasing household consumption requirements, the effective household labour supply will increase. It is thus important to control in the regressions below for household life cycle effects, labour supply and consumption requirements. This will be done by including the age of the head of the household in the analysis.

While controlling for household consumption requirements, it is expected under the null hypothesis of post-war land abundance that a higher labour endowment will increase the area farmed per household, therefore leaving the area farmed per capita constant. While it may be difficult to decompose the role of war, land abundance, economies of scale, and transaction costs on the coefficient of household size, this is nevertheless the strongest test for land abundance given the available data.

Other Exogenous Variables

In addition to the above test of the BM model and its prediction of land abundance, the variables used in the regression can help explain the actual determinants of land use. The following paragraphs will summarise the expected effects of exogenous variables (other than household size and composition) on the natural log of the size of cultivated land holdings in hectare per capita in 1994-95.

Higher human capital may have a positive effect on a household's cultivated land holdings, as the better management of the farm and the higher quality of tasks undertaken could improve farm efficiency and productivity, thus permitting a larger area to be farmed per capita. In the unlikely case that a household has a fixed output target (incorporating its expected consumption needs in a risky environment during the hungry season), better farm management will result in lower area farmed. Such target may have existed during the war while a household operated in complete autarky. Furthermore, more human (or physical capital) may also encourage non-agricultural production strategies. Overall, the net effect of increased human capital on the demand for more land is therefore ambiguous.

Higher soil quality, fewer crop pests and adequate rainfall should allow the household to achieve higher output for a given labour output and should thus reduce the average land/labour ratio. However, the effect of soil quality on the area farmed may be dependent on the extent to which the quality of new land is known ex ante. On the one hand, better soil quality of existing land may reduce the need for future land expansion while, on the other hand, better soil quality may also provide the surplus required to buy new tools and seeds which permit the expansion of the farm size.

Some agricultural land was forcibly or by choice unused during the war because some areas were to dangerous and because households chose to reduce the scale of farming (chapter 2). Such fallow land may have maintained its soil quality. Yet during the war, household and government investment in land quality was much reduced. For example the killing of livestock reduced the availability of manure for fertilising the soil. Land which has been farmed continuously throughout the war, for example relatively safer land near the villages, may currently be of poor quality thus increasing the need of these households for more land. Given the low level of post-war agricultural input use, land quality becomes an important determinant of agricultural productivity and thus of household land choices, and one would expect this variable to be significant. Yet the sign of the coefficient in this equation appears indeterminate a priori, given the various possible interpretations of soil quality.

Better household technology as represented by more and more varied household tools and nearby grain and oil mills can be expected to lead to higher household land holdings as the negative effects of seasonality (and hence the diminishing returns of planting and weeding outside the climatic optimal time) can be offsets with, for example, fertilisers, better tools, or new crop varieties suited to milling. With average household technology being low in the aftermath of the war, a higher availability of tools or more access to processing technology (e.g. mills) should result in relatively large effects on area farmed.

More past assets and a smaller cyclone shock could have similarly positive effects and may increase the amount of farmed land per household. However, with increasing off-farm income opportunities asset-rich households may increasingly reduce the area farmed and start to earn an increasing share of household income from non-farming activities. The above predictions are based on constant off-farm profit-opportunities.

A household which is related to a community leader or a household whose head is himself a political or traditional community leader should have improved land access and hence an increased land/labour ratio. In addition, household area farmed may be affected in the post-war period by unusually high costs of negotiating land access in both the formal and

the traditional land tenure systems. The fragmented nature of a war-affected society and with competing claims for community leadership originating from different groups, the costs of procuring, clearing and preparing land or of maintaining land access are high and households may find it difficult to forecast if these costs are likely to fall in the near future. Thus it is important to consider a variety of variables which may have an impact on such transaction costs, such as if a household is a refugee household, if a household is female-headed, if husband or wife were born locally, or if the household has ancestors buried locally.

The total cultivated area per household worker for each household is limited by a variety of factors (Binswanger and McIntire 1987: 81). First, the hiring and supervision costs of off-farm labour reduce the optimal land-labour ratio. These costs are higher in the post-war period when the labour market density is still low and enforcement costs high (e.g. due to the absence of trust built up over many years). Second, the diminishing returns based on seasonality reduce the ratio, as they imply that later planting times are less productive. Such effects of seasonality are more marked after a war when input markets (e.g. for fertilisers) are still weak. Third, the low marginal utility to effort given the low density of markets and the resulting features of the BM model reduce the land-labour ratio. As war increases the economic isolation crucial to the BM model, this marginal utility effect is also significantly enhanced. These three factors suggest that population density, labour market, and output market indicators will be significant determinants in the land access regression.

Assessment and Outlook

From a theoretical perspective, this approach is important because it aims to integrate a more detailed view of the production process into the BM model. This can help to determine the nature of post-war reconstruction at the household level. The above analysis thus indicates possible transmission mechanisms of the war legacy on micro-level decisions. By considering land area, land investment and tenure insecurity to be potentially endogenous (as discussed in chapter 5), the decision between different growth paths is made explicit at the household level.

One the one hand, farm households may extend the extensive margins if land is abundant and if the household has enough appropriate resources to do this. On the other hand, a farm household could intensify its agricultural production if its individual war legacy better prepares the household for such a course. These alternative growth paths may have very different implications for food security, rural poverty alleviation and income distribution in northern Mozambique.

In particular, if exogenous and locational differences in endowments and transaction costs significantly affect production choices, then growth may become unbalanced across different districts of a given province. Government and donor agencies may thus wish to equalise economic opportunities across districts wherever feasible. These household production choices should therefore be seen in conjunction with those of chapter 6, which addresses off-farm income and market participation decisions.

From an empirical perspective, this discussion addresses a key policy paradox in Mozambique, namely the divergence between a suspected general land abundance (as suggested by a relatively flexible access to land) and the inequality in land holdings across households. The theoretical discussion so far emphasises the likely role of the war legacy in explaining this paradox.

4.5 Results and Discussion

This section will review the key findings of the econometric analysis of land access. It will be found that the paradox of land abundance with land inequality can be explained with the augmented, post-war BM model. Furthermore, it will be shown that land abundance is a household-specific concept. This differs from the way land abundance has been viewed traditionally in the literature. Whether or not a household is land constrained or not is determined by its experience of the war and its individual characteristics. Households thus choose extensive or intensive farming strategies but the use of an extensive farming strategy may not allow households to escape from long-term absolute poverty. Note that a complementary analysis of changing patterns of land distribution across time, which is based on a large number of data sources, is presented in appendix A.2.

Choice of Dependent Variable

The determinants of land holdings at the household level will be analysed here using primarily the dependent variable AREA35, which is defined as the natural log of cultivated area per capita per household in 1994-95.[34] On the one hand, a measure of cultivated area per household may have been preferable as the dominant unit of analysis in this thesis is the household. On the other hand, and as argued in more detail in chapter 7, the per household, per capita and per ACE specifications all attach varying weights to household size and composition, thus making implicit assumptions about economies of scale and equivalence weights.

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[34] See chapter 3 for a discussion of the (probably small) degree of measurement error of this variable.

Given that the per capita specification has been adopted for the poverty analysis, it seems a natural extension to consider land use on a per capita basis while also comparing the results with alternative per household specifications further below. In addition, the per capita specification seems preferable for the analysis of land abundance as under an extreme form of land abundance (but in the presence of functioning markets) one might expect the per capita endowment of land to be constant irrespective of household size.

The dependent variable is also available for the agricultural season 1995-96. However, in a preliminary regression analysis this variable yielded significantly reduced R^2 values, a result of many land-related variables having been collected in 1994-95. The accuracy of these two dependent variables is likely to be high, but the mismatch in time periods between the dependent and independent variables appears to cause significant problems in the regressions for 1995-96.

There appears to be quite a large degree of change in area cultivated, fallow area and total area between these two seasons (figure 4.2). While a fifth of all households do not vary the area cultivated per household between 1994-95 and 1995-96, the area cultivated per household declines by 10% in that period. However, this change is not statistically significant. The change in area farmed per capita is larger still but it is not significant, either. Interestingly, the fallow area, however measured, changes dramatically between these seasons as does the total amount of land controlled per household. Note that unlike in more densely populated areas or in countries with more formal property rights, households can claim new land for various uses or may find it profitable to abandon land entirely, thus explaining such strong changes in total farm sizes within such short period. Overall, these changes suggest that farm size, as measured variously by area farmed or controlled, is indeed a choice variable for households and that all households cultivate significant areas, i.e. that there is no landlessness at the household level.

The analysis below focuses on cultivated area and not on total area as the former has the greatest effect on production and welfare outcomes for a farm household. The dependent variable will be expressed in its natural log form as this transforms the variable into a near-normally distributed shape (figure 4.3) and assists in the interpretation of some of the independent variables. Figure 4.4 summarises all the definitions and names of the cultivated land endowment variables used in this chapter.

The regression summarised in figure 4.5 has a very good fit with an R^2 of 0.69 and is highly significant. Using variance inflation factor (VIF) analysis, no evidence of multicollinearity could be identified (see also chapter 3). While some coefficients are not significant individually at the usual levels of significance, each of the following group of variables is

jointly strongly significant: household characteristics (including education variables), land control variables, asset and technology variables, village and market characteristics, and village categorical variables. Their effects on the dependent variable will be discussed in this order below.

Household Size

The key variable of interest in the regression is MEMND01L which is the natural log of the number of non-dependent (i.e. potentially working adult) household members in 1994-95. Given the log specification, its coefficient can be interpreted as an elasticity. Recall that the joint assumptions of land scarcity and flexible markets would imply a land endowment elasticity of household size of about -1 (i.e. a larger households farms no extra land) while the joint assumptions of land abundance and flexible rural markets would imply a land endowment elasticity of household size of near zero (i.e. a larger household expands the area farmed correspondingly). In fact, the estimated coefficient is -0.47 and it is highly significant (figure 4.5). This implies that a 10% increase in non-dependent household members would lead to an approximate decrease of 5% in the area farmed per capita.

This result for MEMND01L is therefore half-way between the land scarcity and the land abundance assumptions. Just as the analysis of the various household surveys indicates a great degree of simultaneous land inequality and flexibility in land endowments (appendix A.2), this result suggests that neither assumption can fully account for the limited but significant degree of responsiveness of land allocation to household size.

This result instead points to the important role played by economies of scale in household size, the transaction costs in searching for, acquiring, clearing and planting new fields, and the diminishing returns of extending farm size with seasonality (Binswanger and McIntire 1987: 81). These factors help to explain why, for example, a larger household would not choose to adjust its area farmed to maintain the previous land-labour ratio. With economies of scale in household size it is instead possible to achieve the same output level with a lower mean labour input. Therefore the intended output can be achieved without a one-to-one increase in farm size.

Furthermore, there are likely to be fixed costs to expanding farm size such as the cost of acquiring land (e.g. the cost of petitioning local authorities for granting access to communally managed land) and clearing previously unfarmed land. With strong uncertainties surrounding future household sizes in the post-war period (e.g. due to poor health and an increasing degree of physical and social mobility), heads of households may find it unprofitable to invest in increasing their farm size if the increase in household size is

transitory. Taken together, these factors can reduce the incentives to maintain a fixed land-labour ratio, implying a smaller elasticity in absolute terms.

Further explanations for the observed elasticity may be imperfect control variables included in the regression, for example for worker ability and health, household technology, soil quality, and labour and output markets. These will be discussed later in this section.

Comparing the logarithmic specification for household size with the quadratic specification of household size which uses the two variables MEMND01 and MEMND02, the fit and most coefficients are practically identical (data not shown). The main difference is the effect of the household size variables on land endowments, especially for very small and very large households (figure 4.6A). Given the shape of the logarithmic transformation of the MEMND01L variable, a small increase in household size has a large (negative) effect on land endowments for very small household sizes but the marginal effects increasingly diminish. The quadratic specification using the linear term MEMND01 and its square MEMND02 have more subtle effects on smaller households, an almost identical effect to MEMND01L on medium-sized households and, eventually, a positive effect on very large households as the minimum of the curve is found at 11.6 non-dependent household members.

Both specifications thus find that very large households experience a smaller reduction or even an increase in per capita land endowments. Even if this effect only applies to the largest households representing about 5% of the sample, it supports the view that land is not scarce per se in northern Mozambique, as otherwise the largest households should face more serious reductions in their land endowments per capita.

The variables MEMD01 and MEMD02, which measure the number and squared number of dependent (i.e. very young or very old and non-working) household members respectively, have the jointly significant coefficients of -0.016 and -0.011.[35] This suggests that each additional dependent household member reduces the per capita endowment of land by an increasing amount. In other words, the household augments at a decreasing rate its overall land endowment for each additional dependent household member. This is illustrated by the dashed line in figure 4.6B.

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[35] As a significant number of cases in the FSP survey do not have any dependent household members, the variable MEMD01 was not transformed into a natural logarithmic variable, as this would have converted cases with zero values into missing cases.

This observation is supported by the coefficients for MEMD01 and MEMD02 in the regression for the natural log of cultivated area per household, AREA55 (regression not shown). The linear coefficient is 0.176 and the quadratic coefficient -0.024, the maximum is at 3.7 dependent household members, and both coefficients are individually and jointly highly significant. Their effect on land per household is illustrated by the continuous line in figure 4.6B. Unlike for non-dependent household members, the marginal increase in household land endowments diminishes for additional dependent household members.

This may be related to barriers to entry into land where local authorities place little extra value on households with many dependent household members (versus households with fewer dependent household members). In addition, households with many dependent household members will face decreasing returns from increasing the land-labour ratios thus reducing the incentive to work even more land per capita. Alternatively, households with many dependent households members find non-land related income strategies preferable, for example by combining home production with the supervision of young children. Without further data on the value and allocation of home versus farm time it is difficult to know why the observed patterns of land allocation have been chosen by households.

Overall, these results indicate that there is a life cycle demand for land which is likely to result from incomplete markets for inputs and outputs in the post-war period. Additional non-dependent household members do diminish the per capita land endowments of the household. However, with increasing household size this effect is itself weakened rather than re-enforced as would have been expected if this result had been driven only by land scarcity. Furthermore, households take into account their overall calorie requirements when deciding on their land requirements, though households do not increase their land endowments uniformly for ever larger numbers of dependent household members.

In the terminology of the BM model, these results suggest that an increase in the maximum leisure availability of the household (L_{max}) has a real production effect, i.e. that labour is a real constraint in agricultural production. This implies that households in figure 2.3 operate on a point B" much closer to the right of the slope A"B"C" than shown. Hence peasant households appear to pursue a strategy which extends the extensive margin where labour is a key factor of production. Increasing the net calorie requirements per worker by increasing the number of dependent household members (i.e. shifting up X_{min}) has a negligible effect. Households thus appear to operate quite far from the X_{min} barrier (i.e. the shift from B' to B" implies a correct move away from the survival constraint) which would imply that basic food security may have been relatively assured in the sample area in 1994-95.

Other Household Characteristics

Another indicator of the land-labour ratio changing throughout the life cycle of the household is the age of the household head (AGEHEAD1) and its square (AGEHEAD2). Both variables are individually and jointly highly significant and their joint effect peaks at 62 years, which is exceeded by 5% of the sample. This implies that land endowments per capita are rising almost throughout the lifetime of a household and do not fall as dramatically as had been simulated in figure 4.1. This confirms that seniority is a strong determinant of land access within Macuan society (Marule 1998: 73).

Households with more females (FEMALE2) for a given household size have less land on average. In fact, the elasticity for this effect is -0.18, so that a 5% increase in the ratio of females to males results in a reduction of area farmed per capita of about 1%. Given a mean of 0.47 (incidentally implying that there is no war-related female "overhang" in the population distribution) and a large standard deviation of 0.17 for this variable, such elasticity can in practice have significant effects.

In addition to the pure gender factor, female-headed households (FEMHEAD1) have less land per capita than male-headed households. Male-headed households farm on average 0.44 ha per capita while female-headed households farm on average 0.23 ha per capita. A number of factors could explain this strong difference. Female-headed households either have less of a comparative advantage in land-based coping strategies, work the land more effectively, or are disadvantaged in the land allocation process (that is they may face higher transaction costs in acquiring land). The latter factor corresponds with common beliefs of aid workers and policy analysts in Mozambique. This suggests that female-headed households, even more so than households with many females but with a male head, are highly vulnerable to war and extreme poverty due to an inefficiently low stock of land endowment. These issues will be investigated in more detail in chapter 7.

The REFUGEE1 variable is insignificant which is not surprising given its definition as discussed elsewhere. ILLDAYS1 has a negative and significant coefficient so that households with more time lost through disease cultivate smaller areas. TIME11 and TIME13 on the other hand have positive coefficients but both are quite small. Households in areas where firewood and water collection require less time thus cultivate larger areas. This is perhaps related to these areas experiencing more drought and soil erosion (i.e. large natural production risks) so that households insure against a possible loss of crop by increasing the area planted. These variables thus appear to proxy not for a household time constraint, as was postulated in the theory section above, but for unobservable environmental risk factors.

Finally, the last household characteristics are the mean educational achievement per capita in years (EDUHH3) and its square (EDUHH4). These indicators take very low values across the sample. Furthermore, neither variable is individually or jointly significant but is significant when tested jointly with the other household characteristics (data not shown). This supports similar evidence on the relation between education and land holdings in Uganda (Baland et al 1999: 19-21). The variables EDUHH3 and EDUHH4 have, however, been retained in the regression to control for the subtle but significant differences in education across households.

Land Quality

Of the various land control variables included in the regression because they are jointly significant, only AREAFER5, PEST01 and RAIN4 are individually significant. These variables respectively indicate households with very high soil quality, households with pest problems for the majority of their harvested crops, and the share of cultivated area lacking rain per household. Given the uncertainties surrounding the household's prior knowledge of the values of these variables, the expected signs of the coefficients for these variables were ambiguous a priori. In fact, higher soil quality has a positive effect on land holdings per capita, more pests also increase these land holdings, and a lack of rain reduces land holdings, though only by a small amount.

These results show that the quality and characteristics of the land farmed has a bearing on the total area cultivated. Households respond to different production risks differently. Where the risk is aimed at the initial growth of crops through a lack of rainfall, households reduce the area farmed. Where the risk is aimed at the storage of the crops (which can perhaps be controlled and to which there are fewer alternatives with poor markets), households increase the area farmed. Households also make use of positive opportunities by increase their acreage if their soil is of higher quality.

The two categorical land tenure variables TENURE1 and TENURE3 indicate households which are worried about household land tenure security and households which believe that additional farm land is easy to access, respectively. These two variables are jointly significant at 90% (figure 4.5). The endogeneity of these two variables was also tested using the DWH endogeneity test summarised in chapter 3. For TENURE1, the F-statistic is 1.22 (with 2, 38 degrees of freedom) which is not significant at any reasonable level, so that endogeneity can be clearly rejected. For TENURE3, the F-statistic is 1.06 (also with 2, 38 degrees of freedom) which is not significant at any reasonable level, either, so that endogeneity can be clearly rejected. This is a key result given the above discussion of this issue.

These findings imply that concern over the household's security of land tenure leads to a marginal increase in area farmed, for two reasons. On the one hand, households will have stronger claims to cultivated land than to fallow land thus encouraging cultivation of contested lands. On the other hand, households uncertain about next year's tenure rights may prefer to increase cultivation in this season thus creating some surplus stored crops for future consumption.

This finding is in contrast with a study which concludes that tenure insecurity reduces land investment and thus area farmed (Feder 1987). The difference between these findings can be reconciled when considering the issue of extensive land use. As Feder's study looks at production (not area farmed), it is possible that tenure insecurity reduces total production but not cultivated area if an insecure household prefers an extensive form of production. This claim cannot be verified with the available data but appears intuitively convincing for the post-war context.

Technology, Assets and Social Capital

The household production technology available to a household has a significant effect on farm size. In the regression, this effect was captured by three variables, all of which represent current technology but are considered to be altered by households only slowly over time, and as such can be included in the regression. TOOL11 measures the total number of handheld tools (like hoes and machetes) per capita while TOOL02 measures the number of types of these tools owned per household. Both variables are individually highly significant. The former has a positive coefficient indicating that an increase in tools owned by the household increased the area farmed, with an elasticity of about 0.30. The latter has a negative coefficient, with an elasticity of about -0.25, so that a household with more types of tools in its control actually cultivates a smaller area.

In interviews conducted in northern Mozambique in 1999, farmers, agricultural extensionists, and aid workers pointed out that there was a shortage of small tools in rural areas, which the private trading system did not respond to adequately. Farmers frequently showed me their few tools (the weighted mean for TOOL11 is 0.93) and commented on their poor quality and thus low life-span, especially compared with tools they used in the pre-war period. Essentially farmers expressed a desire to improve their given technology of tools, not to change to a different technology entirely (cf. Boserup 1965: 26-7). Many farmers still used tools from recent NGO- and government-projects. It was not clear if households kept off purchasing new tools after having been given some for free in the immediate post-war period.

In addition, it appears that labour sharing (i.e. group labour) is often a device used to overcome household-specific shortages of tools, without households having to surrender control over their own tools. The perceived shortage of tools does not appear to stem from a lack of purchasing power for all households, as some farmers stated that they had enough cash to buy tools but could not find appropriate ones in local markets. Apart from these supply constraints in the tool market, the tool shortage had a differential effect on better off compared to worse off households. If purchasing power is the main constraint to acquiring a sufficient number of tools, then poorer farmers may be prevented from achieving their optimal farm size while richer farmers can further expand the scale of their operation.

The negative effect of an increasing number of types of tools on farm size suggests that households also engage in a significant range of off-farm activities which also require tools in their production. Hence households view agricultural and non-agricultural production activities as substitutes and choose to invest either in more agricultural tools to expand farm size or in a broader range of tools to pursue both agricultural and off-farm activities. Tools are thus important assets in either production activity. These issues will be addressed again in the context of household activity choices.

The presence of a local grain mill (MILL01) strongly reduces the area farmed per household, probably as households can increase their agricultural value added and crop marketing, therefore relying less on growing and storing subsistence crops. The emergence of grain mills in northern Mozambique is strongly linked to the end of the war as transport costs and risks as well as the risk of operating a mill would have been prohibitive during the war. The fact that less than a fifth of all households live near a grain mill during the sample period indicates how small the improvements in transaction costs have been since the end of the conflict.

On the one hand, higher past assets were expected to help households to expand their farms. This effect should be strengthened by the low level of household assets in 1992, with a mean of 192 constant 1996 US$ and a median of 34 constant 1996 US$. On the other hand, having higher assets seems unrelated to undertaking subsistence-oriented farming. Having had higher household assets in recent years may even encourage some households to undertake more cash crop cultivation or off-farm activities, instead of the predominant subsistence farming (chapter 6). In practice, the value of the household assets held at the end of the war have a highly significant but small effect on current land farmed with an elasticity of 0.04. This suggests that these contrary effects are important but almost cancel each other out.

The variable ANIMAL5 identifies households which owned at least one large animal (mainly cows, pigs or goats) in October 1992. Its mean is 11%, with the mean of the total number of large livestock being 0.67 animals per household in the whole sample and the conditional mean for households with at least one such animal being about 6 animals per household. These data show how small the livestock base in the sample was at the end of the war. The significant and large positive coefficient for ANIMAL5 then points to important synergies between livestock rearing and farm size. These synergies may operate directly, for example through the use of livestock in ploughing or fertilising the land, or indirectly, for example through livestock being used as a collateral for agricultural input credit. Furthermore, households owning livestock may have additional land requirements for grazing the livestock. However, AREA35 and related variables only measure land used for crop growing but not for grazing only so that this is unlikely to be an important explanation for the observed coefficient.

The variable CYCLONE2 indicates households which have been affected by the cyclone Nadia in early 1995. As this variable was defined via the impact of the cyclone on cashew trees (which suffered the biggest losses due to the cyclone compared to other types of assets), it is effectively a proxy for significant tree ownership. The positive and significant coefficient thus indicates that households with large stocks of cashew trees tend to have larger farms than other households, probably due to strong synergy effects in production. Owning more cashew trees does not increase the dependent variable AREA35 directly, as land which is only used for growing trees is not included in the definition of any of the land variables.

While being related to a local authority leader (AUTH11) has been omitted from this regression due to insignificance, the head of the household being a local political leader (AUTH12) is an individually significant variable with a positive coefficient. This suggests that the transaction costs of land access are lower for these leaders and that the traditional forms of land allocation (over which these households have particular control) are still very important in northern Mozambique.[36] This also suggests that political leaders may be the long-term beneficiaries of the currently dominant form of land access.

These results for political leaders are in strong contrast to the insignificance of the other social capital variables measuring the degree of linkage that households have with the local

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[36] Marule discusses the Macua saying "luck follows the lineage" in this context and offers an interesting analysis of the role of kin for land access (1998: 76).

community. In part, this may be related to the notion, discussed in greater detail in later chapters, that social capital correlates strongly with market development. These are both adversely affected by highly correlated risks, low levels of trust and extreme poverty, which would imply that these two factors do not compensate for each other. However, the social capital variables are not perfect indicators and it may be that a different variable would have suggested further effects on area farmed.

While Marule (1998: 72, 76) argues that social institutions matter for land access, with this more complex dataset and improved econometric techniques it can be shown that the majority of the variation in land endowments is not due to social institutions (though they are likely to be more important than can be derived here with limited social institution variables). Given that Marule describes a large number of ways in which households can influence, choose and modify social institutions, Macua and Mozambican social institutions appear endogenous in the long-term. This implies that there is no strong need to modify exogenously these institutions except to protect the most income-vulnerable households.

Village and Market Characteristics

LABOUR5 is a measure, expressed in natural log form, of the number of hours of off-farm labour hired per capita per village. This is not a direct estimate of the total village labour market as no separate information was collected on this issue but it measures the relative density of the local labour market. LABOUR5 is just significant at 90% and its coefficient suggests that for a 10% increase in local labour traded, households extend their land endowment per capita by almost 1%.

As was expected, this coefficient is positive but given the known weaknesses in labour markets with land abundant areas, this elasticity is quite small. It appears likely that the elasticity would increase with a higher population density and with lower labour market transaction costs. It also seems likely that poorer households in more remote areas may stay poor if they can neither sell their labour nor increase their area cultivated with off-farm labour, as would be assumed to be possible in most economic models.

MARKET7 measures a similar village-level output market density in natural log form, based on FSP survey data on crop sales. Its coefficient is also expected to be positive. In fact it is highly significant and positive, with an elasticity of 0.23. This confirms the hypothesis that, with lower transaction costs and thus higher market activity, households face an increased marginal utility from effort. In effect, an increasing market density counteracts to some degree the effects of land abundance.

The maize yield variable YIELDL7 was expected to be significant but is not, perhaps because it does not capture differences between productivity at the household level, which are determinants of area farmed as shown above. The various Paasche price indices PRICEXX for purchased food, non-food, and home-produced food items act as control variables capturing further unobservable differences between the sample households. Similarly, the village dummies ALDXXX control for unobservable differences between locations. The fact that both sets of control variables are significant indicates that there are determinants of land endowments which are only captured imperfectly by the survey variables.

Endogenous Variables

Ignoring a significant degree of endogeneity may cause a spurious correlation between the seemingly independent and dependent variables (Foltz et al 2000: 6). Several potential instances of endogeneity problems exist in this analysis. First, the analysis above has shown that there is no endogeneity problem in the case of tenure insecurity.

Second, a DWH test of endogeneity of investment in the cultivated area regression does not suggest that exogeneity should be rejected with any reasonable degree of significance. This linkage between area and investment will be analysed in more detail in the next chapter. The analysis shown here indicates already that the specification of the area equation (e.g. equation 4.1c) does not have to account for endogeneity problems.

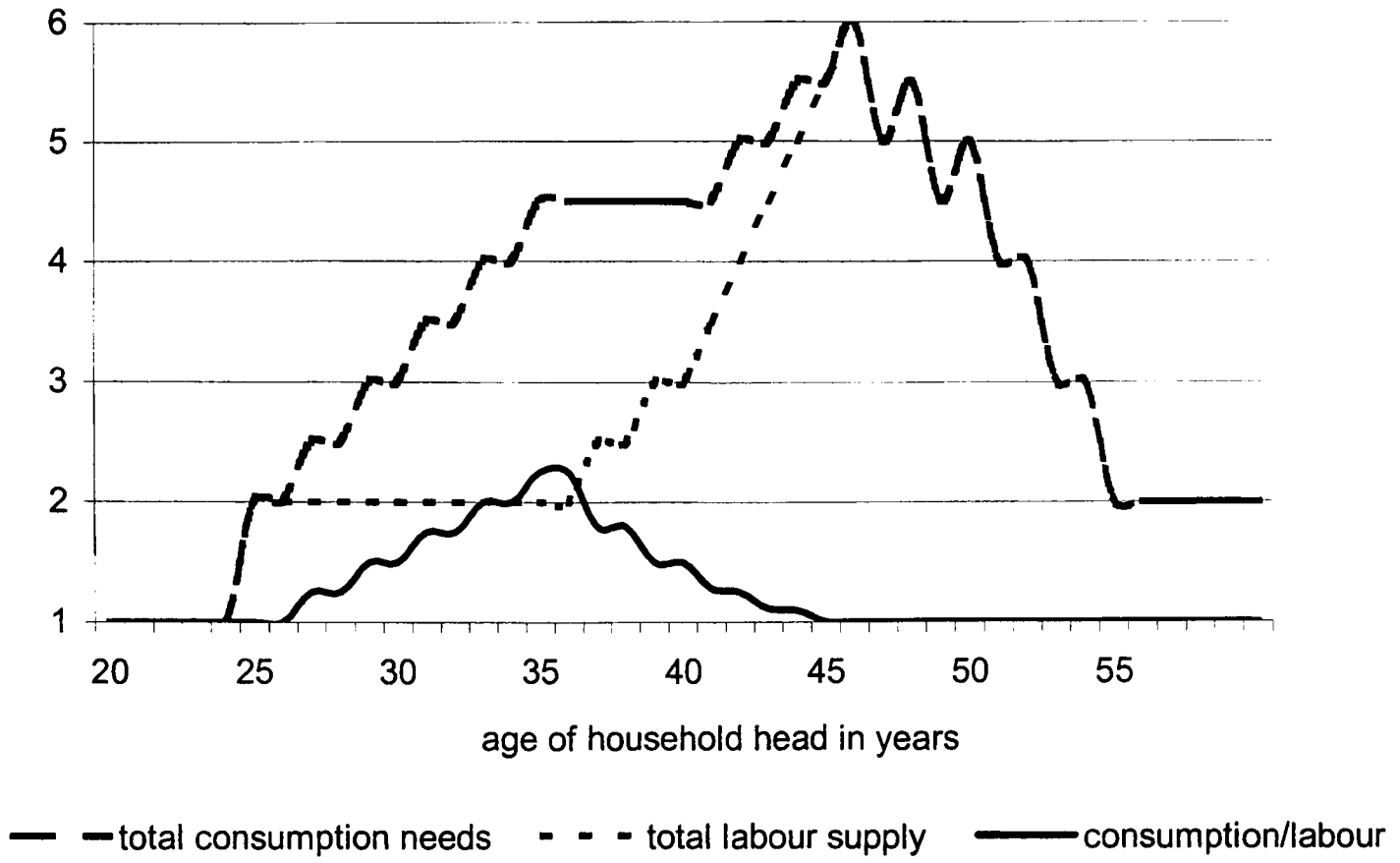
Third, some studies have found that poorer households farm larger areas (Place and Migot-Adholla 1998). However, it is not feasible to analyse this issue in greater detail with the available data. Analytically, income cannot cause farm size within a given time period as farm size is determined at the start of the agricultural year and agricultural income is determined at the end of that period. This issue would thus require a panel dataset to allow a dynamic analysis of the effects of past income on current land choices.

4.6 Summary

The objective of this chapter was to analyse the nature of land access and quantitative land use by peasant households in the post-war period. The analysis found that the area cultivated varies more strongly across households than would be expected under conditions of land abundance. Nevertheless land is not the key constraint as many households can freely adjust their land use to their labour supply. Instead, household-specific effects determine the degree of land access so that land abundance can be re-defined as a household-specific concept.

Post-war peasant households are thus faced with two alternative agricultural production strategies. They can either follow an extensification strategy, where limited labour resources are used on abundant land, or they can follow an intensification strategy where relatively more labour and assets are employed per unit land farmed. It appears that most post-war households cannot freely choose between these strategies as they face significant labour, asset, technology, social and village-level constraints. The regression analysis shows that households less constrained in some of these factors adjust their production strategies accordingly. Households in rural areas are therefore quite responsive but also very constrained due to the severe war legacy.

Figure 4.1: Life Cycle Simulation



The total consumption needs and the total labour supply curves overlap in the early and late phases of the life cycle in this graph. The simulation is described in more detail in the text.

Source: Own calculations (lifecyclesim-01).

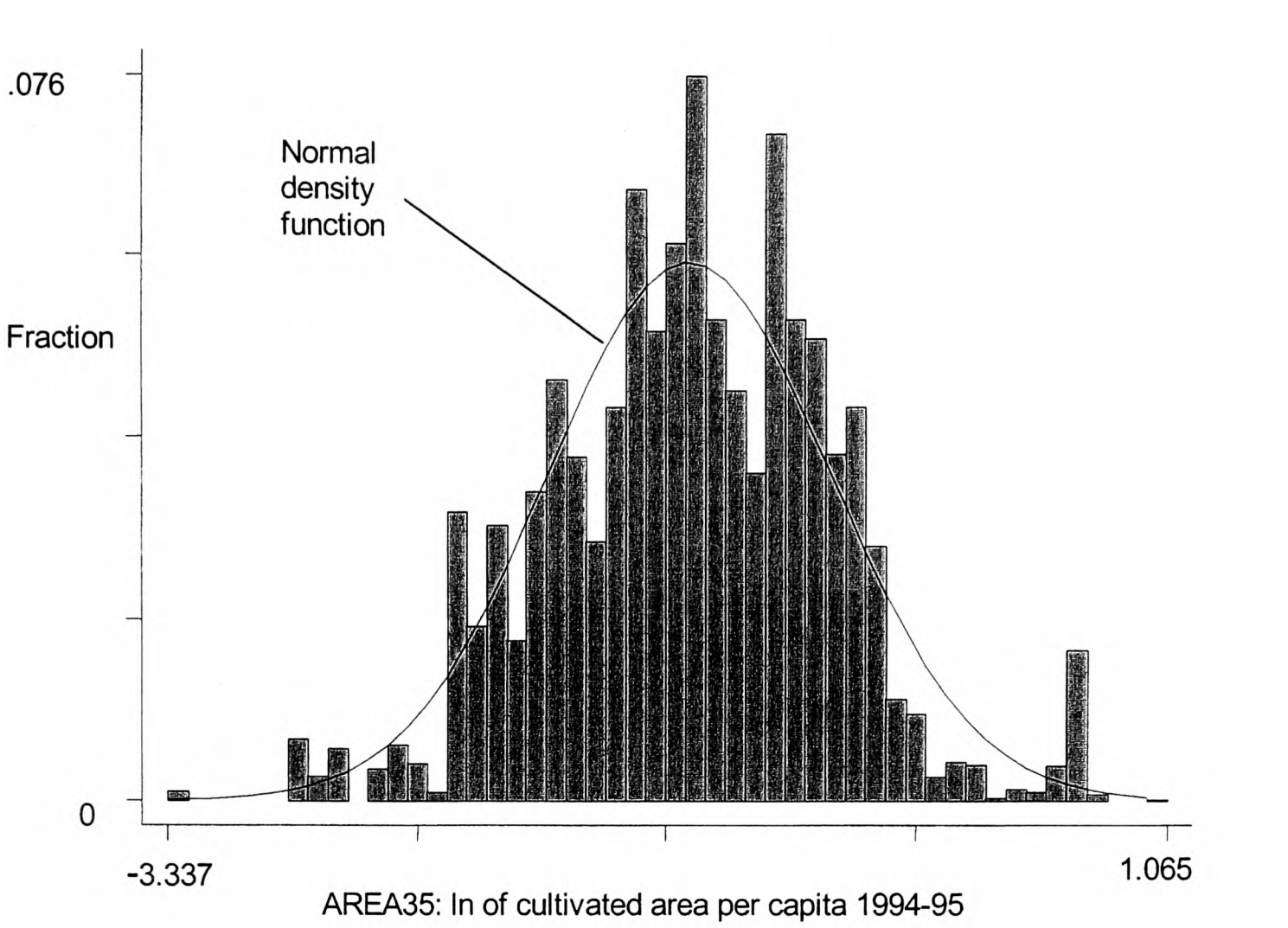
Figure 4.2: Land Holdings in Northern Mozambique

	1994-95	1995-96	Change (in %)	F-Tests
Cultivated Land				
ha/household	2.87	2.59	-9.8	
st err	0.19	0.23		
ha/person	0.433	0.376	-13.2	
st err	0.045	0.029		
Fallow Land				
ha/household	1.16	1.82	56.9	***
st err	0.09	0.18		
ha/person	0.175	0.274	56.6	***
st err	0.015	0.034		
Total Land				
ha/household	4.02	4.41	9.7	***
st err	0.25	0.28		
ha/person	0.608	0.650	6.9	**
st err	0.055	0.051		
N	371	371		

The F-Tests test the hypotheses of the equality of the survey means using the Stata 6 "svytest" command. *** indicates that the null hypothesis of equality can be rejected at 99% and ** indicates that it can be rejected at 95%.

Source: FSP data and own calculations (010108a).

Figure 4.3: The Distribution of the Dependent Variable AREA35



The data is weighted.

Source: FSP data and own calculations.

Figure 4.4: Summary Definitions of Cultivated Land Variables

		Log	Level
Per Capita	**1994-95**	AREA35	AREA45
	1995-96	AREA36	AREA46
Per Household	**1994-95**	AREA55	AREAC94
	1995-96	AREA56	AREAC95

Figure 4.5: The Determinants of Land Use in 1994-95

Survey Linear Regression

pweight: WEIGHT2
Strata: CATEG1
PSU: ALD

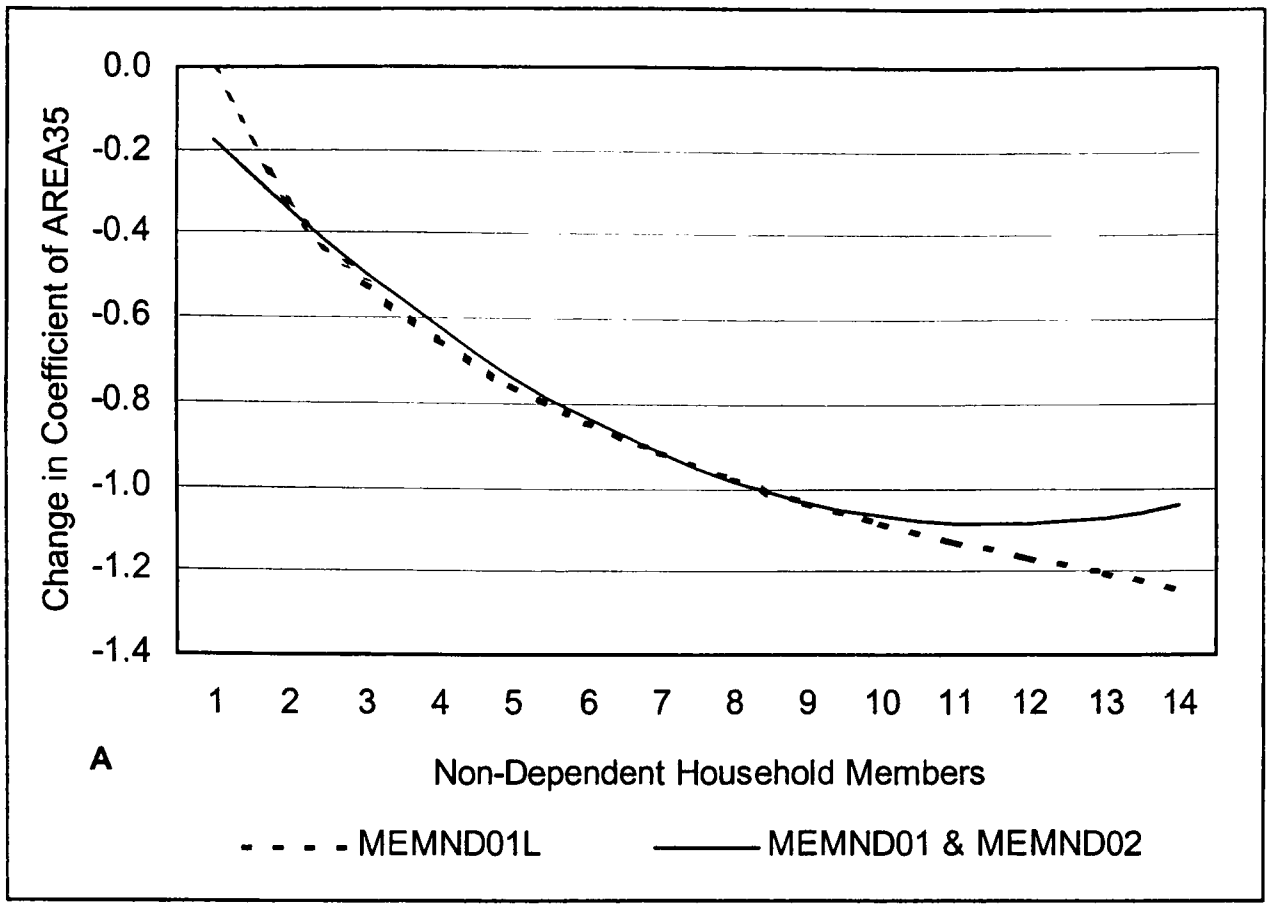
Number of obs = 370
Number of strata = 4
Number of PSUs = 42
Population size = 32511.33
F(37, 2) = 403.78
Prob > F = 0.0025
R-squared = 0.6942

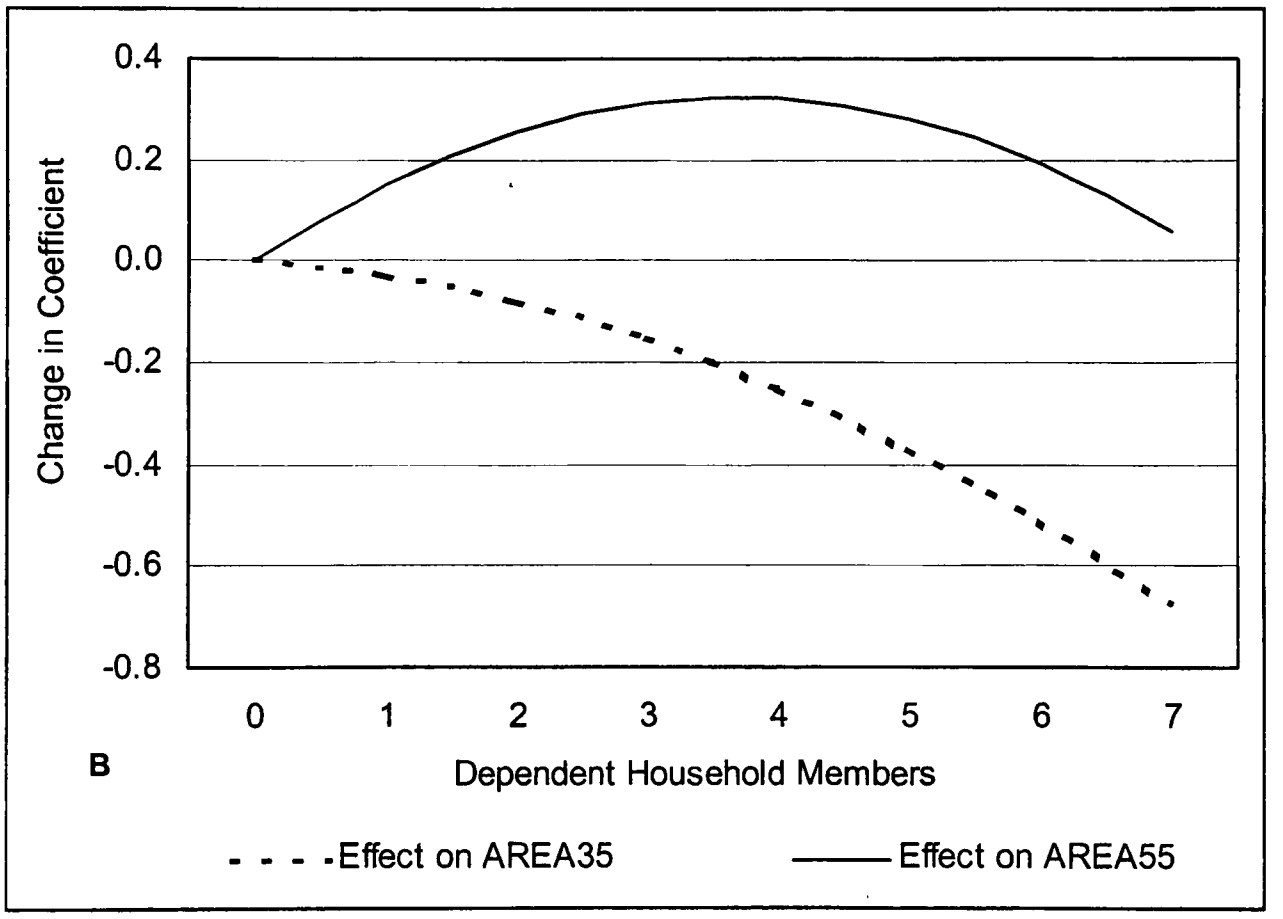
AREA35	Coef	St Err	t	P>|t|	(95% ConfInterval)	
MEMND01L	.4702394	.0824674	-5.702	0.000	-.6371858	-.303293
MEMD01	-.0164612	.055997	-0.294	0.770	-.1298213	.0968988
MEMD02	-.0114902	.0104381	-1.101	0.278	-.0326211	.0096407
AGEHEAD1	.0479591	.0098596	4.864	0.000	.0279994	.0679188
AGEHEAD2	-.0003856	.0001033	-3.734	0.001	.0005947	-.0001765
FEMALE2	-.3947785	.1629363	-2.423	0.020	-.7246259	-.0649311
FEMHEAD1	.8037668	.1893944	-4.244	0.000	-1.187176	-.420358
ILLDAYS1	-.001064	.0003382	-3.146	0.003	-.0017487	-.0003793
TIME11	.0636326	.031074	2.048	0.048	.0007265	.1265387
TIME13	.0992986	.0395766	2.509	0.016	.01918	.1794172
EDUHH3	.1743973	.1072858	1.626	0.112	-.0427915	.391586
EDUHH4	-.04762	.0383624	-1.241	0.222	-.1252806	.0300406
AREAFER5	.1778114	.0505416	3.518	0.001	.0754952	.2801275
DISTANC2	-.0009648	.0009244	-1.044	0.303	-.0028362	.0009066
PEST01	.1119596	.054878	2.040	0.048	.000865	.2230542
RAIN4	.1602318	.0889356	-1.802	0.080	-.3402724	.0198088
TENURE1	.1022752	.0632325	1.617	0.114	-.0257323	.2302827
TENURE3	.0441012	.039618	1.113	0.273	-.0361012	.1243035
TOOL11	.290088	.0892215	3.251	0.002	.1094686	.4707075
TOOL02	-.0939396	.0281738	-3.334	0.002	.1509744	-.0369047
MILL01	-.2437487	.0763139	-3.194	0.003	-.3982382	-.0892593
VASSET5	.0409816	.0101334	4.044	0.000	.0204676	.0614956
ANIMAL5	.2507198	.0986519	2.541	0.015	.0510095	.4504301
CYCLONE2	.2001949	.0640512	3.126	0.003	.07053	.3298598
AUTH12	.2369866	.0722516	3.280	0.002	.090721	.3832522
LABOUR5	.0903335	.0523875	1.724	0.093	-.0157194	.1963864
MARKET7	.2263223	.0380612	5.946	0.000	.1492714	.3033733
PRICE15	-.1753119	.0708829	-2.473	0.018	-.3188069	-.0318169
PRICE24	.1745751	.0922659	1.892	0.066	-.0122075	.3613577
PRICE33	.6522673	.4217434	1.547	0.130	-.2015076	1.506042
PRICE35	-.1396945	.0571238	-2.445	0.019	-.2553355	-.0240534
ALD111	-.0473971	.1244829	-0.381	0.706	-.2993995	.2046052
ALD112	.1517166	.1488981	1.019	0.315	-.1497118	.453145
ALD113	-.7519469	.2618346	-2.872	0.007	-1.282003	-.2218905
ALD121	-.1926139	.1074531	-1.793	0.081	-.4101414	.0249136
ALD122	.0453932	.1238617	0.366	0.716	-.2053518	.2961382
ALD214	.0640056	.0945338	0.677	0.502	-.1273681	.2553792
ALD221	-.0850709	.1715149	-0.496	0.623	-.4322848	.2621429
ALD231	-.2120501	.1125006	-1.885	0.067	-.4397957	.0156955
ALD312	-.2118496	.2142861	-0.989	0.329	-.6456491	.22195
ALD313	-1.146419	.460125	-2.492	0.017	-2.077893	-.2149447
ALD321	.0405718	.1741433	0.233	0.817	.3119628	.3931065
ALD332	-.3554744	.2080097	-1.709	0.096	.7765679	.0656191
_cons	-4.112174	.5215684	-7.884	0.000	-5.168034	-3.056314

AREA35: The natural log of cultivated area per capita in hectares in 1994-95. ALD114, ALD123, ALD215 and ALD232 have been dropped due to collinearity. Svytest MEMD01 MEMD02: Adjusted Wald test F(2, 37) = 9.04, Prob > F = 0.0006. Svytest TENURE1 TENURE3: Adjusted Wald test F(2, 37) = 2.82, Prob > F = 0.0725. Command: svyreg AREA35 MEMND01L MEMD01 MEMD02 AGEHEAD1 AGEHEAD2 FEMALE2 FEMHEAD1 ILLDAYS1 TIME11 TIME13 EDUHH3 EDUHH4 AREAFER5 DISTANC2 PEST01 RAIN4 TENURE1 TENURE3 ANIMAL5 VASSET5 CYCLONE2 MILL01 TOOL11 TOOL02 AUTH12 LABOUR5 MARKET7 PRICE15 PRICE24 PRICE33 PRICE35 ALD1* ALD2* ALD3*.

Source: FSP data and own calculations (010103a, 010428a).

Figure 4.6: The Effect of Household Size on Cultivated Land in 1994-95





Graph A plots two alternative measures of household size on the land endowment variable AREA35. The coefficient for MEMND01L is shown also in figure 4.5. The complete regression output showing the coefficients of MEMND01 and MEMND02 is not shown. Graph B plots the effects of the same measures for the number of dependent household members (MEMD01 and MEMD02) on two distinct regressions. In the first regression, which is reproduced in figure 4.5, the dependent variable is AREA35 while in the second regression, for which no complete regression output is shown, the dependent variable is AREA55.

Source: FSP data and own calculations (land-calcs-other).

Chapter 5: Land Tenure Insecurity and Land Investment

5.1 Introduction

Building on the analysis of land access in the previous chapter, this chapter will analyse land tenure insecurity and land investment in post-war northern Mozambique. It will be shown that the PH model of land use is a useful tool but that the common specification of its theoretical components has been limited and could be usefully extended. In particular, farm size is commonly assumed to be fixed, which may not be true even in areas with a high degree of land inequality. Therefore, the assumption of land inequality (or of a fixed farm size) should be tested empirically. The approach adopted in this chapter extends the empirical literature by considering land access, land tenure insecurity and land investment to be potentially endogenous and simultaneously determined. It will be argued that this is particularly likely for the case of a war-affected economy, though some authors have recently argued similarly for peacetime economies (Hayes et al 1997).

This chapter will show that even in the post-war economy land tenure insecurity is predominantly determined at the village level and that land investment does not affect tenure insecurity. Land investment will be shown to be very low and to be negatively affected by tenure insecurity. Area farmed in the previous agricultural year is a key determinant of both tenure insecurity and land investment. This can be explained with the detrimental effects of war on household opportunities, which encourage investment in intra-household controlled subsistence resources. In fact, life-cycle and social capital variables are also important determinants of land investment, which indicates that land investment plays an important role for war-affected households. Nevertheless very war affected households are unable to undertake land investments. For these households the lack of land investments may represent a post-war poverty trap.

The chapter will start by outlining key hypotheses concerning both land tenure insecurity and land investment before discussing the available data and the econometric specification of the PH model. The expected signs of the determinants of both dependent variables and a discussion of the findings will then be presented.

5.2 Hypotheses Concerning Tenure Insecurity and Land Investment

Much of the theoretical literature on land tenure in Africa deals with the emergence and the role of formal property rights in agriculture.[37] While Mozambique has debated various forms of formal property rights since independence, the predominant de facto form of land tenure in rural areas in 1995 was a system of flexible, traditional property rights (chapter 3). The perception of these rights are hypothesised to vary with a variety of local and household-specific factors, rather than being fixed by law, thus giving rise to equation 4.2a as first introduced in chapter 4:

$$T_i = f(\mathbf{L}_{Ti}, \mathbf{F}_{Ti}, \mathbf{K}_{Ti}, \mathbf{V}_{Ti}, A_i, I_i) \quad (4.2a)$$

where T_i denotes tenure insecurity at the household level for all households $i = 1...N$. $\mathbf{L}_{Ti}$, $\mathbf{F}_{Ti}$, $\mathbf{K}_{Ti}$, and $\mathbf{V}_{Ti}$ denote the household-, plot-, asset-, and village-level determinants of tenure insecurity, respectively (with bold characters indicating vectors).[38] A_i and I_i denote the area farmed and the land investment per household.

Given the nature of the RHS variables, tenure insecurity is related to the effects of the war. In particular, the generally high war and post-war transaction costs reduced the turnover of informal land transactions and created a degree of mismatch between the demand for and the supply of land (Besley 1995b). In such a situation and where marginal adjustments to land ownership and use may not be possible, the disequilibrium in the traditional land market may express itself instead as insecurity and uncertainty concerning land status.

Furthermore, the subjective valuation of leisure may lead to a stronger variation in the demand for land across years for each household than would occur if households could hire-in and hire-out labour more freely. Certain types of households may hence find that their allocation of land is not optimal to their circumstances or they may fear that a favourable land allocation may be withdrawn eventually. Thus both under- and overendowed households can experience land tenure insecurity.

One key hypothesis of this section is that in the context of rapid structural change, due mainly to the end of the war, the determinants of land tenure insecurity have changed from being long-term and community-wide factors (such as changing population density) to

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[37] See chapter 4 for definitions of land tenure, property rights, and land tenure insecurity. Key contributions to this literature include Atwood (1990), Bassett and Crummey (1993), Berry (1997), Besley (1995b), Boserup (1965), Bosworth (1995), Bromley (1989, 1991), Bruce and Migot-Adholla (1994), Hayes, Roth and Zepeda (1997), Migot-Adholla et al (1991), and Platteau (1992, 1996). Note that the term land tenure insecurity (not security) is frequently used as this is how the variable TENURE1 is defined in the FSP dataset.

[38] The equation numbering in this chapter will be continued from the previous chapter for simplicity.

more short-term household- and village-specific variables (such as household size or labour market size) which vary in accordance with the effects of the war.

Another key hypothesis is the potential interdependence between land tenure insecurity and land investment. In the post-war period, households may wish to compensate for increased general insecurity of land tenure arrangements by investing in land improvements such as tree planting, a traditional and recognised method of expressing a claim on a plot in Sub-Saharan Africa (Besley 1995b, Place and Hazell 1993: 13). While the previous chapter has shown that area farmed is exogenously determined by tenure insecurity but not by land investment, this chapter will explore further causalities between area farmed, tenure insecurity and land investment.

The remainder of this section will address the determinants of land investment and derive key hypotheses. Investments in land are household-level measures to improve the agricultural productivity of land by enriching the soil quality, by protecting fields from erosion, sunshine and predators, and by easing the watering of crops. In addition, households undertake land investments to secure their property rights in an environment with increasing population density.

In the FSP survey, the number of land investment projects undertaken per household in 1995-96 including and excluding investments in trees is captured by INVEST01 and INVEST03, respectively. The binary variables summarising whether any investments had been undertaken are INVEST05 and INVEST07, respectively.

Building on the BM and the PH models, land investment is expected to depend on a variety of exogenous and endogenous factors (Brück 1996: 9-10):

$$I_i = f(\mathbf{L}_{Ii}, \mathbf{F}_{Ii}, \mathbf{K}_{Ii}, \mathbf{V}_{Ii}, A_i, T_i) \qquad (4.3a)$$

where the variables are defined as in equation 4.2a. The different variables on the RHS thus represent the joint effects of war on household and asset endowments, the slowly emerging markets for inputs and outputs, and changing post-war technologies and investment opportunities (Barrows and Roth 1990: 295, Bruce 1993).

The negative effects of war increase the option value of investment and thus reduce the overall post-war level of investment undertaken compared to a standard peace-time economy (Collier and Gunning 1995, Dixit and Pindyck 1994, Rodrik 1991). Given the availability of land and the high post-war option value of investment, households are therefore expected to undertake only few investments in land in the survey period. This hypothesis will be tested in the results section below.

The area cultivated A_i can be an endogenous determinant of I_i as households are likely to choose the quantity and quality of their farmed area at the same time. This does not apply in rural economies such as Rwanda where household land endowments are fixed or exogenously determined (e.g. through inheritance). With the relative land surplus in northern Mozambique, investment may also be determined endogenously by area farmed.

Tenure insecurity T_i may reduce land investments endogenously for three reasons (Besley 1995b). First, higher tenure insecurity represents a higher risk of expropriation of the plot which reduces the net present value of the investment in that plot. Second, households experiencing a higher degree of tenure insecurity offer a lower collateral value for their land than if they had very secure land tenure thus reducing credit-based land investments. Third, households with more tenure insecurity face smaller gains from the trade of land, therefore reducing the incentive to invest in their land. The second case is not likely to hold in northern Mozambique in 1995 given the virtual absence of credit contracts based on land as a collateral.

Another reason why the perception of tenure insecurity may be endogenous even if it is pre-determined is that farmers may choose the tenure status of their land when they first claim a plot. For example, farmers may occupy fertile but contested land or they may occupy uncontested but infertile land. Hence there is a correlation between the error and TENURE1. The model must therefore account and test for this endogeneity to prevent unobserved variables biasing the estimated coefficients.

5.3 Data and Econometric Considerations

This section will start by expanding the basic model by Place and Hazell (1993: 10-1) as introduced in chapter 4 to accommodate land tenure status and land investment activities. The subjective, household-specific land tenure insecurity has been measured by the FSP survey for 1995 and is captured in the variable TENURE1, where tenure insecurity is coded as 1 and no tenure insecurity as 0.

A more subtle measurement of tenure insecurity (e.g. through the construction of a continuous index) may have been desirable and would have permitted the use of linear rather than of binary regression techniques. However, such insecurity indices are difficult to construct and they may not, ex ante, be able to differentiate more clearly between less and more insecure households than the subjectively recorded indicator TENURE1 used here (see also the methodological discussion of poverty lines and of equation 7.3 in chapter 7). Overall, the enumeration of such variable, even if imperfectly measured, is an analytical

and methodological improvement as many agricultural household surveys fail to address this issue entirely.

Building on the introduction of the logit equation 3.1 in chapter 3 and the discussions of equations 4.2b and 4.2a above, consider the case where households will perceive significant tenure insecurity if its actual level T_i exceeds a barrier t_i and they will not perceive tenure insecurity otherwise:

$$\text{TENURE1} = 1 \quad \text{if } T_i > t_i \qquad (4.2c)$$
$$\text{TENURE1} = 0 \quad \text{otherwise.}$$

The binary model to be estimated is then:

$$\text{Prob (TENURE1} = 1) =$$
$$F\,(t_i - \beta_0 + \beta_1 \mathbf{L}_{Ti} + \beta_2 \mathbf{F}_{Ti} + \beta_3 \mathbf{K}_{Ti} + \beta_4 \mathbf{V}_{Ti} + \beta_5 \mathbf{Z}_{Ai} + \beta_6 \mathbf{Z}_{Ii}) \qquad (4.2c')$$

where F is a cumulative probability function. This model can be estimated by logit or probit, if the error term follows a logistic or normal distribution, respectively. As for equation 4.1c, these RHS variables take linear and quadratic forms depending on the nature of the expected effects of the dependent on the independent variable.

Equation 4.2c' thus contains household ($\mathbf{L}_{Ti}$) and asset endowments ($\mathbf{K}_{Ti}$), controls for the plot ($\mathbf{F}_{Ti}$) and village characteristics ($\mathbf{V}_{Ti}$), while the exogenous instruments $\mathbf{Z}_{Ai}$ and $\mathbf{Z}_{Ii}$ account for the potentially endogenous variables cultivated area and land investments. An alternative implementation could have been specified with multiple plot- or household-level data. However, the FSP survey does not provide such data. Instead, plot and household fixed effects are controlled by a variety of variables as described in chapter 3.

The dependent variable TENURE1 is unusual in that it represents the current and subjective perception of each household about its land tenure insecurity. If TENURE1 was correlated with the error term e_{Ti} in any way, then the estimated coefficients would be biased and inconsistent. For example, subjective perceptions cannot be independently verified so that the accuracy of the response may vary with unobserved household characteristics such as education. However, in this respect the FSP sample is more homogenous than many other household surveys as most household heads did not complete primary education due to the war.

The land module of the questionnaire was designed as part of a joint research project of the FSP and the Land Tenure Centre (LTC) at the University of Wisconsin-Madison. The land module contained other questions concerning plot sizes, location and characteristics as well as household attitudes to land. Such large number of land-related questions ensured

that during the interview, the responses could be cross-checked by the enumerator using related responses from the land module.[39]

Finally, the categorical nature of the TENURE1 variable will help ensure that the response is correct on average compared to more subtle continuous variables. In other words, the binary nature of TENURE1 may be an advantage in this context even if in the poverty analysis of chapter 7 it will be found to be preferable to use the continuous variables income and consumption as dependent variables.

Equation 4.2c' will be estimated with the "ivprob" command in Stata 6, which can account for the endogeneity of area and investment in the estimation of a categorical variable. This two-stage technique first runs regressions for the endogenous variables then includes the estimated values in the second-stage regression for tenure insecurity (Harkness 2000, Maddala 1983: 247-52, Newey 1987). It is therefore possible to estimate consistent coefficients despite the potential endogeneity of some of the right-hand side variables.[40]

Recall the reduced form expression of the determinants of investment in land at the household level:

$$I_i = g(\mathbf{L}_{Ii}, \mathbf{F}_{Ii}, \mathbf{K}_{Ii}, \mathbf{V}_{Ii}, \mathbf{Z}_{Ai}, \mathbf{Z}_{Ti}) \quad (4.3b)$$

where the vectors $\mathbf{Z}_{ji}$ denote the exogenous determinants of j for j = A and T such that $\mathbf{Z}_{Ai} \neq \mathbf{Z}_{Ti}$. For an investment variable measuring the level of investment, equation 4.3b can be reformulated into an econometric specification with a set of linear and quadratic dependent variables as follows:

$$I_i = \gamma_0 + \gamma_1\mathbf{L}_{Ii} + \gamma_2\mathbf{F}_{Ii} + \gamma_3\mathbf{K}_{Ii} + \gamma_4\mathbf{V}_{Ii} + \gamma_5\mathbf{Z}_{Ai} + \gamma_6\mathbf{Z}_{Ti} + e_{Ii} \quad (4.3c)$$

where e_{Ii} is an error term which is not correlated with the exogenous variables hence yielding unbiased and consistent estimates for the coefficients γ_h for h = 0...6.

For a discrete variable measuring if a household undertook any investments ($I_i = 1$) or not ($I_i = 0$), different modifications to equation 4.3b are necessary.[41] Consider the case where a household will undertake an investment I_i only if its expected return π_i is positive:

$$I_i = 1 \text{ if } \pi_i > 0 \quad (4.3c')$$

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[39] The assessment of the strengths and weaknesses of the land module in the FSP survey were greatly assisted by discussions in Maputo and Nampula with FSP and LTC analysts and with enumerators while the data was being collected in 1995.

[40] Note that the svyivreg or ivprob commands in Stata do not explicitly account for endogenous variables of a categorical format, which would be treated as continuous in both cases. There does not seem to be an econometric technique capable of fully accounting for this data feature.

[41] See also the discussion of discrete variables in the section on tenure insecurity and in the context of poverty functions (chapter 7).

$$I_i = 0$$

otherwise.

The binary model to be estimated is then:

$$\begin{aligned} &\text{Prob}\,(I_i = 1) \\ &\quad = F\,(\pi_i) \qquad (4.3c'') \\ &\quad = F\,(\gamma_0 + \gamma_1 \mathbf{L}_{Ii} + \gamma_2 \mathbf{F}_{Ii} + \gamma_3 \mathbf{K}_{Ii} + \gamma_4 \mathbf{V}_{Ii} + \gamma_5 \mathbf{Z}_{Ai} + \gamma_6 \mathbf{Z}_{Ti}) \end{aligned}$$

where F is a cumulative probability function and π_i is a function of the variables specified in 4.3c. This model can be estimated by logit or probit, if its error term follows a logistic or normal distribution, respectively (section 3.7).

Equations 4.3c" and 4.3c will be estimated with the "ivprob" and "svyivreg" commands in Stata 6. The former was discussed above and the latter can similarly account for the endogeneity of area and tenure perception in the estimation of a linear regression model for investment using instrumental variables (i.e. two-stage least squares) techniques. In addition, the latter command can account for the survey design of the data, making further adjustments to the standard errors of the estimates (StataCorp. 1999: svyivreg).

5.4 Expected Signs of the Determinants

Determinants of Land Tenure Insecurity

An increase in the household labour supply may increase tenure insecurity (or raise the odds of TENURE1) if new land obtained by the household as a consequence of its increase in household size has initially higher tenure insecurity than land previously cultivated. At the same time, the average tenure insecurity may decrease with extra household labour if this strengthens the household's claim to the land within the community. The net effect of household size on TENURE1 may thus be indeterminate.

Refugee households and female-headed households are most likely to have been significantly affected by the war, thus undermining their land tenure status. Such loss of security may have come about through displacement or through the loss of local social linkages and status.

Other household-level variables may be significant if local land allocation mechanisms take them into account. A higher age of the head of the household may for example decrease tenure insecurity, as older people (especially men) in northern Mozambique generally have a higher social standing. Land tenure may also become less insecure with better education as the household may have a stronger bargaining position with the local community.

Higher quality land may increase land tenure insecurity as the land becomes more attractive to other, perhaps more powerful, members of the community. At the same time, land

which has become more fertile as a result of investments in its quality (e.g. by crop rotation and fallow) may only be land which is more secure in the first place, suggesting the opposite sign may hold as the causality reverses. Furthermore, the war may have affected positively or negatively the fertility of the land through neglect (chapter 3). The sign on this coefficient in the regression is hence indeterminate.

Better household technology should reduce the odds of TENURE1 as the household should have more resources to obtain higher security land and to invest in better relations with the traditional authorities. In addition, higher past assets should have similarly positive effects to better technology and should decrease land tenure insecurity. In particular, not very many households had significant asset endowments immediately after the war so that some households may have had significantly better opportunities for investing in land quality and the social relations necessary to maintain secure land tenure.

As reviewed by the literature cited at the start of this section, land tenure in African societies is strongly shaped by social institutions, suggesting that social institution variables will be significant. For example, a stronger association with traditional authorities should significantly strengthen a household's land tenure if land is primarily allocated by traditional authorities. However the war may have weakened this link thus diminishing the probability that this variable is in fact significant.

The frequent association of land with ancestors in Sub-Saharan countries indicates the strong underlying rules of and commitment to land tenure where land "ownership" can only change through people changing kinship. This has for example led to the rise of matrilineal societies and to strong patterns of migration as features of the land tenure system (Meillassoux 1981: 36). Both of these effects can be observed in northern Mozambique and they are indeed related. The Macua society is matrilineal and young couples often live in the wife's village for a few years after their wedding before moving to the husband's village of origin. The association of either partner's family with the village can thus be expected to reduce the odds of land tenure insecurity.

As discussed above, a higher population density at the district level raises land tenure insecurity for households. However, land tenure insecurity is also correlated with input and output market density and with the type of land use, for example for subsistence or for commercialisation (Bassett and Crummey 1993, Bruce and Migot-Adholla 1994, Platteau 1996). If households face more stable and reliable markets (as measured by traded market volume) then households are more likely to choose market-oriented crops which may require multi-period learning, investment or commitment to a certain crop variety, input

supplier or output trader. In addition, land markets and thus tenure security will strengthen if complementary markets are better developed (e.g. for credit).

If land is generally abundant and land allocation mechanisms are predictable, then opting for a cash-crop farming strategy may increase land tenure security as traditional authorities may respect previous household farming decisions. However, if land is very scarce then more market activity for crops may increase competition for better land and thus reduce land tenure security. In addition, given the post-war trend for reduced transaction costs and the resulting drop in the economic isolation of rural households, markets complementary to land transactions should strengthen over time. Given the general assumption of land surplus and declining transaction costs in northern Mozambique, more crop market activity will strengthen post-war land tenure.

Finally, land tenure insecurity is closely related to the endogenous issue of investment in soil quality and other land attributes (here called land investment). Local authorities are more likely to respect land tenure if households have actively worked the land, and spent time and other resources improving the quality of the plot. In the war period, this does not typically involve purchased inputs but could include regular ploughing (though rarely with draft animals), weeding, fertilising with non-commercial material (e.g. ashes), building and mending fences, planting trees for demarcating and shading land and reducing wind- and water-induced soil erosion, building and maintaining wells and irrigation pipes, terracing land, and planting soil-enhancing crops such as beans.

In the post-war period, such activities may particularly improve land tenure security as they are clear and not easily imitated signs of previous, long-term use of land. For example, it is unlikely that a displaced household can claim land for cultivation which has been fenced, terraced or irrigated by other households in recent seasons. In the absence of a clear, formal regulatory framework for land tenure, such activities enhance both the quality of the soil and the security of tenure for households. Both the variation in land used and the clear differentiation of tenure security according to household and village characteristics therefore strongly suggest a degree of endogeneity between land tenure and land investment (Foltz et al 2000: 6, Place and Migot-Adholla 1998). It thus does not seem warranted to assume that households have no control over their land tenure security in the case of northern Mozambique, as has been assumed in some studies of African agriculture (e.g. Hayes et al 1997).

This analysis has indicated a range of likely determinants of land tenure insecurity and their expected signs. In particular, the discussion provided detailed arguments for the two key hypotheses, namely why household-level factors are also important determinants of tenure

insecurity in the post-war period and how the post-war period is likely to see a high degree of interdependence between tenure insecurity and land investment. The next section will continue this analysis for the case of land investment.

Determinants of Land Investment

Given the extreme uncertainties in the post-war period, households are most likely to invest in land improvements which yield short-term benefits and where the investments themselves exhibit a low level of war vulnerability. For example, households are unlikely to invest in irrigation machinery which could be easily stolen. Instead, households are more likely to improve immobile aspects of their plots, for example by planting nitrogen-fixing crops.

Increased land investment may even correlate with extending total farm sizes as leaving land unused for several seasons (i.e. fallow land) tends to improve the quality and productivity of the land. Such strategy requires large areas of unused and unclaimed land and also significant labour resources as the fallow land must be cleared and prepared for cultivation after the fallow period. Fallow land is, however, nearly war invulnerable as only land mines will render such land worthless.

The actual level of land investment can thus be expected to vary with a variety of exogenous and some endogenous variables, such as household characteristics, plot characteristics, asset endowments, social capital, and village level variables.

Household size and the household life-cycle may affect land investment as children may invest in land they plan to use for their own future household (Boserup 1965: 104-6, Meillassoux 1981). In addition, there may be diminishing returns from extending farm size, for example through an increase in the distance travelled to the plots or through labour supervision problems on a large number of plots per household. These may also encourage investments in land with an increasing household size.

During the war, households had little time to invest in land improvements as household members had to look out for random attacks and had to hide themselves and their belongings from soldiers. The availability of time should improve suddenly with the ceasefire and thus help increase post-war land investment. Households with less time to spare due to continuing environmental constraints derived from scarce drinking water or fire wood may however find it harder to invest in land.

Households are less likely to invest if they experience large shocks to or variations in their human capital, as this may reduce their time horizon and increase their discount factor.

Households with high levels of illness, high dependency ratios, refugee status, or female heads may thus invest less than other households.

The effects of given soil characteristics on investment in land are ambiguous as poor soil quality may imply that investments yield a high return or perhaps little return. Much depends on the dimension of soil quality under consideration. For example a dry and fertile soil would benefit much from irrigation while dry and exhausted land may need both irrigation and fertilisers in order to increase yields. Given the generalizations inherent in the definition of the soil quality variables used, these variables may not be significant in the regression.

In the immediate post-war period, households had few resources to invest in the quality of land. In addition, livestock would have been abducted, killed, died due to untreatable diseases or killed for household consumption as a direct result of war and its induced food insecurity. Hence there would have been less manure available for enriching soil quality, especially as the war continued and had an increasing negative impact on household livestock. All these effects would only slowly improve in the post-war period. Households with more assets, more livestock, or better household technology may have found it easier to undertake land investments, suggesting positive coefficients for these variables.

The war reduced land investment further through the high probability of population displacement resulting either in local households having to move away or from having to share existing land with newly arrived, displaced households. Displacement weakens claims to land held in the area of origin, hence increasing the incentive for households not to return to their original area of residence. This effect is likely to deepen with the lengthening of the conflict and the corresponding lengthening of a household's absence from their village of origin. Therefore a longer war is likely to have a stronger negative impact on permanent population displacement and thus on land tenure and investment.

While the end of the war reduced the need to move to avoid rebels, displacement from land may continue voluntarily and indefinitely if displaced households choose to stay after the end of the war, for example due to the proximity to social and economic infrastructure at the new residence. The end of the war also saw an increase in general intra- and inter-household mobility, for example as part of cultural and religious practices (as described above). These changes in war-related migratory patterns create localised excess pressure for land access and a degree of tenure insecurity which may discourage land investment. On the other hand, in areas much affected by migration, households may choose to invest in land instead of extending the area farmed. The net effect of war-related and post-war migration on land investment is thus ambiguous a priori.

Instead, strong linkages with local social institutions will help stabilise expectations of future land access and should have a positive effect on land investment, both for migrants and long-term local residents. The local origin of husband and wife, the husband being a local authority or being related to local authorities, or locally buried ancestors should thus all have positive effects on land investment.

The availability of local input and output markets might increase household level land investments as the markets provide opportunities for households to accumulate resources which can be re-invested in their land. Similarly, better crop yields may provide excess profits which can be reinvested in land. Better markets and yields also provide further incentives to invest in land. These variables therefore represent both supply of and demand for investment effects. Finally, a set of price indices will control for further unobservable household and village-level effects.

5.5 Results and Discussion

Land Tenure Insecurity

Land tenure insecurity is assumed endogenous in the farm household village economy, thus permitting an econometric analysis of its determinants. In particular, this section tests the hypothesis that, as a result of the war, the determinants of this variable include many short-term, household-level variables while there is a significant degree of interdependence between tenure security and land investment. In addition, other potential endogeneity issues will be considered. These issues have important implications for the design of land laws in Mozambique and other war-affected African economies.

Summary Statistics and Methodological Considerations

In January 1996, the only time this question was asked in the survey, 52% of all FSP sample households were worried about the security of their land tenure. The question does not define tenure insecurity in any particular way and so households might respond in the affirmative for a range of reasons (e.g. due to boundary disputes, strong local population pressures, arguments with local authorities, or the need to sell land to raise money). In addition, only a binary respond to this question was recorded which implies that households which feel only "somewhat (in-) secure" are grouped with households feeling "strongly (in-) secure". Finally, the data was unfortunately not collected on a per plot basis but on a per household basis and no plot or land histories were collected (unlike, e.g., in Baland et al 1999). This reduces the accuracy and the predictive power of the analysis.

The top panel in figure 5.1 shows how land tenure security (TENURE1) does not vary systematically with the perceived availability of arable land in households' vicinity

(TENURE3) and a formal Pearson test of independence does not reject the hypothesis of no systematic difference, either. TENURE1 does vary strongly with location (ALDXXX) of the household though, as also shown in figure 5.1. The Pearson test of independence confirms this result, as indicated by the high test statistics.

Such bivariate profile of tenure insecurity cannot clarify whether it is the location per se which drives the differences in security or if the locational variables proxy for other influences on household tenure insecurity. To pursue this issue further, two regression specifications are reported in figure 5.2. In addition to using other regressors, regression 1 uses categorical district-level variables to identify if a household resides in one of the three sample districts Montepuez, Meconta or Monapo. Regression 2 instead uses categorical village-level variables to identify in which of the 16 sample villages each household resides. Both regressions have been implemented in Stata 6 as survey logit regressions, which assume underlying logistic functions (chapter 3 and Kennedy 1998: 234). Figure 5.2 reports the coefficients of the regressions as odds ratios, where a coefficient larger (smaller) than 1 indicates a variable's increasing (decreasing) effect on tenure insecurity.

The signs and the scale of the regressors MEMND11 to YIELD08 are quite similar, suggesting robustness in the final estimations. The pseudo-R^2 values for regressions 1 and 2 are 0.44 and 0.43, respectively, when implemented as weighted, clustered logit regressions.[42] Both regressions are highly significant and specification tests implemented as F-tests of the joint significance of the variables MEMND11 to PRICE35 and DIS1 to DIS3 in regression 1 and of MEMND11 to PRICE35 and ALD 112 to ALD332 in regression 2 are all highly significant (figure 5.2). However, a Hausman specification test rejects the hypothesis that the difference in the coefficients of regressions 1 and 2 is not systematic and thus indicates that regression 2 is a more efficient estimate (StataCorp. 1999: hausman).

Overall, the locational variables ALDXXX are key determinants of tenure security in northern Mozambique. However, household-level variables also help explain household tenure security, as had been suggested above. While regression 2 appears to be the more efficient estimate, the strong effect of the ALDXXX variables also hide some of the household variable effects on TENURE1. The discussion of the individual coefficients below will therefore utilise both regression results.

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[42] The logit command in Stata 6 cannot account for survey stratification thus giving misleading standard errors for the coefficients. The svylogit command used for both equations as shown in figure 5.2 accounts for survey weights, clusters, and stratification but does not calculate a pseudo-R^2 value (StataCorp. 1999: svy).

Interpretation of the Regressions

Both specifications include some variables which are individually insignificant but which help control for a variety of household characteristics and which are jointly significant with other, related variables. The effects of household labour supply on land tenure insecurity appeared ambiguous a priori and in practice are insignificant in both regressions (even when testing for the joint significance of MEMND11 and MEMND12, data not shown). This implies that very large households at least do not suffer from noticeable land tenure insecurity, which confirms the results from the cultivated area regressions which showed that households with changing household size in northern Mozambique have flexible land access. However, this result contradicts evidence from Uganda where a larger household size increases land tenure significantly (Baland et al 1999: 30).

Interestingly, refugee status (REFUGEE1), female-headed status (FEMHEAD1), and the age of the household head (AGEHEAD3 and AGEHEAD4) are not significant determinants of tenure insecurity, as had been expected and as research for southern Mozambique (Gengenbach 1998) and for Uganda (Baland et al 1999: 29) has confirmed to be important. Instead, households which experience more current illness (ILLDAYS2) face higher insecurity.

Households with a higher level of maternal education and residing in areas with fewer infrastructure problems (EDINFRA3, EDINFRA4) report less tenure insecurity (though the effect diminishes with higher levels of education). Both of these variables are similar in both regressions but are only jointly significant in regression 1 (test statistic not shown). This result confirms the importance of investment in public infrastructure and education to generate an environment of greater tenure security (Feder and Feeny 1991: 143).

The results so far indicate that land tenure institutions are not very responsive to household characteristics such as household size, gender and age composition. Furthermore, these results indicate how the process of tenure individualisation (Baland et al 1999) in northern Mozambique is lagging behind other regions. It is not inconceivable that, unlike hypothesised above, the process of tenure individualisation (or social change more broadly) has been slowed down by the war, especially with high war-induced isolation and transaction costs.

For the household land characteristics, their expected effects on land tenure security appeared ambiguous though important ex ante. In fact, the two variables RAIN4 and AREA45 are strongly significant in both regressions. RAIN4, defined as the proportion of the area cultivated with a lack of rainfall, is interesting as it represents a risk of production which appears to raise the odds of land tenure insecurity. This may work either through

social allocation mechanisms which reduce the land allocation to households which experienced "bad luck" in previous seasons. Alternatively, and more endogenously, this may work through households voluntarily giving up some tenure security as its reserves (e.g. of stored grain) are diminished and as the household may have to move some household members to other locations to better spread its risks.

The experience of serious productions risks in the precarious post-war period thus appears to affect the confidence of households in the control of their most important remaining production asset, land. This contrasts with the above finding of no effect of female-headedness, which does not reduce the ability to undertake farming. If households experienced such production shock repeatedly, this observed reduction in tenure security may represent a transition mechanism by which the household adjusts to crises and changes its activity portfolio or by which households are pushed closer to starvation.

The area cultivated per capita in the preceding agricultural year (AREA45) is another important determinant of household tenure insecurity in both specifications. Note that AREA45 is an exogenous variable as TENURE1 measures insecurity for the second sample year 1995-96 while AREA45 refers to 1994-95. The coefficients indicate that households with higher land endowments per capita experience significantly higher land tenure insecurity. This suggests that households with small farm sizes (i.e. a low land quantity) have fairly secure land tenure (i.e. a high subjective land quality), as if to compensate for the small quantity of land with a better quality of land. Female-headed households for example have much smaller land endowments per capita (figure 4.5) but their land tenure security in turn appears to be higher. This is not because they are female-headed households (FEMHEAD1 is insignificant in figure 5.2) but simply because their land endowments are small.

No other land variable is significant in either regression. In particular TENURE3 (measuring the ease of land access) might have been expected to be a determinant of land tenure insecurity. However, as already indicated by figure 5.1, TENURE3 is not a significant determinant of TENURE1 and an unreported test of endogeneity confirms that this result is not due to a potential endogeneity bias.

Better household technology, higher household assets and stronger social capital are expected to lower land tenure insecurity. While the number and types of household tools are not significant, having more local grain mills near the household (MILL11) increases tenure insecurity significantly in regression 1. This may result from the fact that grain mills are more likely to be located in more densely populated areas where in turn the population pressure on land and thus tenure insecurity may be higher. In fact, the correlation

coefficient between MILL11 and the district level population density is positive and highly significant. The variable MILL11 may thus proxy for a population density effect on tenure insecurity. In regression 2 this effect is not significant as it is already accounted for by the location variables ALDXXX.

Unexpectedly, households with more large animals in late 1992 (ANIMAL1) experience larger tenure insecurity in 1995-96. It is possible that the local community believes that households with relatively large livestock holdings require less area for cultivation and instead more area for grazing. Grazing land is not commonly considered to be under specific household control in northern Mozambique and the response coded in TENURE1 would not typically have considered non-cultivated land. This result represents an instance where livestock keeping and crop cultivation do not necessarily create synergies as they are sometimes considered to do in African agriculture.

A similar coefficient obtains for ASSET13, an indicator of the household asset endowment in 1992. However, this variable and the variables capturing tool and tree ownership are not significant, and as such some have been entirely omitted from the regression. Note that neither TREE01 nor TREE11 are endogenous as established by a DWH test of endogeneity (data not shown, see chapter 3 for a discussion of the methodology). Their non-significance may be related to the fact that asset endowments are quite low on average in the post-war period.

It is surprising that tree ownership is not significant as planting trees on or near fields in northern Mozambique is often considered to be a way of improving tenure security. From my interviews with farmers it appears that arable land and tree ownership are separable in northern Mozambique, so that secure tree ownership need not imply secure land ownership even for adjacent land. In addition, the insignificance of the tree variable may derive from the nature of the TENURE1 variable. In particular, tenure status on a per plot basis as implemented in other studies (e.g. Baland et al 1999) may have tested this relationship more subtly. This study does indeed find that planting trees increases the land tenure security, in particular for households with other low asset endowments, and acts as a first step to building up a portfolio of tangible assets and intangible asset rights.

Household heads in a position of local authority (AUTH12) and household heads born locally (ORIGINM1) are the only significant social capital variables in the insecurity regressions. An affirmative answer to either question significantly reduces a household's land tenure insecurity, emphasising the important role of local political and social connections in obtaining secure land tenure for a household. This finding conforms to previous research on Mozambican land tenure systems (Gengenbach 1998).

Unlike expected, the variable ANCEST1 (which codes 1 if some ancestors are buried locally) is not significant. This might either indicate a war-induced reduction of some channels of social support and cohesion, as hypothesised above. In Uganda, land held for a longer period by the household is more securely held (Baland et al 1999: 29). Unfortunately, this interesting variable was not included in the FSP survey. However, the strongly significant and, in absolute terms, large coefficients for AUTH12 and ORIGINM1 point to a similar process where land tenure is earned over time and through social rank.

This would suggest that changes in mobility brought about either by the war or through the lowering of transaction costs in the post-war period will lead to reductions in land tenure security and hence weaken the social safety net of the rural poor. In interviews, Mozambican policy analysts also emphasised the long-term role of household land rights in rural areas (even for urban middle class households), both as an expression of family identity and to generate revenue or to maintain an income source of last resort. A similar observation has been made in a different context in Ghana (Berry 1997). The evidence from the FSP survey then supports the role of social capital in maintaining tenure security, though much depends on what is being measured and on how this is measured.

A more dense labour market at the village level (LABOUR4) reduces land tenure insecurity but is only significant in regression 1. In regression 2, village-level effects are captured by the location variables ALDXXX. Higher population density could have been expected to increase labour market density and thus to raise tenure insecurity. Instead, stronger labour markets can help households to secure their land tenure by contracting in labour to help farm all available household land and by providing alternative, off-farm income opportunities which reduce the need for distress land sales (Baland et al 1999: 7, Reardon et al 1992).

Higher village-level cotton yields in monocropped cotton fields (YIELD08) significantly increase land tenure insecurity in either regression. This variable can help capture strong differences between locations with respect to rainfall, land characteristics, and market and institutional arrangements, all of which may affect farm productivity. It is not entirely clear why higher cotton yields should lead to increased tenure insecurity. One factor may be the increased competition for better land between households in more productive cotton areas (cf. chapter 6). This would suggest that stronger market-oriented rural areas undergo stronger structural changes including in their land institutions.

The price variables PRICEXX have been included in the regressions to further control for unobserved differences between households, rather than as indicators of household

characteristics. The three price variables, which control for further unobserved effects, are jointly significant in both regressions (test statistics not shown).[43]

Finally, the two potentially endogenous variables income and land investment will be discussed. First, it is possible that land tenure insecurity is related to income per household or per capita. DWH tests for endogeneity indicate that INCOME04 cannot be considered endogenous in either TENURE1 regression (data not shown). Furthermore, when included in either regression 1 or 2 INCOME04 was highly insignificant, suggesting that tenure insecurity is not related to household income levels (data not shown).

Second, and as postulated in the context of equation 4.2c' above, land tenure insecurity may be related to the level of land investment undertaken by a household (INVEST01, discussed below). Several studies of African land tenure systems have, for example, found that land investment increases household property rights (Bruce and Migot-Adholla 1994, Migot-Adholla et al 1991) and vice versa (Place and Hazell 1993). In one study, this effect worked particularly for the less well land-endowed households thus partly compensating for their smaller quantity of land with better land characteristics (Baland et al 1999). In the FSP survey, TENURE1 and INVEST01 are significantly correlated with a correlation coefficient of -0.17. DWH tests of endogeneity, however, did not suggest that this variable is endogenous in either regression 1 or 2 while INVEST01 is also insignificant in both regressions (data not shown).

Methodologically, this latter result may be due to the aggregate level at which tenure insecurity has been measured in this survey. If the data had been collected on a per plot basis, then more accurate estimates of the relationship between investment and tenure insecurity may have been possible.

Conceptionally, the finding derives from the legacy of the war. In the post-war period, households have strong incentives not to invest, with tenure insecurity being only one of the reasons for this behaviour. While the two variables TENURE1 and INVEST01 may be related, it is likely that other economic incentives overshadow the motivation for not undertaking more post-war household investment. The finding from Uganda that tree investments increase tenure security may thus not apply for the late post-war period or less war-affected areas in Mozambique (Baland et al 1999: 28). But given that the war affects both tenure insecurity and tree investments (as will be shown further below), the causality from investment to tenure insecurity is very hard to detect at the household level.

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[43] See the beginning of this section for a discussion of the location variables DISX and ALDXXX.

In summary, the empirical analysis does not support the view that the war experience has entirely shifted the emphasis in the determinants of tenure insecurity from the community to the household level. Some household-level variables such as education, risk as experienced through rain, area farmed, cattle endowments, and social capital are significant. These are important variables which are also strongly shaped by the war. However, the many insignificant household-level variables such as household size, age of the head, female-headedness, and physical assets as well as the strong village level variables such as local labour markets, cotton yields, and village level dummies suggest that community-wide factors are also important determinants of land tenure insecurity. In addition, land investment is not a determinant of land tenure insecurity, unlike suspected a priory.

The analysis clearly shows that in the post-war, land abundant case of Mozambique land tenure insecurity cannot be assumed to be exogenously given. Nevertheless, the degree of household-level determination is relatively low and village level effects matter a lot. A dataset with plot-level data would have permitted a different methodology which might have provided useful complementary insights.

The change in Mozambican land law towards formalised communal land tenure rights may therefore be appropriate to the post-war setting. It is not clear, however, how households and communities would cope with a gradual shift of tenure determination to the household level. This would require further analysis, preferably involving repeat observations at the plot level.

Land Investment

This section will analysis the empirical determinants of investment in land, which are predicted to be low. It is also expected that the area and the quality of land farmed are chosen simultaneously and that land tenure insecurity may reduce land investment.

Summary Statistics and Methodological Considerations

Households in the FSP sample undertake a range of investment activities aimed to improve soil quality and other land characteristics. The FSP survey counted the number of different land investment activities that households undertook in 1995-96 (INVEST01) but did not attempt to quantify each activity, for example by measuring the number of hours

committed to each type of investment project or the value of each project. Thus the scale and the quality of the investment are not known.[44]

Figure 5.3 summarises the key variable of interest, INVEST01, and also indicates the relative frequency of the different activities. On average, 69.5% of all households undertook at least one investment project in 1995-96, and on average households undertook 1.22 land-related investment activities in 1995-96, with a conditional mean of 1.76 for households with one or more investment projects. Half a percent of all households undertook four types of land-related investment projects, which is the maximum number. Even though there is no data on value or time spent on these projects or any inter-temporal data to allow comparisons, land investment appears low given that these households derive over 82% of their net household income from agricultural activities.

Investments in fruit trees and cashew trees were clearly the most common activities, with about 40% of all activities belong to each group. This is a common pattern for poor, rain fed agriculture in southern and east African agriculture (Baland et al 1999: 27). The remainder is split between "other" (not further specified) activities (9%), crop storage (7%) and investment in fences and terracing (5%).

This list of activities shows how post-war farm households do not yet invest heavily in soil- and land-improving projects, for example by fencing or irrigating land. Instead, planting and tending trees is the dominant activity. This is probably due to the relative safety of trees from theft and their broad range of benefits, including fruit to broaden the household diet, nuts to earn cash, possibly some benefits to land tenure (see the discussion above though), fire wood, and (this was often mentioned in interviews with farmers) shade for the family to work in. The main disadvantage of investing in trees is that some of their benefits only materialise after many years. However, this seems to be outweighed by their various advantages.

The FSP survey also asked households why they might plan not to invest in the next year. Few households said they would not invest in trees but the main reasons for not planning to build terraces were a perceived lack of need (50.4% of all those not planning this type of investment for 1996-97) or a lack of resources to carry out such project (40.6%). The main reasons for not planning to construct fences were again a perceived lack of need for fences for various reasons which may also be linked to the low incidence of livestock ownership in

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[44] Similar definitions of household land investments have been used in other studies, as discussed by Place, Roth and Hazell (1994: 31).

the sample area (83.7%) and a lack of resources to construct them (11.0%). Crop storage facilities were in principal desired but were not planned for fear of thieves (84.2%) rather than a lack of need (11.2%).

These subjective reasons for low investments in land point to three conclusions. First, households are not very keen to intensify their agricultural mode of production. They may be constrained in doing so for various reasons but from the reasons they give, households prefer to rely on the extensive margin, to use a concept introduced earlier in this thesis. In other words, households do not appear to aim to increase farm productivity by investing in land.

Second, households did not say that they did not intend to invest due to a lack of funds, a common response in household surveys where participants may hope for increased aid donations after listing requests for tangible resources. This was confirmed in my own farm interviews, in which households appeared keen to air their opinions and where survey fatigue had not yet set in.

Third, 256 of 322 households not planning crop storage investments specifically pointed to theft as their main concern. This is a direct evidence of how uncertainty and weak law enforcement prevent investment. The war directly raised crime rates (e.g. through making guns more widely available and reducing the respect for the law) but it also weakened public infrastructure especially in rural areas thus weakening law enforcement and raising the net returns to criminal activity (see also chapter 3 for a discussion of how the war affected public spending).

The nature of the dependent variable INVEST01 suggests that either a survey linear regression (regression 1) or a survey ordered logistic regression (regression 2) may be appropriate modelling techniques. Both regressions are reported in figure 5.4. They are both highly significant and the linear specification has a good fit with an R^2 of 0.51. Furthermore, the signs of the coefficients and their significance (as shown by their p-values) are very similar, suggesting that the estimates are robust. All groups of variables (household characteristics, plot characteristics etc) as grouped in figure 5.4 are jointly significant (test statistics not shown).

Interpretation of the Regressions

This section will analyse the cross-sectional determinants of the number of types of household-level investments in land (INVEST01, also called "land investment" for simplicity). The two most interesting conclusions from this section are that larger farms undertake more land investment (which contradicts many other empirical findings) and that

land tenure insecurity reduces land investment (which corresponds to other empirical findings). Other interesting findings from this analysis include the strong effects of household life-cycle changes, education characteristics and village fixed effects on land investment.

The linear and quadratic household size variables MEMND11 and MEMND12 are jointly highly significant in both regressions. This indicates that larger non-dependent household sizes have an increasing effect on land investment, as was expected. This may relate to the better availability of labour for undertaking these investments, to the longer planning horizon which may be adopted by larger households (which are likely to have both older and younger household members), or to economies of scale effects (where small scale investments are less worthwhile than larger investments). The latter argument seems plausible for investments in irrigation and fencing but less so for investments in trees, which may be more related to household planning horizons. More dependent household members (MEMD11) have a negative effect on land investment, probably as such households have fewer spare resources available for investments at that point of the household life cycle.

The age of the household head (AGEHEAD3, AGEHEAD4) has a significant quadratic effect on land investment, with the minimum being between 28.3 years (regression 1) and 33.6 years (regression 2). Therefore between 19% and 32% of the sample face declining investments while the rest of the sample increases land investments with increasing age of the household head. As predicted, this is another life-cycle effect. Very young and older household heads appear to have enough spare resources to invest in land improvements. Middle-aged heads of households instead control households during a phase of the life cycle where the subjective wage is high and production is geared towards current returns. Households at this point of the life cycle hence do not focus on land improvements but on obtaining short-term returns.

The refugee variable REFUGEE1 has an unexpected positive but insignificant coefficient in both regressions. The coefficient for the number of days spent ill in the household in the proceeding agricultural year (ILLDAYS1) is negative, as expected, but this variable is also insignificant. In addition, the time constraint variables (TIMEXX) were highly insignificant and have thus been dropped from both regressions.

Total accumulated household education in areas with fewer infrastructure problems (EDINFRA7, EDINFRA8) has a quadratic effect on land investment, with the maximum being near 11 years of education. These maxima imply that almost 90% of the sample increase their land investments as they increase their educational attainment. Raising the

very low levels of human capital in rural areas thus has strong spill-over effects in raising agricultural investments. It is not only paternal or maternal education which matters for raising agricultural investments but the entire household human capital as alternative educational variables proved less efficient regressors. Finally, this specification implies that there are strong complementarities between raising human capital and public infrastructure, which confirms the findings of a similar investigation into household investment in land in Uganda (Roth et al 1994: 192-5).

There is a clear positive effect of area cultivated per capita in 1994-95 (AREA45) on current investment in land. As in the TENURE1 regression, AREA45 has been included in the regressions to avoid problems of endogeneity. The t-test of the null hypothesis of no endogeneity for AREA45 actually yields the test statistic t (38) = -2.210, which is statistically significant at 95%. However, households decide the cultivated area for the agricultural year 1994-95 in mid-1994 (AREA45) and then, at least a year later, undertake the investments in land (INVEST01). From that point of view it is misleading to speak of endogeneity, even if there is statistical evidence to suggest otherwise.

However, to overcome any remaining statistical evidence of endogeneity, an instrumental variable regression for INVEST01 has been estimated as well, with AREA45 as the presumed endogenous variable. The first stage of this 2SLS regression is significant at 99% and has a good fit with an R^2 of 0.63 (data not shown but see figure 4.5 for a similar result). The second stage is shown in figure 5.5. It is also highly significant and has an R^2 of 0.47, which is slightly lower than that of regression 1 in figure 5.4. The key differences to the regressions of 5.4 are that the land coefficient has increased about threefold, that the effect of household size on investment has changed to a quadratic (though further inspection indicates that a linear specification with only MEMND11 would be preferable), and that the household technology (TOOL11) has become insignificant (see also the discussion on this coefficient below).

The most important change appears to be the change in the coefficient for AREA45. This coefficient suggests a land investment elasticity for area cultivated per person of 0.65, so that a 5% increase in farmed area per capita induces an increase in land investment of about 3%. This evidence significantly strengthens the previous observation of economies of scale in rural production. Larger farms may find it easier to produce enough surplus to build up investments and on average they may find investments cheaper to implement than smaller farms. In particular, larger farms may internalise benefits of investments and may more easily overcome the transaction costs associated with implementing investments. These costs in turn will be higher in a post-war environment, thus favouring larger farms,

especially in strongly war-affected rural areas. Effectively, larger farms self-insure against the costs of conflict through scale economies.

Other studies of smallholder investment in land quality in LDCs have found the opposite relationship (Baland et al 1999: 31, Barrows and Roth 1990: 275), with smaller farms investing more and thus increasing the tenure security for their smaller land endowment, or no significant relationship between farm size and land investment (Foltz et al 2000: 24). This suggests that in northern Mozambique in the immediate post-war period such equalising process is not taking place, with larger farms instead increasing its land investments. This also indicates that smaller farms are more vulnerable to the effects of war and may find it more difficult to escape these effects through endogenously generated and re-invested agricultural surpluses. A small farm size may thus be one obstacle to escaping a post-war poverty trap.

The three land characteristic variables AREAFER5, PEST01, and RAIN4 are jointly highly significant and each variable is (almost) significant at 90%. Interestingly, poor soil quality and a high degree of crop pests in the fields reduces investments in land, perhaps because the returns seem unfavourable. A higher degree of rain shortage, however, has the opposite effect, increasing land investment. This shows how households do not always reduce investment in the face of risk, especially when some investments can help manage the underlying risk. Distance to the fields and the subjectively perceived availability of new land both do not affect INVEST01 significantly and have thus been omitted from the regressions.

TOOL11 measures the number of household tools per capita and thus proxies broadly for household technology. The variable is marginally significant in both regressions in figure 5.4, where it has positive coefficient as expected, but it is highly insignificant (and the coefficient much reduced) when included in the 2SLS regression in figure 5.5. This suggests that household tools and technology encourage investments but also increase area farmed (figure 4.5), so that TOOL11 in part proxies for area in figure 5.4.

A surprisingly negative coefficient is that of MILL01, which is a categorical variable indicating if there is a grain mill near the household. Such opportunity acts as a substitute for investing in land, rather than as an opportunity to help raise funds to undertake complementary investments in land.

The other household asset variables (ANIMAL5, DONA1, and CYCLONE2) are positive as expected. Note that DONA1 indicates that the household has been a recent recipient of government or NGO aid. This is typically not a large share of household income and is quite impossible to interpret as the rules for the distribution of assistance are not known in

detail. It is merely included here to control for possible differences in household asset endowments. Note also that CYCLONE2, while technically controlling for the negative effects of the cyclone, in fact tends to control for household tree ownership, thus representing another asset control variable which is unsurprisingly positive.

Of all possible social capital variables only ANCEST1 and AUTH12 are jointly significant, with ANCEST1 also being individually significant. The positive coefficient for ANCEST1 indicates that stronger local ties help to undertake land investments. The reasons might be that locally well rooted households plan to stay in their villages for a longer period thus extending their planning horizon and strengthening their property rights of land investments. The negative coefficient for AUTH12 is more surprising, though it may be that local chiefs do not feel the same need to invest in land as they have more secure income opportunities than most other households.

The village-level labour and output market variables LABOUR5 and MARKET8 were expected to raise investment but in fact they reduce it significantly. A similar argument as for MILL01 may apply here. Furthermore, it is possible (though difficult to confirm with the current data) that households undertake land investments primarily to secure their subsistence income activities, rather than their crop market participation. Thus better alternative income opportunities through labour and crop markets may reduce on-farm subsistence activities to a small degree.

These results contrast with evidence from East Africa where market imperfections restrict land investments (Barrows and Roth 1990: 294). Either the different results derive from the effects of war or from the different definitions of the variables used. In particular, the FSP village-level variables used here may not reflect market imperfections per se. Instead the East African evidence may support the earlier finding that education in more accessible areas raises land investment. LABOUR5 and MARKET8 might rather indicate the existence of very strong village level fixed effects.

On the other hand, a higher cotton yield at the village level (expressed in its natural log in YIELDL8) has a significant and positive effect on land investment, suggesting that areas where households can obtain better cotton yields and thus higher profits end up investing more in their land. The price variables PRICEXX and the categorical village variables ALDXXX act primarily to control for otherwise unobservable effects in the regression. The village variables are jointly and many are individually significant so that there appear to be further important village level effects which also help to determine household investment in land.

Finally, the potentially endogenous effects of household income and household land tenure security on land investment will be discussed. Applying the DWH test of endogeneity (chapter 3) with the determinants of household income derived in chapter 7 yields a test statistic of t (39) = -0.012, which is not significant at any reasonable level. The null hypothesis that net household income per capita in 1995 or its natural log (INCOME05 and INCOME04, respectively) are not endogenous can therefore not be rejected. Furthermore, including either INCOME05 or INCOME04 in any regression for INVEST01 shows that household income is not a significant determinant of household land investment.

Testing for the endogeneity of land tenure security is slightly complicated by the fact that TENURE1 is a categorical variable. Applying the DWH test of endogeneity using the residuals of TENURE1, which were obtained from a standard regression, the resulting test statistic under the null hypothesis of no endogeneity is t (39) = 1.764 which is significant at 90%. The hypothesis of no endogeneity can thus be cautiously rejected. Calculating the residuals from a TENURE1 survey logistic regression (using the residuals obtained either from a linear prediction or from the predicted probability of a positive outcome) yields the two DWH test statistics t (36) = -1.573 and t (36) = -1.391, which are only significant at 85% and 80%, respectively. These results imply that exogeneity cannot be rejected convincingly.

As these tests of endogeneity are inconclusive, an alternative method may be to estimate the effect of TENURE1 on INVEST01 in a 2SLS regression. The first stage will again suffer from a degree of misspecification resulting from the modelling of a binary variable using a linear regression command. However, no alternative command for estimating 2SLS regressions with a first stage limited dependent variable is available in Stata 6. In addition, the fit of the first stage regression is quite good with an R^2 value of 0.54 and a highly significant overall specification (figure 5.6A) thus restricting the degree of error at this stage. The second stage regression (figure 5.6B) is also highly significant and has an R^2 of 0.46 compared to 0.47 in the previous 2SLS regression and 0.51 in regression 1.

The coefficients of the second stage regression appear quite robust when compared to regression 1 in figure 5.4. In particular the coefficients for non-dependent household size again indicate an exponential effect on land investment, instead of the quadratic one in figure 5.5. Most importantly, the coefficient for TENURE1 is significant at 95% and suggests a strong negative effect of household-level land tenure insecurity on investments in land (i.e. a positive effect of tenure security on investment).

This result contrasts interestingly with other findings from rural household surveys. In Nicaragua, a similarly poor and war-affected country (Brück et al 2000), an econometric study of total household investment and land-specific investment found that tenure security did not affect either type of investment significantly (Foltz et al 2000). In fact, only locational variables appeared significant thus raising doubts over the specification adopted in that study. In particular, the possible endogeneity of tenure and investment was not tested or controlled explicitly thus perhaps explaining the result obtained.

In Rwanda, one study observed a positive effect of land tenure security on investment but no effect on the type of land improvement (Place and Hazell 1993: 14-5). The observed significant effect can be explained by Rwanda's very high population density. The interesting fact is then that a similar effect would also obtain in Mozambique, with a much lower population density. This indicates how Boserupian theories of induced innovation must also consider additional determinants of investment, beyond those related to population density.

More land tenure security raises land investment in Thailand (Feder and Feeny 1991: 145) where the effect works through the credit market. This effect cannot apply to the case of Mozambique as credit markets are non-existent in post-war rural Mozambique (cf. chapters 2 and 3). The most likely explanation of the tenure security effect on investment is through the lowering of the risk of loosing an investment which leads to a higher net present value of land investment. Such effect was observed in several other African countries and would apply in peace- and war-time economies alike.[45]

The effect of tenure status on land investment could be analysed more subtly using panel data at the field level which could account for local fixed effects. Alternatively, Feder made use of nearly experimental data from Thailand where he compared the land investment of tenure secure households with those of squatting households, which suggested that tenure status has a strong impact on land investment behaviour (1987). The analysis so far extends the dominant view that tenure security raises land investment to the case of the rural post-war period in northern Mozambique.

Beyond the issue of tenure-specific insecurity, it appears that after so many years of fighting and the continued tension between the two sides of the war, especially in the

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[45] Empirical studies which observe or discuss such effects for Sub-Saharan Africa include Baland, Gaspart, Place and Platteau (1999: 28), Besley (1995b), Hayes, Roth and Zepeda (1997: 371), Migot-Adholla, Hazell, Blarel and Place (1991: 155), Place and Hazell (1993: 13), and Roth, Cochrane and Kisamba-Mugerwa (1994: 190-7).

countryside, households still did not trust the peace agreement and were thus unwilling to commit to long-term investment. This was borne out by interviews with smallholders in mid-1995 and in early 1999. Smallholders repeatedly reported that there would be another war as there always had been war in the province and that they were preparing for such war by building new hide-outs in the bush. Such sense of insecurity and uncertainty is difficult to measure for the purpose of survey work but it is likely that household behaviour, especially investment, is strongly affected by such concerns.

In summary, the expectation that land investment in the post-war period would be low was supported through the evidence. The area farmed was also found to be a key determinant of land investment, with larger farms undertaking more investment, which contrasts with empirical results from peace-time economies. This is likely to relate to the ability of larger households to protect their investments and thus to overcome the negative effects of conflict. This effect is thus linked with the other observed effects of household size and age of the head of household.

The degree of endogeneity of the area variable could not be resolved entirely. On the one hand the DWH test of endogeneity yielded a significant test statistic. On the other hand, endogeneity does not appear likely given the definition of the variables. The currently available data cannot resolve this ambiguity but the evidence on the significant positive effect of land size on land investment is strong.

As expected, land tenure insecurity lowers land investment, which corresponds with findings from many other studies though none had so far confirmed this effect for the post-war context. The key post-war transmission mechanism of this effect is likely to be the negative effect of insecurity on the net present value of the investment, not the credit market or resale effects. In addition, post-war uncertainty is generally higher than uncertainty in peace-time economies and this effect may re-enforce the effect of tenure insecurity.

Other key determinants of land investment include life-cycle, subjective wage, social institution effects as well as joint education and infrastructure effects, all of which may reinforce post-war poverty traps for many poor households. Finally, location-specific fixed effects also appear to be very important. These may include unobserved variables which were not enumerated through the FSP survey. Panel data at the field level would yield more detailed results but were unavailable for this period and area of analysis.

5.6 Summary

This chapter analysed two further aspects of land use patterns in post-war northern Mozambique. It found that the common theoretical specification of the PH model is quite limited and could be usefully extended. In particular, farm size was shown not to be fixed, despite the high degree of land inequality in northern Mozambique. The modelling approach adopted in this chapter is thus that land access, land tenure insecurity and land investment could be potentially endogenous and simultaneously determined, especially in a war-affected economy. The post-war land production model of northern Mozambique can thus be summarised by the following variants of equations 4.1a to 4.3a:

$$A_i = f(\mathbf{L}_{Ai}, \mathbf{F}_{Ai}, \mathbf{K}_{Ai}, \mathbf{V}_{Ai}) \quad (4.1d)$$

$$T_i = f(\mathbf{L}_{Ti}, \mathbf{F}_{Ti}, \mathbf{K}_{Ti}, \mathbf{V}_{Ti}, A_{i\,t-1}) \quad (4.2d)$$

$$I_i = f(\mathbf{L}_{Ii}, \mathbf{F}_{Ii}, \mathbf{K}_{Ii}, \mathbf{V}_{Ii}, A_{i\,t-1}, T_i) \quad (4.3d)$$

where the land variables $A_{i\,t-1}$ refer to past values of A_i.

The key findings of this chapter are that even in the post-war economy land tenure insecurity is predominantly determined at the village level and that land investment does not affect tenure insecurity. Land investment is very low and is negatively affected by tenure insecurity. Area farmed in the previous agricultural year is a key determinant of both tenure insecurity and land investment. This result contrasts with the literature, which generally shows that smaller farms invest more in land quality.

The finding from Mozambique can be explained with the detrimental effects of war on household opportunities, which encourage investment in intra-household controlled, subsistence resources. Life-cycle and social capital variables are also important determinants of land investment, which indicates that land investment plays an important role for war-affected households. However, very war affected households cannot engage in land investment and for them the lack of access to land investments may represent a post-war poverty trap.

Figure 5.1: Land Tenure Insecurity Summary Statistics

(in %)		TENURE1		
		Yes	**No**	**Total**
TENURE3	Yes	21.7	20.6	**42.3**
	No	30.5	27.2	**57.7**
	Total	**52.2**	**47.8**	**100.0**
	ALD111: Mararange	3.38	0.78	**4.16**
	ALD112: Nacuaia	3.45	0.71	**4.16**
	ALD113: Nacuca	3.20	0.69	**3.89**
	ALD114: Mondlane	1.83	0.32	**2.15**
	ALD121: Nacimoja	6.45	3.98	**10.43**
	ALD122: 25 Setembro	4.90	3.49	**8.39**
	ALD123: Linde	14.37	2.51	**16.88**
	ALD214: Mepine	2.42	2.29	**4.71**
	ALD215: Natete	0.09	3.32	**3.41**
	ALD221: Napipine	3.97	0.25	**4.22**
	ALD231: Varrua	0.00	3.51	**3.51**
	ALD232: Napita	0.37	3.45	**3.82**
	ALD312: 3 Fevereiro	0.00	9.51	**9.51**
	ALD313: Namacopa	1.68	5.50	**7.18**
	ALD321: Nacololo	1.92	6.31	**8.23**
	ALD332: Picadane	4.16	1.19	**5.35**
	Total	**52.19**	**47.81**	**100.00**

TENURE1: Is the household worried about land tenure security in 1995-96? TENURE3: Is it very easy to obtain new arable land in 1995-96? ALDXXX: The FSP sample villages. Data are weighted. Pearson test statistics TENURE1 and TENURE3: uncorrected chi2 (1) = 0.093; design-based F(1, 39) = 0.036, P = 0.85. Pearson test statistics TENURE1 and ALD: uncorrected chi2 (15) = 159.507; design-based F(2.35, 91.61) = 4.622, P = 0.01. For a discussion of the Pearson test of independence, see StataCorp. (1999: svytab).
Source: FSP data and own calculations.

Figure 5.2: Two TENURE1 Regressions

TENURE1	Regression 1				Regression 2			
	Survey Logistic Regression				Survey Logistic Regression			
	Number of obs = 371				Number of obs = 351			
	Number of strata = 4				Number of strata = 4			
	Number of PSUs = 43				Number of PSUs = 40			
	Population size = 32539.53				Population size = 31397.55			
	F(20, 20) = 6.53				F(29, 8) = 13.36			
	Prob > F = 0.0000				Prob > F = 0.0004			
	Odds Ratio	St Err	t	P>|t|	Odds Ratio	St Err	t	P>|t|
MEMND11	.6343775	.2154108	-1.340	0.188	.814265	.3428042	-0.488	0.628
MEMND12	1.031702	.0242925	1.326	0.193	1.013879	.0307488	0.454	0.652
REFUGEE1	.3409753	.245373	-1.495	0.143	.5676687	.4836079	-0.665	0.511
ILLDAYS2	1.01013	.0057568	1.769	0.085	1.018805	.008338	2.276	0.029
EDINFRA3	.2750457	.2145804	-1.655	0.106	.3244666	.3948155	-0.925	0.361
EDINFRA4	1.188816	.1621007	1.268	0.212	1.183143	.2937455	0.677	0.503
RAIN4	2.953299	1.441563	2.219	0.032	3.327859	1.585895	2.523	0.016
AREA45	4.078105	3.019658	1.898	0.065	6.278375	5.650474	2.041	0.049
MILL11	1.730452	.2229839	4.256	0.000	1.360372	.3616191	1.158	0.255
ASSET13	1.891504	.9253247	1.303	0.200	2.62121	1.631185	1.549	0.130
ANIMAL1	1.115851	.0525256	2.329	0.025	1.198124	.0986927	2.194	0.035
AUTH12	.0882413	.0655062	-3.270	0.002	.0486402	.0389458	-3.776	0.001
ORIGINM1	.256844	.0759316	-4.598	0.000	.5474475	.1258245	-2.621	0.013
LABOUR4	.9032267	.0416165	-2.209	0.033	.914716	.0764788	-1.066	0.293
YIELD08	1.002102	.0007458	2.822	0.007	1.014611	.002576	5.713	0.000
PRICE15	2.969847	2.304984	1.402	0.169	7.645423	7.799522	1.994	0.054
PRICE24	.0675718	.0759919	-2.396	0.021	.3644123	.3476091	-1.058	0.297
PRICE35	3.104973	1.245485	2.825	0.007	195.1725	119.1254	8.641	0.000
DIS1	2.436915	2.454256	0.884	0.382				
DIS3	.32557	.2641535	-1.383	0.175				
ALD112					221.2673	120.3862	9.924	0.000
ALD113					378.7621	596.6493	3.769	0.001
ALD121					123.7255	87.21613	6.835	0.000
ALD122					298682.6	450922.5	8.351	0.000
ALD214					709.2004	671.8375	6.929	0.000
ALD215					383.3809	629.3204	3.624	0.001
ALD221					278621.9	469362.6	7.443	0.000
ALD232					2273.514	3197.415	5.496	0.000
ALD313					10.12824	12.62956	1.857	0.072
ALD321					11898.09	19916.66	5.606	0.000
ALD332					258.2189	210.6172	6.809	0.000

TENURE1: Is the household worried about land tenure security in 1995-96? Hausman test of the null hypothesis that the difference in the coefficients is not systematic: chi2 (18) = 70.17, Prob>chi2 = 0.000. Pweight: WEIGHT2, strata: CATEG1, PSU: ALD.

Notes on Regression 1: Adjusted Wald test of zero coefficients for the variables MEMND11 to PRICE35: F(18, 22) = 5.70, Prob > F = 0.000. Adjusted Wald test of zero coefficients for the variables DIS1 and DIS3: F(2, 38) = 5.10, Prob > F = 0.011. Command: svylogit TENURE1 MEMND11 MEMND12 REFUGEE1 ILLDAYS2 EDINFRA3 EDINFRA4 AREA45 RAIN4 ANIMAL1 ASSET13 MILL11 AUTH12 ORIGINM1 LABOUR4 YIELD08 PRICE15 PRICE24 PRICE35 DIS1 DIS3, or.

Notes on Regression 2: ALD231~=0 predicts failure perfectly; ALD231 dropped and 20 observations not used. ALD111, ALD114, ALD123 and ALD312 dropped due to collinearity. Adjusted Wald test of zero coefficients for the variables MEMND11 to PRICE35: F(18, 19) = 9.07, Prob > F = 0.000. Adjusted Wald test of zero coefficients for the variables ALD112 to ALD332: F(11, 26) = 12.64, Prob > F = 0.000. Command: svylogit TENURE1 MEMND11 MEMND12 REFUGEE1 ILLDAYS2 EDINFRA3 EDINFRA4 AREA45 RAIN4 ANIMAL1 ASSET13 MILL11 AUTH12 ORIGINM1 LABOUR4 YIELD08 PRICE15 PRICE24 PRICE35 ALD1* ALD2* ALD3*, or.

Source: FSP data and own calculations (010112a).

Figure 5.3: Land Investment Summary Statistics

	Mean (#)	St Err	Share (%)
Actual Investment Projects 1995-96 (INVEST01)	1.22	0.12	
INVEST01 by Number of Types of Projects			
No Projects			30.5
1 Type of Projects			27.3
2 Types of Projects			32.5
3 Types of Projects			9.2
4 Types of Projects			0.5
Total			100.0
INVEST01 by Types of Projects			
Investment in Fruit Trees			40.5
Investment in Cashew Trees			38.6
Other Investment			9.0
Investment in Crop Storage			6.8
Investment in Fences			4.6
Investment in Terraces			0.5
Total			100.0
Planned Investment Projects 1996-97 (INVEST02)	0.64	0.11	

Data has been weighted.

Source: FSP data and own calculations.

Figure 5.4: Two INVEST01 Regressions

INVEST01	Regression 1				Regression 2			
	Survey Linear Regression				Survey Ordered Logistic Regression			
	Number of obs = 371				Number of obs = 371			
	Number of strata = 4				Number of strata = 4			
	Number of PSUs = 43				Number of PSUs = 43			
	Population size = 32539.53				Population size = 32539.53			
	F(38, 2) = 1162.56				F(35, 5) = 18.18			
	Prob > F = 0.0009				Prob > F = 0.0021			
	R-squared = 0.5094							
	Coef.	St Err	t	P>|t|	Coef.	St Err	t	P>|t|
MEMND11	.017942	.1125154	0.159	0.874	.1456921	.3521393	0.414	0.681
MEMND12	.0050378	.0069206	0.728	0.471	.0090432	.0215935	0.419	0.678
MEMD11	-.0858845	.0413826	-2.075	0.045	-.283445	.1611885	-1.758	0.087
AGEHEAD3	-.0208224	.0236857	-0.879	0.385	-.0961662	.0794105	-1.211	0.233
AGEHEAD4	.0003675	.0002438	1.507	0.140	.0014331	.0008244	1.738	0.090
REFUGEE1	.2107917	.1469293	1.435	0.159	.7623713	.5187777	1.470	0.150
ILLDAYS1	-.0005367	.000347	-1.547	0.130	-.0011643	.0012	-0.970	0.338
EDINFRA7	.0492739	.0127364	3.869	0.000	.1585528	.0623344	2.544	0.015
EDINFRA8	-.0021389	.0005336	-4.008	0.000	-.0072957	.0031175	-2.340	0.024
AREA45	.5177773	.2460395	2.104	0.042	1.575967	.7385601	2.134	0.039
AREAFER6	-.2137764	.1285008	-1.664	0.104	-.7386233	.434298	-1.701	0.097
PEST01	-.264484	.1278815	-2.068	0.045	-.7428049	.4274943	-1.738	0.090
RAIN4	.2382774	.1398552	1.704	0.096	.7856491	.4232791	1.856	0.071
TOOL11	.1660627	.0957095	1.735	0.091	.483546	.2946583	1.641	0.109
MILL01	.4106271	.220557	-1.862	0.070	-1.45068	.7242425	-2.003	0.052
ANIMAL5	.3822973	.1026784	3.723	0.001	1.002056	.3594019	2.788	0.008
DONA1	.5836673	.1484761	3.931	0.000	1.810471	.4613669	3.924	0.000
CYCLONE2	.4485795	.1670393	2.685	0.011	1.114341	.5778578	1.928	0.061
ANCEST1	.2798297	.1227523	2.280	0.028	1.049114	.4701123	2.232	0.031
AUTH12	-.2684955	.1833978	-1.464	0.151	-.7011127	.5255379	-1.334	0.190
LABOUR5	-.4994025	.1075049	-4.645	0.000	-1.708824	.4612427	-3.705	0.001
MARKET8	-.5201315	.1309891	-3.971	0.000	-2.111568	.5593619	-3.775	0.001
YIELDL8	1.437763	.2325713	6.182	0.000	6.210124	1.429366	4.345	0.000
PRICE14	.5717089	.2853245	2.004	0.052	1.870203	.8863621	2.110	0.041
PRICE23	1.508707	.6958265	2.168	0.036	4.79258	2.714078	1.766	0.085
PRICE34	.5162412	.2020636	2.555	0.015	1.253337	.5413092	2.315	0.026
ALD111	.4431217	.30871	1.435	0.159	2.235219	1.119819	1.996	0.053
ALD112	-.7079322	.5793147	-1.222	0.229	-2.868991	2.102805	-1.364	0.180
ALD113	-.6497382	.2245491	-2.894	0.006	-1.585461	.9095565	-1.743	0.089
ALD123	-.8535091	.350426	-2.436	0.020	-2.546285	1.393807	-1.827	0.075
ALD214	-.9709026	.2052333	-4.731	0.000	-3.480846	.9072853	-3.837	0.000
ALD221	-2.132417	.5063038	-4.212	0.000	-6.617264	2.076506	-3.187	0.003
ALD231	-.3426367	.2189689	-1.565	0.126	-1.300496	.6464863	-2.012	0.051
ALD232	-1.144716	.3408048	-3.359	0.002	-3.842671	1.384129	-2.776	0.008
ALD312	-.9565483	.4181977	-2.287	0.028	-1.841369	1.061612	-1.735	0.091
ALD313	.7226522	.1986434	3.638	0.001	2.041269	.7038631	2.900	0.006
ALD321	.3823424	.2910096	1.314	0.197	2.14077	.9702574	2.206	0.033
ALD332	-1.037365	.2635064	-3.937	0.000	-2.788797	1.027005	-2.715	0.010
_cons	-6.23773	1.038483	-6.007	0.000				
/cut1					28.52662	6.674584	4.274	0.000
/cut2					30.50048	6.891045	4.426	0.000
/cut3					33.54455	6.98817	4.800	0.000
/cut4					37.13263	7.09882	5.231	0.000

INVEST01: The actual number of land-related investment projects per household in 1995-96. ALD114, ALD121, ALD122, and ALD215 were dropped in both regressions due to collinearity. Pweight: WEIGHT2, strata: CATEG1, PSU: ALD. Command Regression 1: svyreg INVEST01 MEMND11 MEMND12 MEMD11 AGEHEAD3 AGEHEAD4 REFUGEE1 ILLDAYS1 EDINFRA7 EDINFRA8 AREA45 AREAFER6 PEST01 RAIN4 TOOL11 MILL01 ANIMAL5 CYCLONE2 DONA1 ANCEST1 AUTH12 LABOUR5 MARKET8 YIELDL8 PRICE14 PRICE23 PRICE34 ALD1* ALD2* ALD3*. Command Regression 2: svyolog INVEST01 MEMND11 MEMND12 MEMD11 AGEHEAD3 AGEHEAD4 REFUGEE1 ILLDAYS1 EDINFRA7 EDINFRA8 AREA45 AREAFER6 PEST01 RAIN4 TOOL11 MILL01 ANIMAL5 CYCLONE2 DONA1 ANCEST1 AUTH12 LABOUR5 MARKET8 YIELDL8 PRICE14 PRICE23 PRICE34 ALD1* ALD2* ALD3*.

Source: FSP data and own calculations (010115a and 010116a).

Figure 5.5: Two-Stage Survey IV Regression for INVEST01 (1)

Second Stage Survey Instrumental Variables Regression

pweight: WEIGHT2 — Number of obs = 370
Strata: CATEG1 — Number of strata = 4
PSU: ALD — Number of PSUs = 42
Population size = 32511.33
F(37, 2) = 5075.52
Prob > F = 0.0002
R-squared = 0.4683

INVEST01	Coef.	St Err	t	P>|t|	(95% Conf.	Interval)
AREA45	1.497112	.4488414	3.336	0.002	.5884802	2.405744
MEMND11	.1662794	.1375822	1.209	0.234	-.1122411	.4447999
MEMND12	-.0026987	.0084603	-0.319	0.751	-.0198257	.0144284
MEMD11	-.0625661	.0446683	-1.401	0.169	-.1529923	.0278601
AGEHEAD3	-.0406206	.0260865	-1.557	0.128	-.0934299	.0121887
AGEHEAD4	.0005239	.0002629	1.993	0.053	-8.23e-06	.001056
REFUGEE1	.2001972	.1494064	1.340	0.188	-.1022602	.5026546
ILLDAYS1	-.0004067	.00048	-0.847	0.402	-.0013784	.0005649
EDINFRA7	.0462645	.0136068	3.400	0.002	.018719	.07381
EDINFRA8	-.0022564	.0005834	-3.867	0.000	-.0034375	-.0010753
AREAFER6	-.142819	.1203893	-1.186	0.243	-.3865344	.1008964
PEST01	-.3203977	.1352844	-2.368	0.023	-.5942667	.0465288
RAIN4	.3022953	.1473476	2.052	0.047	.0040057	.6005848
TOOL11	.0520923	.1094114	0.476	0.637	.1693995	.2735841
MILL01	-.3446393	.2343576	1.471	0.150	-.8190714	.1297927
ANIMAL5	.3085896	.110049	2.804	0.008	.0858072	.5313721
DONA1	.6186469	.2005166	3.085	0.004	.2127222	1.024572
CYCLONE2	.3106194	.1709541	1.817	0.077	.0354591	.6566979
ANCEST1	.3145211	.1360306	2.312	0.026	.0391416	.5899006
AUTH12	-.3544571	.1942034	-1.825	0.076	.7476012	.0386871
LABOUR5	.4923032	.1221006	-4.032	0.000	-.7394829	-.2451234
MARKET8	-.6039892	.1341088	-4.504	0.000	-.8754783	-.3325001
YIELDL8	1.478385	.2518982	5.869	0.000	.9684441	1.988326
PRICE14	.5987394	.2917059	2.053	0.047	.0082116	1.189267
PRICE23	1.358029	.8184666	1.659	0.105	.2988704	3.014928
PRICE34	.384691	.161909	2.376	0.023	.0569234	.7124585
ALD111	.5892288	.3333518	1.768	0.085	-.0856067	1.264064
ALD112	-.7709357	.6428291	-1.199	0.238	-2.072275	.5304038
ALD113	-.3685729	.2904944	-1.269	0.212	-.9566482	.2195023
ALD123	-.7023779	.4003831	-1.754	0.087	-1.512911	.1081553
ALD214	-.9396743	.2340186	-4.015	0.000	-1.41342	-.4659284
ALD221	-1.918066	.6345651	-3.023	0.004	-3.202676	-.633456
ALD231	-.2490888	.2584523	-0.964	0.341	-.7722981	.2741204
ALD232	-1.030379	.4037327	-2.552	0.015	-1.847693	-.2130651
ALD312	-.6897464	.3582498	1.925	0.062	-1.414985	.0354925
ALD313	.9182755	.2018006	4.550	0.000	.5097515	1.3268
ALD321	.2850481	.3799217	0.750	0.458	-.4840631	1.054159
ALD332	-.7363012	.3458545	-2.129	0.040	-1.436447	-.0361552
_cons	-6.067164	1.217976	-4.981	0.000	-8.532827	-3.6015

Instrumented: AREA45
Instruments: MEMND01L MEMD01 MEMD02 AGEHEAD1 AGEHEAD2 FEMALE2 FEMHEAD1 ILLDAYS1 TIME11 TIME13 EDUHH3 EDUHH4 AREAFER5 DISTANC2 PEST01 RAIN4 TENURE1 TENURE3 ANIMAL5 VASSET5 CYCLONE2 MILL01 TOOL11 TOOL02 AUTH12 LABOUR5 MARKET7 PRICE15 PRICE24 PRICE33 PRICE35 ALD111-ALD332 + MEMND11 MEMND12 MEMD11 AGEHEAD3 AGEHEAD4 REFUGEE1 ILLDAYS1 EDINFRA7 EDINFRA8 AREAFER6 PEST01 RAIN4 TOOL11 MILL01 ANIMAL5 DONA1 CYCLONE2 ANCEST1 AUTH12 LABOUR5 MARKET8 YIELDL8 PRICE14 PRICE23 PRICE34 ALD111-ALD332

INVEST01: The actual number of land-related investment projects per household in 1995-96. ALD114, ALD121, ALD122 and ALD215 were dropped due to collinearity. Command: svyivreg INVEST01 MEMND11 MEMND12 MEMD11 AGEHEAD3 AGEHEAD4 REFUGEE1 ILLDAYS1 EDINFRA7 EDINFRA8 AREAFER6 PEST01 RAIN4 TOOL11 MILL01 ANIMAL5 DONA1 CYCLONE2 ANCEST1 AUTH12 LABOUR5 MARKET8 YIELDL8 PRICE14 PRICE23 PRICE34 ALD1* ALD2* ALD3* (AREA45 = MEMND01L MEMD01 MEMD02 AGEHEAD1 AGEHEAD2 FEMALE2 FEMHEAD1 ILLDAYS1 TIME11 TIME13 EDUHH3 EDUHH4 AREAFER5 DISTANC2 PEST01 RAIN4 TENURE1 TENURE3 ANIMAL5 VASSET5 CYCLONE2 MILL01 TOOL11 TOOL02 AUTH12 LABOUR5 MARKET7 PRICE15 PRICE24 PRICE33 PRICE35 ALD1* ALD2* ALD3*).

Sources: FSP data and own calculations (010115a).

Figure 5.6: Two-Stage Survey IV Regression for INVEST01 (2)

A: First Stage Survey Logistic Regression

pweight: WEIGHT2
Strata: CATEG1
PSU: ALD

Number of obs = 351
Number of strata = 4
Number of PSUs = 40
Population size = 31397.55
F(29, 8) = 13.37
Prob > F = 0.0004

TENURE1	Odds Ratio	St Err	t	P>|t|	(95% Conf.	Interval)
MEMND11	.814265	.3428042	-0.488	0.628	.3467007	1.912392
MEMND12	1.013879	.0307488	0.454	0.652	.953397	1.078198
REFUGEE1	.5676687	.4836079	-0.665	0.511	.1008633	3.194898
ILLDAYS2	1.018805	.008338	2.276	0.029	1.002034	1.035856
EDINFRA3	.3244666	.3948155	-0.925	0.361	.0275051	3.827609
EDINFRA4	1.183143	.2937455	0.677	0.503	.7150861	1.957563
AREA45	6.278375	5.650474	2.041	0.049	1.011918	38.95376
RAIN4	3.327859	1.585895	2.523	0.016	1.26597	8.747951
MILL11	1.360372	.3616191	1.158	0.255	.7934562	2.332344
ANIMAL1	1.198124	.0986927	2.194	0.035	1.013792	1.415972
ASSET13	2.62121	1.631185	1.549	0.130	.7419666	9.260178
AUTH12	.0486402	.0389458	-3.776	0.001	.0095886	.2467378
ORIGINM1	.5474475	.1258245	-2.621	0.013	.3434813	.8725332
LABOUR4	.914716	.0764787	-1.066	0.293	.7720475	1.083748
YIELD08	1.014611	.002576	5.713	0.000	1.0094	1.019849
PRICE15	7.645423	7.799522	1.994	0.054	.9657363	60.52635
PRICE24	.3644123	.3476091	-1.058	0.297	.0526522	2.522142
PRICE35	195.1725	119.1249	8.641	0.000	56.60075	673.0001
ALD112	221.2673	120.3859	9.924	0.000	73.40101	667.0102
ALD113	378.7621	596.6492	3.769	0.001	15.52002	9243.593
ALD121	123.7255	87.21563	6.835	0.000	29.61963	516.8195
ALD122	298682.6	450919.4	8.351	0.000	13979.33	6381657
ALD214	709.2004	671.8353	6.929	0.000	103.8447	4843.435
ALD215	383.3809	629.3164	3.624	0.001	13.73477	10701.37
ALD221	278621.9	469361.4	7.443	0.000	9146.452	8487464
ALD232	2273.514	3197.395	5.496	0.000	131.2149	39392.35
ALD313	10.12824	12.62955	1.857	0.072	.8076443	127.0128
ALD321	11898.09	19916.61	5.606	0.000	399.1103	354700
ALD332	258.2189	210.6162	6.809	0.000	49.38237	1350.219

TENURE1: Is the household worried about land tenure security in 1995-96? ALD111, ALD114, ALD123 and ALD312 were dropped due to collinearity. ALD231~=0 predicts failure perfectly and was thus dropped and 20 observations were not used. Command: svylogit TENURE1 MEMND11 MEMND12 REFUGEE1 ILLDAYS2 EDINFRA3 EDINFRA4 AREA45 RAIN4 ANIMAL1 ASSET13 MILL11 AUTH12 ORIGINM1 LABOUR4 YIELD08 PRICE15 PRICE24 PRICE35 ALD1* ALD2* ALD3*, or.

Source: FSP data and own calculation (010115a).

B: Second Stage Survey Instrumental Variables Regression

pweight: WEIGHT2
Strata: CATEG1
PSU: ALD

Number of obs = 371
Number of strata = 4
Number of PSUs = 43
Population size = 32539.53
F(38, 2) = 1012.15
Prob > F = 0.0010
R-squared = 0.4550

INVEST01	Coef.	St Err	t	P>|t|	(95% Conf.	Interval)
TENURE1	-.8555357	.3338051	-2.563	0.014	-1.53072	.1803512
MEMND11	.009529	.1020721	0.093	0.926	-.1969313	.2159894
MEMND12	.0063764	.0062548	1.019	0.314	-.006275	.0190279
MEMD11	-.0870425	.0516936	-1.684	0.100	-.1916026	.0175176
AGEHEAD3	-.0244697	.0289645	-0.845	0.403	-.083056	.0341165
AGEHEAD4	.0003869	.0002975	1.300	0.201	.0002149	.0009888
REFUGEE1	.1376001	.1319666	1.043	0.304	-.1293276	.4045278
ILLDAYS1	-.0008229	.0005151	-1.598	0.118	-.0018649	.000219
EDINFRA7	.0516514	.0127843	4.040	0.000	.0257927	.0775101
EDINFRA8	-.0024301	.0005864	-4.144	0.000	-.0036161	-.0012441
AREA45	.816321	.3719799	2.195	0.034	.0639207	1.568721
AREAFER6	-.1646145	.1298905	-1.267	0.213	-.4273428	.0981138
PEST01	-.287691	.1384814	-2.077	0.044	-.567796	-.0075859
RAIN4	.290428	.1431459	2.029	0.049	.0008881	.5799678
TOOL11	.1881202	.0926629	2.030	0.049	.0006919	.3755486
MILL01	.4057091	.2150289	-1.887	0.067	-.8406461	.0292278
ANIMAL5	.4328253	.1143149	3.786	0.001	.2016016	.6640489
CYCLONE2	.3549752	.1781091	1.993	0.053	.0052845	.715235
DONA1	.6821241	.1599897	4.264	0.000	.3585145	1.005734
ANCEST1	.1784887	.1654302	1.079	0.287	.1561255	.5131029
AUTH12	-.5433228	.2828188	-1.921	0.062	1.115378	.0287322
LABOUR5	-.6284772	.1363499	-4.609	0.000	-.9042709	-.3526835
MARKET8	-.3823586	.1576272	-2.426	0.020	.7011898	-.0635274
YIELDL8	1.352516	.2351279	5.752	0.000	.8769246	1.828107
PRICE14	.6315037	.4243158	1.488	0.145	-.226756	1.489763
PRICE23	1.569147	.5842253	2.686	0.011	.38744	2.750854
PRICE34	.9421158	.3375265	2.791	0.008	.2594039	1.624828
ALD111	.2606234	.3240338	0.804	0.426	.3947968	.9160436
ALD112	-.3846588	.5986541	-0.643	0.524	1.595551	.8262335
ALD113	-.7406941	.2653726	-2.791	0.008	-1.277461	-.2039273
ALD123	-.9151804	.3296782	-2.776	0.008	-1.582018	-.2483433
ALD214	-1.106012	.2567772	-4.307	0.000	-1.625392	-.5866308
ALD221	-2.075514	.5794187	-3.582	0.001	-3.247499	-.9035293
ALD231	-.6425837	.2562227	-2.508	0.016	-1.160843	-.1243244
ALD232	-1.481366	.3916158	-3.783	0.001	-2.273484	-.6892487
ALD312	-2.1504	.796902	-2.698	0.010	-3.762287	-.538514
ALD313	.4088095	.2632885	1.553	0.129	-.1237418	.9413607
ALD321	.023606	.3284571	0.072	0.943	.6407611	.6879731
ALD332	-.9129136	.3193628	-2.859	0.007	-1.558886	-.2669415
_cons	-6.402721	.8597083	-7.448	0.000	-8.141645	-4.663796

Instrumented: TENURE1
Instruments: MEMND11 MEMND12 REFUGEE1 ILLDAYS2 EDINFRA3 EDINFRA4 AREA45 RAIN4 ANIMAL1 ASSET13 MILL11 AUTH12 ORIGINM1 LABOUR4 YIELD08 PRICE15 PRICE24 PRICE35 ALD111-ALD332 + MEMND11 MEMND12 MEMD11 AGEHEAD3 AGEHEAD4 REFUGEE1 ILLDAYS1 EDINFRA7 EDINFRA8 AREA45 AREAFER6 PEST01 RAIN4 TOOL11 MILL01 ANIMAL5 DONA1 CYCLONE2 ANCEST1 AUTH12 LABOUR5 MARKET8 YIELDL8 PRICE14 PRICE23 PRICE34 ALD111-ALD332

INVEST01: The actual number of land-related investment projects per household in 1995-96. ALD114, ALD121, ALD122 and ALD215 were dropped due to collinearity. Command: svyivreg INVEST1 MEMND11 MEMND12 MEMD11 AGEHEAD3 AGEHEAD4 REFUGEE1 ILLDAYS1 EDINFRA7 EDINFRA8 AREA45 AREAFER6 PEST01 RAIN4 TOOL11 MILL01 ANIMAL5 DONA1 CYCLONE2 ANCEST1 AUTH12 LABOUR5 MARKET8 YIELDL8 PRICE14 PRICE23 PRICE34 ALD1* ALD2* ALD3* (TENURE1 = MEMND11 MEMND12 REFUGEE1 ILLDAYS2 EDINFRA3 EDINFRA4 AREA45 RAIN4 ANIMAL1 ASSET13 MILL11 AUTH12 ORIGINM1 LABOUR4 YIELD08 PRICE15 PRICE24 PRICE35 ALD1* ALD2* ALD3*).

Source: FSP data and own calculation (010115a).

Chapter 6: Household Coping Strategies

6.1 Introduction

While the traditional coping strategy literature[46] has focussed mainly on the household activity choices leading up to and during a crises, this chapter will analyse the post-crisis activity choices by households. In particular, it will be argued that the individual experience of war conditions the response to risk and thus the reconstruction choices of households. Furthermore, it will be found that these choices differ from pre- and ongoing crisis coping strategies and non-war coping strategies as outlined in the literature. Finally, war-affected households have a higher demand for risk diversification yet they may be constrained in their activity choices due to the war's multiple effects on forms, levels and effects of risk and vulnerabilities to risk. Such households may thus be forced to adopt very risky coping strategies that re-enforce their vulnerability and reduce their welfare. This last effect will be studied in more detail in the subsequent chapter. Households also have to choose between market and non-market forms of exchange or indeed consider to exit all types of markets entirely, an option not often considered by basic models of farm household behaviour.

This analysis of post-war household coping strategies combines a theoretical analysis, especially of the effects of risk and other war legacies on household choices in a portfolio-choice framework, with an empirical analysis of such coping choices. Despite the many strengths of the FSP dataset used, some aspects of the empirical analysis could be strengthened further with better data. Especially panel data could help to differentiate more clearly between better defined and better enumerated sources of exogenous risk (such as rainfall) and household-specific causes for activity diversification (e.g. resulting from life-cycle induced changes in labour valuation). In this analysis, risk cannot be identified directly in most cases and various risk proxies from the FSP survey are used instead. Both the theoretical and empirical analyses yield interesting results but these conclusions could be strengthened and refined with better data.

In section 6.2, the literature on household choices between alternative coping strategies is reviewed. This suggests that the key issues in income diversification are risk and risk aversion, household assets and characteristics, production technologies, and markets and other institutions. These variables are also used in a simple household coping strategy

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[46] See for example Corbett (1988: 1100), Davies (1996: 47), Devereux (1992), Fafchamps (1999: 7-36), Leonard (2000), Reardon (1991: 95), Walker and Jodha (1986), Watts (1983), and Webb, von Braun and Yohannes (1992: 30-31).

model with two risky income activities, which builds on the analysis of chapter 2 and which is summarised graphically in figure 6.2 and mathematically in appendix A.3.

The household allocates its labour between coping activities depending on relative risks, prices, technologies and the household's subjective valuation of labour. In addition, commodity-specific transaction costs and household assets can further influence the optimal allocation of resources in this model. These predictions for the determinants of the household activities differ from those of a neoclassical model with complete markets. Yet in a war-affected economy such assumptions are not realistic and alternative predictions are derived instead.

Section 6.3 discusses the effect of war in the model and shows how there are different transmission mechanisms for the negative effects of war on household labour allocation. In the extreme, severely war-affected households close to starvation may be forced to undertake risky activities even though their risk aversion is extremely high. While some effects of war may cease with the end of the war, the household labour allocation will only slowly revert back to the peace-time optimal value. This is caused by village-, household- and commodity specific transaction costs which cause selective market failure and by the difficulty to rebuild household assets. Household may thus remain stuck in a post-war poverty trap, even if shocks have a zero mean after the end of the war.

These expected effects of war on activity choices differ from the coping strategy literature and from the standard post-war reconstruction literature. The former pays less attention to the post-disaster constraints and choices by households. The coping strategy literature occasionally proposes or assumes that households rebuild their livelihoods in reverse order compared to how the approach of the disaster forced them to adjust initially. The latter, which in the case of Mozambique frequently disregards the important effects of the war for post-war reconstruction (cf. chapter 3), underestimates the war-induced difficulties for households to rebuild their livelihoods, for example through re-capitalising the agricultural production process or through the inability to insure effectively even against idiosyncratic risk. The analysis of this thesis also emphasises the role of transaction costs at the village, household and commodity levels and the need to rebuild markets for inputs and outputs.

Section 6.4 derives the econometric specification of the model and discusses methodological and data issues. The subsequent section summarises the expected determinants of a variety of coping strategies. While the model discusses only one generic case of choosing between two risky activities, households in the post-war period face a variety of important coping choices which are determined by many exogenous variables. These concern the determinants of on-farm versus off-farm activities, the decision to enter

output markets, the decision to adopt cash crops, and the level of income derived from social exchange. In addition, some indices of diversification are constructed and their expected determinants are reviewed. Section 6.6 then reviews some summary statistics and discusses the econometric results, as indicated at the start of this introduction. Section 6.7 concludes the chapter.

6.2 The Determinants of Activity Portfolios

The main determinants of activity portfolios in non-war, African situations are risk and risk aversion, household characteristics, production technology, and institutions including markets.[47] Subsequent sections will integrate these arguments into a formal model of activity choices and will discuss the effects of war on each of these determinants, thus deriving a set of hypotheses concerning the effects of the war legacy on activity portfolios.

Definitions

An activity or a coping strategy is a type of income-generating work households can undertake. The main activity distinctions are between on- and off-farm (or agricultural and non-agricultural) activities, between subsistence and market activities, and between labour- and capital-intensive activities (Ellis 1998: 5-6). Each of these categories includes a broad range of detailed activities (e.g. there are many food crops grown in Mozambique) but these distinctions capture their main market, risk, and asset characteristics. Portfolios of activities may reduce the covariance of risks at the household level but the mean return on all activities may also be lower than the return from the activity in which the household has a comparative advantage (Bardhan and Udry 1999: 106-8, Bodie and Merton 1998).

Households can also engage in market (i.e. impersonal inter-household) and social (i.e. personal inter-household) exchange to deal with risk (Binswanger and Rosenzweig 1986: 505) but there is some moral hazard implicit in inter-household risk pooling (Dasgupta 1993: 204). Kinship groups can overcome this moral hazard by building social insurance systems (Kandori 1992). Such institutions can be difficult to describe empirically, especially when analysing data collected at the household level (Dasgupta 1993: chs. 8-9).

The analysis will focus on post-war activity diversification (including output market participation) by households while recognising that inputs into household activities can also

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[47] Note that Sub-Saharan African off-farm labour market participation decisions (and hence coping choices) may be different from those in Asia or Latin America (Skoufias 1994).

derive from multiple sources and that diversification can also occur at the village level (Delgado and Siamwalla 1999: 126, von Braun et al 1994: 11).

Sources of Risk, Risky Activities and Household Risk Aversion

Activity diversification is affected by the types of risks households face (figure 2.1), by the risk vulnerability of each activity, and by the risk attitude of households.[48] This section will outline how households face different sources of risk and how these sources of risk affect household choices between different activities. The regression analysis below will then model the household choices between risky and less risky activities (such as off- and on-farm activities) based on different variables reflecting risk factors (such as rainfall) and risk aversion (such as household composition). The following sections will outline complimentary motivations for activity choices such as asset endowments, production technologies, and market imperfections.

Figure 6.1: Activity Characteristics

	On-Farm Activities		Off-Farm Activities	
	Food Crop	**Cash Crop**	**Entrepreneurial**	**Social and Wage**
Household Risk	high	high	high	high
Natural Risk	high	high	low	low
Market Risk	low	high	medium	medium
War Risk	(medium)	high	medium	low
Main Risks	production and storage risks	production and market risks	physical, human and social capital	market risk
Intra-Category Covariance	medium	high	low	high
Asset Constraint	low	high	high	low
Returns	medium	high	medium-high	low

The relationships between sources of risk and the risk vulnerability of activities are respectively summarised in the rows and columns of figure 6.1. The figure demonstrates that all types of activities are strongly affected by household-level risks (e.g. via the importance of household labour for all forms of production) and that natural risks affect food and cash crop activities proportionately more than off-farm activities (especially in the low intensity system of agriculture dominant in Mozambique). Market risks have a relatively stronger impact on cash crop than on food crop or off-farm activities. Food and cash crop

[48] For further discussions of risk, activity diversification and the peasant household see also chapter 2 and Alderman and Paxson (1992), Binswanger (1980), Bryceson (1996), Carter (1997), Dasgupta (1993: 206), Ellis (1993: 95-98, 1998: 12-4), Fafchamps (1992a, 1999: 71, 93-4), Maxwell and Wiebe (1998: 16), Liedholm and Kilby (1989), Moscardi and de Janvry (1977), Reardon, Delgado and Matlon (1992: 267-9), Roumasset (1976), Rosenzweig and Binswanger (1993), Shahabuddin, Mestelman and Feeny (1986), and Walker and Ryan (1990).

production are both strongly affected by production risks. In addition, the former encounters storage risks while the latter encounters price and market risks both in the sale of cash crops and in the subsequent purchase of consumer goods. Such price risks include uncertainty about the mean and the variance of prices.

These variables will be included in the regression analysis wherever possible. For example, risk will be represented through the location of households (which reflects generally expected levels of risks) and through illness, rainfall, crop and storage pests, crop yields, and price variability (which reflect individually uncertain realisations of risks).

In addition, the local covariance of returns to similar activities (i.e. the intra-category covariance of returns across small distances) differs across activities (figure 6.1). Cash crop activities have the highest covariance due to their dependence on locally correlated climatic and market risks. Food crops have a relatively lower degree of local covariance, especially as traditional food crops are often well-adjusted for local conditions and are intercropped and planted at various times thus reducing the risk of correlated output failure under reasonable climatic conditions. Entrepreneurial activities have a low degree of local covariance as they consist of a variety of different activities resulting from household comparative advantage and are not directly linked to local determinants such as rainfall. Competition may also be less severe for entrepreneurial activities than for any other activities. Wage opportunities and social exchange on the other hand are highly covariant, especially formal sector wage opportunities such as work on a plantation or in a factory.

The vulnerability of activities to different sources of risks and the covariance of returns thus determine the risks households face in undertaking a given activity. This discussion also indicates that cash crop production is generally more risky than food crop (or subsistence) production (Kunreuther and Wright 1979: 217) and that some on-farm activities are less risky than some off-farm activities.

More generally, peasant households must choose between a priori more or less risky activities when deciding on the planned production and marketing activities for the subsequent agricultural year. For these choices, households are likely to view the set of entrepreneurial activities as being constrained by activity-specific physical, human and social capital. Wage and social activities on the other hand are vulnerable to factors reducing the demand for labour or for social exchange.

As shown formally below, households can reduce these risks (for given fixed costs, assets, skills, and technologies) by combining different activities in a portfolio of activities. In addition to the activities shown in figure 6.1, households may further reduce their risk exposure by diversifying their spatial activities, i.e. by planting on many small plots of land

simultaneously. Such non-market forms of household diversification will be analysed econometrically below. Building on this analysis, chapter 7 will assess the welfare effects of these activity choices.

Risk averse farm households are interested in achieving smooth consumption across all seasons but are often unable to use credit markets to do so and hence practice activity diversification and thus income smoothing instead (Morduch 1994). The coping literature suggests that households whose survival is acutely threatened may choose very risky activities in a desperate gamble for survival (Corbett 1988, Dasgupta 1993: 199-201, Shahabuddin et al 1986: 123). As the model below will demonstrate, this is likely to result from a sharply reduced choice set containing only high risk activities. Therefore, households may be forced into a gamble for survival despite strong underlying preferences for activity diversification.

Furthermore, households possessing more wealth are more likely to have a lower risk aversion and thus prefer and are more able to diversify into more risky activities (Bardhan and Udry 1999: 108, Reardon et al 1992: 269). The higher wealth implies that the household can self-insure against negative outcomes and still smooth inter-temporal consumption while poorer households pursue low variance, low return activities. Therefore, the regression analysis below will include continuous and binary risk variables as indicators of likely risk aversion at the household level. These include household size, age and composition as well as refugee and female-headed status.

Household Characteristics and Assets

The comparative advantage of a household combined with an initially high degree of specialisation in subsistence farming creates an incentive for household income diversification beyond that of risk aversion discussed above (Dercon and Krishnan 1996, Fafchamps 1999: 66-8, Reardon et al 1992). Economies of scale for the new activity, indivisibilities and large fixed costs of starting a new activity may however prevent diversification among poor households. The entry constraints may include credit, ability, or locational factors.

Higher household wealth, for example, permits a larger number of activities to be considered. Adopting cash crops and entrepreneurial activities may require large fixed costs which poorer, more credit constrained farmers cannot overcome. Very wealthy households may thus end up specializing entirely in one type of activity, for example cash crops, and purchase all its consumption goods in the market. When considered from the point of view of a poor farm households, slightly increased wealth will reduce risk aversion and thus increase, rather than reduce, activity diversification.

The life cycle of a household and household asset ownership will affect its comparative advantage, the optimal degree of specialisation and the available labour resources (Abdulai and Delgado 1999, Becker 1965, Low 1986, von Braun and Pandya-Lorch 1991: 15-7). For example, a lower dependency ratio within the household reduces the relative value of home produced goods and encourages the production of marketable goods and services. Similarly, female-headed households may possess more skills suitable for home-good production and may thus diversify less into market-good production.

Production Technology

The technology of producing agricultural goods is, in the absence of irrigation, intricately linked to local climatic conditions. These may reduce the number of feasible crop cycles and the certainty equivalent income per year.[49] Seasonality is one reason why farms face decreasing returns to their inputs. As off-farm diversification increases, households can avoid diminishing returns to inputs within each activity and they can avoid exposure to risky agriculture. Seasonality does not require households to face risks to encourage activity diversification. Instead, seasonality entails changing returns to labour throughout the year and thus makes different activities profitable at different times of the year. Seasonality also encourages intercropping, planting traditional seeds, and pursuing non-agricultural activities which can be carried out in the agricultural off-peak seasons.

Institutions and Market Imperfections

Even for given endowments, income diversification at the household level can be encouraged by functioning, flexible economic and social institutions, including social support mechanisms, property rights and markets.[50] For example, social norms may control land access so that cash crop adoption may only be possible if the local community permits the use of land for such purpose (chapter 4). A limited land market or other (e.g. social) constraints on household access to land may imply that households have to diversify into other activities, irrespective of their preferences, endowments and comparative advantage (Reardon et al 1992: 269).

The household location also determines the type of constraints households face. Socio-economic constraints such as lack of markets, transport, information, or human capital

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[49] These issues are addressed by Alderman and Sahn (1989), Ellis (1998: 11-2), Fafchamps (1999: 11-2), Norman (1974), and Sahn (1989b: 8-9).

[50] Key contributions to this literature include Abdulai and Delgado (1999), Berry (1989, 1993, 1997), Bromley (1989), Ellis (1998: 16), and Platteau (1996). Land market institutions are also discussed in chapters 3 to 5.

enhancing infrastructure such as schools, extension services etc affect the degree of diversification (Dercon and Krishnan 1996). Similarly, climatic and geographic location constraints such as rainfall patterns, temperatures and soil characteristics may only permit one or two agricultural activities (Fafchamps 1999: 8). Both of these constraints are potentially captured by the FSP survey, through variables such as INFRA4, LABOUR3, MARKET7 and YIELDL7 (which will be defined and discussed in more detail below).

In many Sub-Saharan African areas restricted credit markets (or their complete absence) encourage income diversification.[51] Off-farm activities in particular can help overcome credit constraints and facilitate agricultural investments, thus further increasing the degree of household diversification. Shortfalls in past harvests can also facilitate current diversification into off-farm activities in the presence of a binding credit constraint. However, the absence of credit markets in Nampula (chapter 3) implies that no credit variables can be included in the analysis.

Income diversification is encouraged by limited labour market opportunities (both to hire-out and to hire-in labour) and by low labour productivity due to low ability, inputs, information etc in households, which all combine to encourage households to undertake several different concurrent activities (Reardon et al 1992). If each activity requires a minimum time input, larger households can compensate for missing labour markets and diversify into more activities (von Braun and Pandya-Lorch 1991: 36). Labour market and human capital variables including indicators for environmental constraints implying a time burden especially for women are thus included in the regression analysis below.

Income diversification is encouraged by better output markets and growth linkages with areas and sectors facing uncorrelated risks, either informally through social networks and gift exchanges or through formal markets.[52] This permits households to earn income and to convert this into food through market transactions. This also permits consumption smoothing not otherwise possible within areas facing correlated risks.

Improved local growth and market linkages, for example through better infrastructure, further help to increase household activity diversification as these growth linkages improve the rents households earn on their labour and capital and thus improve the supply of inputs

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[51] This is discussed in Alderman and Paxson (1992), Bardhan and Udry (1999: 91-2, 106-8), Bigsten and Kayizzi-Mugerwa (1995), Dercon (1996a), Dercon and Krishnan (1996), Ellis (1998: 15), Eswaran and Kotwal (1986, 1989, 1990), Feder, Just and Zilberman (1985), Niemeijer and Hoorweg (1994), Reardon (1997), Reardon, Delgado and Matlon (1992), and Rosenzweig and Binswanger (1993).

[52] As discussed by de Janvry, Fafchamps and Sadoulet (1991), Fafchamps (1999: 70-4), Hazell and Röell (1983), Liedholm and Kilby (1989), and von Braun and Pandya-Lorch (1991: 20-1).

into various activities. Improved output markets provide higher incentives to earn cash hence encouraging diversification into cash crops and entrepreneurial activities. In addition, with imperfect output markets, household preferences for consumption diversity may support activity diversification. The village-level variables indicating the size of the labour and output markets may therefore help to capture these motivations for activity choices in the regression analysis.

Summary

The determinants of activity portfolios can be summarised for the case of a two-activity household as shown in figure 6.2 or as derived mathematically in appendix A.3. The share of household labour dedicated to more risky activities is denoted q and the risk of a household's activity portfolio is denoted by V. At $q_{V_{min}}$ a household is engaged in the lowest risk portfolio possible. Higher risk activities permit higher expected returns E(R) which in turn yield higher expected profits $E(\pi)$, once the labour costs of the peasant household are accounted for. Households have preferences between risks endured and expected profits obtained and these define the utility map represented by $U_3U_2U_1$. The curve abcd represents the feasible set of activity portfolios, though only the segment abc is efficient. Equilibrium is obtained at point b, where the optimal activity mix yields the highest possible utility. Note that at point b, q^* does not necessarily equal $q_{V_{min}}$.

Figure 6.2: The Two-Activity Peasant Household Model

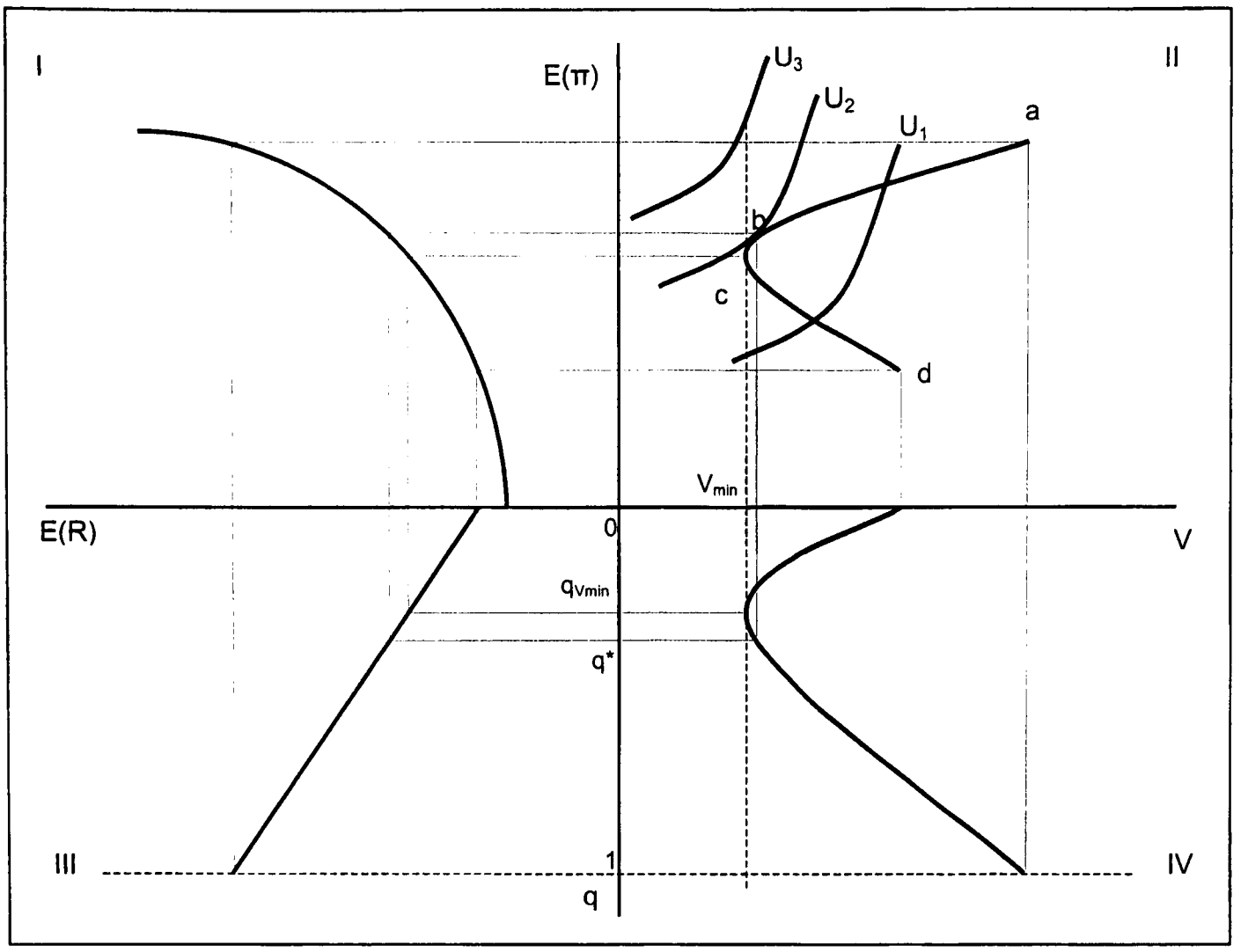
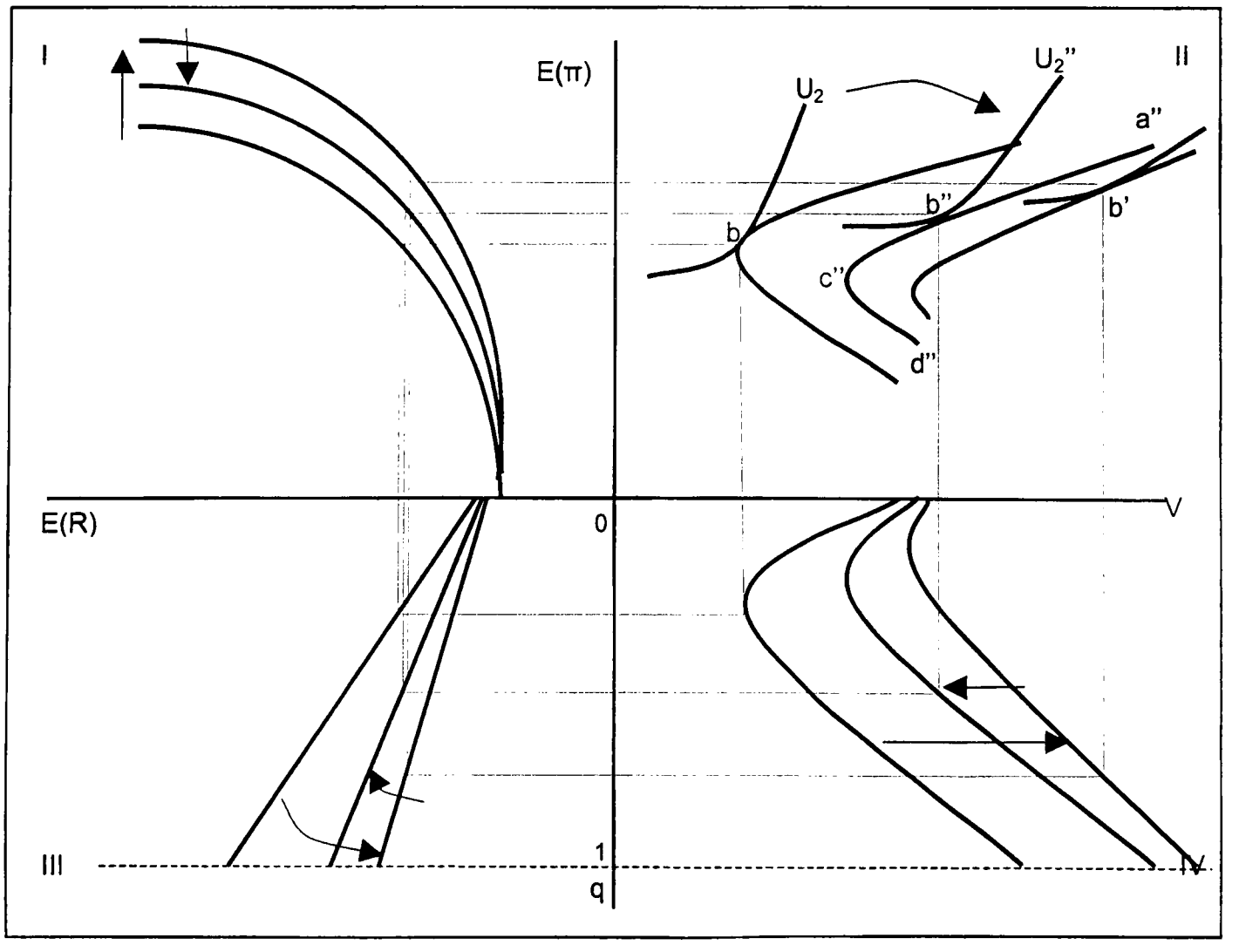


Figure 6.3: The War Legacy in the Two-Activity Peasant Household Model



6.3 Activity Portfolios in the Post-War Period

This section will discuss how the war legacy affects risk, production, profits, utility and equilibrium in the model and how households adjust their activity portfolios accordingly. Figure 6.3 summarises this extension of the basic two-activity model to the war and post-war cases. The subsequent section will then discuss some data and econometric issues before section 6.5 will derive the expected determinants of activity portfolios in a rural post-war economy.

Risks and the Spatial Correlation of Risks

War will increase the absolute level of riskiness of each activity (s_i^2) and thus of the overall portfolio (V) as well as changing the relative riskiness of the activities (s_1^2 versus s_2^2). In the case of cash crops, their returns are likely to increase in riskiness by more than the returns to food crops, as discussed in more detail in chapter 3 and in appendix A.3. War increases storage risks in food cropping directly (through looting) and indirectly (through the reduction in pest controls and reduced level of extension advice). War also increases the market risks of cash cropping by undermining cash crop input and output markets.

In addition, the correlation coefficient ϱ_{12} may change due to the war, if for example the reduced level of inputs increases the relative importance of local covariant causes of risk such as rainfall. War risks are likely to correlate across households within a village when a village is attacked during the war (thus war risks are typically excluded from many insurance contracts). However, to the extent that not all villages in a province are attacked at the same time, war risks do not correlate strongly across larger distances for a given point in time.

War risks may become idiosyncratic (i.e. s_{12} approaches zero) if a household has an important social position or displays unusual levels of assets within a village that may become the focus of military attacks. The social capital of a household may thus help to reduce or increase its vulnerability to attack and therefore its post-war asset position (see also below for further asset effects).

In addition, larger households and those better integrated into a village community can more easily avoid attacks by posting look-outs near their fields. It can be expected that such households were more likely to maintain agricultural production during the war and are thus more likely to engage in post-war cash crop production, rather than off-farm survival activities.

In the post-war period, a lower war risk can obtain soon after fighting stops and will therefore immediately affect the variables s_i^2 and s_{ij} in equation A.3. This in turn will permit

households to adjust their coping strategies, as summarised in figure 6.4. Households can reverse a part of the precautionary reduction in their food consumption as food storage and food market transports are not directly threatened any more. Households may also reduce the collection of famine foods (such as roots and insects), which is a labour intensive way of avoiding the storage of food in times when such storage is very risky. Households may also return to their original settlement if the risk of attack or from landmines is judged sufficiently reduced. These post-war coping strategies imply that social activities and urban wage activities may be reduced while a larger labour supply and higher returns are available for on-farm activities.

These war-induced changes have three effects on the labour-risk relationship of the basic model (i.e. equation A.4 in appendix A.3). These effects are shown in quadrant IV in figure 6.3 first for the shift from peace to war and then for the post-war economy, where the post-war outcome is an intermediate case.

First, the increase in overall risk due to war will shift right the whole curve (i.e. $\partial V/\partial s_i > 0$) with the war legacy ensuring that the post-war outcome will still be to the right of the pre-war case. Second, the relative increase in risk of activity 2 will shift the lower section of the curve even further to the right (i.e. $\partial V/\partial s_2 = 2q^2 s_2$) so that with a large q an increasing s_2 leads to a further increase in V. This effect is reduced in the post-war period. Third, the increase in the correlation coefficient flattens the slope near q_{Vmin} (i.e. $\partial(\partial V/\partial q)/\partial s_{12} = 2-4q$) thus reducing the scope for risk reduction through portfolio diversification. In the post-war period, there is still a higher correlation coefficient though its scale may be lower than during the war.

Figure 6.4: Post-War Household Coping Strategies and Labour Allocation

Post-War Effects	Post-War Household Strategies	On-Farm Activities		Off-Farm Activities	
		Food Crop	Cash Crop	Entrepreneurial	Wage & Social
Reduced Risk (s_i^2, s_{ij})	Reverse Reduction of Household Food Intake	n.a.	n.a.	n.a.	n.a.
	Reduce Collection of Famine Food			decrease	
	Return Migration to Former War Zone	increase	increase		decrease
Increased Assets (a_i)	Rebuild Livestock and Non-Productive Assets	change	increase	increase	decrease
Improved Technology (p_i, a_i)	Change Agricultural Techniques	change	change	change	
Stronger Institutions and Markets	Reduce Consumption Loans from Moneylenders			increase	decrease
(p_i, a_i, L_i)	Reduce Social Exchange with Kin	increase	increase	increase	decrease
	Reduce Procurement of Food Aid				decrease
	Reduce Local Off-Farm Labour Supply	increase	increase	decrease	decrease
	Reduce Non-Food-Producing Activities	increase	decrease	decrease	decrease
	Rebuild Household Structure (Increase On-Farm Labour)	increase	increase	change	change
War Vulnerability		medium	high	medium	low-medium
Expected Net Change		**increase?**	**increase**	**ambiguous**	**decrease?**

The net effect of the changes is that the curve abcd shifts down and to the right due to war to an area of unambiguously lower utility for the household. In the post-war period, the curve will shift partially back towards the peace-time position (e.g. to be a"b"c"d" in figure 6.3). The extent of that shift depends on the severity of the war legacy and its composition, especially concerning the relative scales of overall risk, relative risk and the risk correlation coefficient.

Household Characteristics and Assets

War will change the profit function (equation A.13 in appendix A.3) by affecting revenue and by changing the equilibrium value of the subjective wage, in particular via enforced life-cycle effects in the household. This is most likely to occur through conflict-related morbidity and mortality in the household, especially in households near the survival threshold. If disaster is imminent, then W will be low and the risk of production and

correlation coefficient of returns are likely to be very high, thus reducing the potential gain from diversification.

Graphically, war will shift the portfolio frontier abcd to the right and the trough through b and c will be less deep, as described above. This causes households to undertake high risk and high payoff results without household risk preferences having shifted. In fact, household utility at the new equilibrium will be significantly lower, reflecting the precarious situation of the household. In the post-war period, households may remain in such high risk, near starvation equilibrium, depending how quickly the value of subjective wages can rise under peace conditions. Under unfavourable conditions, a post-war poverty trap exists in the bottom right corner of quadrant IV in figure 6.3.

This model can therefore resolve the apparent paradox noted in the safety-first literature where destitute households engage in very risky behaviour even though they are least able to withstand the risks inherent in such a portfolio (Kunreuther and Wright 1979: 217, Shahabuddin et al 1986: 122-3). It does so by valuing the trade-off between leisure and labour in regard to the survival constraint through the term W, which captures the household consumption requirements.

The reduction of expected revenue will push households down along the expected return curve in quadrant I in figure 6.3. As households draw closer to their survival constraint and/or increase the war-induced dependency, their subjective equilibrium wage diminishes. This would increase the subjective profitability of household production for a given level of revenue thus shifting the curve up in quadrant I. This effect compensates somewhat for the negative effects on portfolio allocation described so far as a higher profitability would shift the portfolio function abcd upwards in quadrant II.

However, this change also affects the utility map of quadrant II. While war does not change preferences per se, changes in household composition in a peasant household model do affect preferences (Bardhan and Udry 1999: 13, Ellis 1993: 114). The post-war utility curves in figure 6.3 are thus flatter than the corresponding peace-time curves (only peace-time curves are shown for clarity). Households with a lower subjective wage are willing to accept a higher level of risk to gain an increase in output. Theoretically, the lower risk aversion implicit in this result is equivalent to the lower leisure valuation of the standard Chayanov model. This effect therefore directly reinforces the explanation of the apparent paradox presented above.

Land is assumed abundant in the model, which in part justifies the assumption of absent labour markets and constant returns to scale (CRS) production technology. Land quality (e.g. soil composition) and available land quantity (e.g. security of tenure) are likely to be

negatively affected by war, further reducing the choice set for households (see chapters 4 and 5). These effects will be incorporated into the analysis of activity choices by including a set of control variables capturing land characteristics (see also the section below on the econometric specification of the model). All other things being equal, having more, better and more secure land in the post-war period is likely to increase agricultural activities versus off-farm activities.

Increased household assets and social capital will improve the technical efficiency of production and hence increase the variables a_i (figure 6.4). With war undermining credit markets, physical and other assets fulfil a key role as both productive inputs and as a self-insurance mechanism in a risky environment. The characteristics of all assets for both purposes and their war vulnerability then combine to make some post-war activities more vulnerable to the preceding war than others. For example, cattle herding may be a productive and a risk-mitigating activity in peace-times. Nevertheless, cattle herding becomes unfeasible in a long-lasting war of destabilisation and may not be worthwhile (due to an expected resumption of hostilities) or possible (due to the collapse of cattle markets and extension services) in a high risk, poor post-war environment. Being able to rebuild financial and non-financial household assets will also reduce the need for consumption loans thus reducing social activities which aim to maintain social networks.

Physical capital is more likely to encourage capital-intensive cash crop and entrepreneurial activities (figure 6.4). However, very few households in the post-war period can be expected to have capital suitable for capital intensive, high return activities. Households may instead depend on their social capital to conduct social exchange and agricultural wage labour, which in rural Nampula is very supply constrained and thus strongly depends on close kin-networks. The portfolio of assets owned may therefore affect the portfolio of activities undertaken.

All assets are also dependent on the existence of markets (see below) so that less war-affected assets and less war-affected markets increase each other's value. The ownership of sufficient tools for growing cash crops is a critical constraint in cotton cropping, along with functioning labour and cotton markets. All these markets, however, were badly affected by war, as first indicated in chapter 3, so that even in 1999 households found it very difficult to re-equip themselves with proper tools even when they had sufficient cash to pay for such purchases.

The post-war absence of asset destruction will permit the gradual accumulation of assets, for example by buying tools, improving housing conditions, and buying or breeding small and later large livestock.[53] These changes will directly involve some on-farm activities and may indirectly favour more risky and more capital intensive cash crop and entrepreneurial activities (figure 6.4).

The model implies that war-affected households facing substantial market constraints smooth consumption by smoothing income. Without such constraints, it would pay households to specialise in the most rewarding activity and to smooth their consumption in the face of potentially very risky income outcomes (Fafchamps 1999: 7, Morduch 1994). This result, which does not obtain in the standard farm household model or in well integrated rural areas as may be found in Asia, has strong implications for rural post-war reconstruction policies aimed at increasing rural income and household welfare.

The negative effects of war on household's asset holdings and on the credit market inhibit capital-intensive activities in the post-war period. Households may not own a critical level of assets and they will not be able to borrow to invest in capital-intensive activities (e.g. entrepreneurial activities). Households can thus only accumulate assets through savings from labour-intensive activities. With high storage losses due to poor storage technologies and limited output markets, however, the return on savings may not be positive in the post-war period. Furthermore, assets will be reduced by occasional negative shocks and income shortfalls so that it may be impossible to rebuild assets to pre-war levels and to restart capital-intensive activities. Households may therefore be caught in a low-level poverty trap (Eswaran and Kotwal 1990: 480, Morduch 1994).

This result is reinforced by locally covariant negative shocks which may induce a number of households to sell their assets simultaneously, leading to lower asset prices and expected future incomes. Asset ownership is thus only a useful insurance against idiosyncratic risks. This effect is somewhat mitigated for richer households by the above average returns that capital-intensive activities can earn in an economy where not many other households pursue such activities. On the other hand, these higher returns may encourage income inequality between quickly and slowly reconstructing households (Bardhan and Udry 1999: 91-2).

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[53] While housing investments are in part an increase in household consumption, for peasant households they also increase farm productivity, for example by buying a front door with a lock or a metal roof, which improve asset security and household health.

Production Technology

War affects relative prices and production technologies so that both p_i and a_i in equations A.6 and A.8 can be expected to fall. In the case of food crops (i=1) versus cash crops (i=2), it is also likely that $\Delta p_1/\Delta p_2 < 1$ and $\Delta a_1/\Delta a_2 < 1$, as war increases the transaction costs for cash crops relatively more than for food crops and as cash crops have a given world price assuming that the war economy is insignificant in the world market (see chapter 3 for the magnitude of these changes in Mozambique).

In addition, war is likely to reduce the availability of modern technologies and enforce the return to or extended use of traditional cropping patterns, seeds and techniques. To the extent that these techniques are more divisible than modern agronomic practices (irrigation being an extreme example of an indivisible modern technique), households adopt a larger number of individual activities within each activity class during the war while reducing the dependence on cash crops. Such traditional techniques include the number of traditional food crops, dividing the cultivated area per household into more but smaller plots and pursuing labour-intensive off-farm activities.

With the emergence of firms offering support for cash crops in the post-war period, farm households may take up cash crop techniques and technologies which are strongly covariant across large areas compared to locally divergent traditional techniques. Cash crops are thus an unsuitable way of insuring against covariant climatic risks unless the degree of modern input use compensates for such increased climatic vulnerability. This suggests that cash cropping may be an activity more suited to farmers who are (i) more capable of purchasing a high degree of fertilisers and pesticides and (ii) less risk averse and thus more able to absorb production risks through own savings in a bad year. However, in the post-war period households' asset position is largely determined by their experience of the war. Less war-affected households with more surviving assets and with better access to modern inputs will adopt cash crops more readily than otherwise similar households.

More fundamentally, war will affect the ability of households to predict changes in relative prices, risks and correlation coefficients as well as the ability to store and pass on technical knowledge and skills. During peace-times, households may typically know the mean and standard deviation of key economic variables such as returns and prices. However during times of war and in the post-war period, these values are not determined in the usual way and households most likely do not know these expected values. This may apply even to values which are not directly affected by local warfare, such as world cotton prices. During or after war, information about such prices is more difficult to obtain and local transport

costs are also increased by war (chapter 3) so that the farm-gate price for cotton is still strongly war-affected.

On the one hand, the ability to predict such values depends on stable system parameters which allow households to extrapolate past trends and to adjust expectations based on past experience. War, however, raises the rate of change and may alter some fundamental parameters of the economic environment in which peasants operate. Thus past experience depreciates and previously useful models of behaviour do not apply any more.

One the other hand, skills cannot be passed on as readily in times of war. For example, locally valid agricultural experiences are depreciated through dislocation and inter-generational systems of information dissemination are placed under strain through the experience of war, particularly under a system of a war of destabilisation.

In the post-war period, households thus have to rebuild their underlying system for forecasting expectations and for generating and transmitting knowledge and skills. This process in itself will take time and must be calibrated with new experiences and events. If the post-war system takes a long time to establish a new equilibrium, then households will find it very difficult to calibrate their forecasting model in such a structurally changing environment, further complicating the path towards a general equilibrium. The reduced abilities of households to predict key economic indicators thus further reduces efficiency and raises uncertainty in the system.

In terms of figure 6.3, a proportionate reduction of the parameters p_i and a_i will shift the E(R) curve to the right in quadrant III. A disproportionately large reduction of the p_2 and a_2 parameters will also reduce the slope of the curve. These war-induced changes in the technology and price variables will be moderated or compensated in part in the post-war period, as had been argued for other effects sketched in quadrants I and IV. In the post-war period, households will thus continue to adjust their agricultural techniques and hence their labour allocation q. The net effect of the changing technological and price signals on activity portfolios is ambiguous a priori. This is also confirmed by the examples shown in figure 6.4.

Institutions and Market Imperfections

Household activity diversification is also encouraged by institutional and market imperfections, which are strongly affected by war. Market and other institutional imperfections in particular affect the degree of technology embedded in production (a_i) and the farm-gate prices (p_i) net of transaction costs (t_i). The total labour availability is also shaped by market imperfections, especially through increased search, information and

supervision costs in land abundant areas which lead to reduced supply of and demand for labour and hence also to different wage rates or even to a breakdown in wage labour markets. Consequently, the variables L, w and W in equation A.12 are shaped by the effects of war on institutions.

Household social capital is a key determinant of the profitability of low-return, off-farm activities, including socially-negotiated group labour, social exchange, and NGO donations. Households with a higher social capital (e.g. households who hold a position of traditional authority in their community) are thus much more likely to command larger labour resources L, have lower transaction costs t_i and achieve higher net prices for off-farm activities p_2.

As Sen has shown, famines can occur while markets are operational (1981). However, and as shown in chapter 3, some wars directly reduce the ability of markets to operate. Where such effect is significant, it will increase household vulnerability by reducing the degree of market entitlements and will affect household decisions among the remaining non-market responses. In particular, a war-induced decrease in market density will reduce the share of cash crop income and also the degree to which food crops are sold in markets and off-farm market activities undertaken.

Money or resources may not be borrowed easily in the post-war period as credit markets may have ceased to exist during the war (chapter 2). This is due to the high cost of information gathering, the reduced ability to enforce contracts while state authority is so severely threatened and the high degree of risk covariance which increases the undiversifiable portfolio risk for lenders. In exceptional and individual circumstances such as illness, very informal forms of intra-kin credit will help to smooth consumption in the short-term. Credit-constrained households are thus likely to increase their share of informal, social, non-market activities to substitute for war-affected credit markets. However, these activities will not form a large share of the activity portfolio for most households as the negative and correlated effects of war also reduce the ability of relatives and neighbours to provide such transfer payments and loans.

Given the reduced number of feasible choices under war conditions, there is an externality effect of household market activity, as similar households will pursue the same strategies thus reducing market prices and exchange entitlements, for example for local wage labour, assets or tradable crops. Transaction costs t_i are in part determined by the equilibrium values of s_i^2 and q for all households and by the degree of market density. Effectively, individual households cease to have a negligible influence on the market, as postulated by perfect competition. At the margin, one more household reducing its market participation

will prevent all other households from forming a market. This effect is particularly pronounced if households' transaction costs are uniformly affected by the war, creating a high covariance of risks, which in turn induces covariant household activity choices. This is a further, indirect reason for market breakdown in war conditions.

Volatile markets thus increase the incentive for households to engage in subsistence or unrelated market activities. Village "enclaves" (Dasgupta 1993: 235) are therefore more pronounced in a post-war environment and location will be a strong determinant of household behaviour. In the extreme, these effects may create village-level poverty traps, from which no individual household can easily free itself. Equivalently, villages where households had diverging experiences of the war may have more opportunities for effective, welfare enhancing market exchange in the post-war period.

These effects of war on risk, household characteristics, assets, production technologies, institutions, and markets imply that different activities have different degree of war vulnerability (figure 6.4). Less market-dependent and capital-intensive social exchanges are least war vulnerable and cash crop production, depending on a chain of market transactions, are most war vulnerable. These activities can be expected to react most strongly to the receding negative war effects. Some entrepreneurial activities may be less war vulnerable or may even be survival activities (e.g. petty trading) while other entrepreneurial activities are very dependent on war vulnerable input and output markets.

In terms of figure 6.3 this implies that different sets of activity choices have different relative risks and returns, i.e. that the slopes of the curves in quadrants IV and III differ depending on the activity choice of the analysis. The net effect in the post-war period on the share of market-dependent activities in total household income is thus ambiguous a priori.

Summary

This section has analysed peasant household choices between different coping strategies (or activities or labour allocations) in the post-war period. Figures 6.4 and 6.3 summarise this discussion in complementary ways. The former shows how the household labour allocation between four different activities responds to the gradual lifting of the war constraint. The net effects are highly dependent on individual circumstances but a decrease of social and wage activities is likely and an increase in cash crops is expected in the long-term.

The latter shows the processes which bring about these changes. The graph traces the effects of war and of the end of war in a 2-activity model and explains why risk averse peasant households may engage in very risky activities during the war. The choice set for

war-affected households is very small, utility is low, risks are high, and households value their labour subjectively. In this framework, households choose activities to smooth consumption. For instance, it is profitable to engage in small scale subsistence activities requiring few (especially indivisible) inputs.

Moreover, households cannot readily form expectations or accumulate assets but individual households can have a significant effect on local markets. Hence locational variables are expected to be key determinants of household activity choices. Post-war activity choices may strongly resemble those of the war period due to the existence of poverty traps, even at the village level, which inhibit post-war reconstruction.

This analysis thus extends the understanding of the motivations for activity diversification and coping strategies of poor farm households to those circumstances where conflict has had a significant effect on the local economy. The analysis differs from the standard diversification literature in that it considers the peasant household model as the point of departure, rather than a SSS-style farm household. This has implications for the role of the subjective wage rate and the role of markets and points to the rigidities that severely war affected regions and households face in coping with the end of the war.

The war legacy also implies that post-war household coping strategies differ substantially in nature and sequence from pre-war or other pre-disaster coping strategies. The lack of markets for instance reduces the scope for household decisions. This is in contrast with pre-disaster coping strategies where some markets are typically present in which households can execute their survival activities.

6.4 Data and Econometric Considerations

This section will derive an econometric specification for the share of labour dedicated to high risk activities, q, and will discuss related data and econometric issues. Section 6.5 will then state the expected signs of the determinants of q, where q will be interpreted in several ways.

Appendix A.3 sets out a theoretical model of household activity choices which yields the following functional form for q in equation A.20:

$$q = - (p_1 a_1 - p_2 a_2 - 2s_1^2) / 2(s_2^2 - s_1^2)$$

where q must lie in the interval 0 to 1. The equilibrium determinants of q are thus closely related to the independent parameters p_i, a_i, s_i^2. Depending on the functional form of the utility function, q also depends on ϱ_{ij}, and W (appendix A.3). This implies that subjective wages and household endowments can generally matter for activity choices. Furthermore, under war conditions the subjective valuation of leisure and the household- and village-

level experience of market transaction costs (equation A.9) are key determinants of activity choices.

Taking q as a general indicator of activity choices (which will be interpreted in several ways below) and replacing the theoretical parameters p_i, a_i, s_i^2, ϱ_{ij}, and W with their corresponding (though often overlapping) household survey indicators thus yields the reduced-form equation:

$$q_i = \alpha_0 + \alpha_1 \mathbf{L}_i + \alpha_2 \mathbf{F}_i + \alpha_3 \mathbf{K}_i + \alpha_4 \mathbf{V}_i + e_i \quad (6.1)$$

where $\mathbf{L}_i$, $\mathbf{F}_i$, $\mathbf{K}_i$, and $\mathbf{V}_i$ are vectors representing household, land, asset and village-level endowments and characteristics, respectively, and where e_i is an error term which is not correlated with the exogenous variables thus yielding unbiased and consistent estimates for the vectors of coefficients α_h for households i = 1...N and groups of coefficients h = 0...4.

The functional form of equation 6.1 is not restricted to a specific form and may thus be guided by theoretical considerations, practical experience (e.g. from previous specifications in chapters 4 and 5), and statistical tests of the econometric results below. A priori considerations and experience suggest mainly linear, log-linear and quadratic forms for the independent vectors $\mathbf{L}_i$, $\mathbf{F}_i$, $\mathbf{K}_i$, and $\mathbf{V}_i$. For example, household size and household education will be found to have a quadratic effect on activity choices. This specification thus corresponds closely to those used in the literature on household income diversification (cf. Reardon et al 1992: 272).

The analysis below will also focus on the respective determinants of the two peasant household decisions to enter any crop output market and to adopt cotton (a key cash crop in northern Mozambique). These are discrete choices (as first defined in equation 3.1 in chapter 3) which cannot be modelled with a linear approach as expressed in 6.1.

Instead, consider that a household enters such a market or adopts such a crop if it considers it to be a profitable move such that:

$$q_i = 1 \text{ if } \pi_i > 0 \quad (6.2)$$
$$q_i = 0 \text{ otherwise}$$

where π_i is the expected rate of profitability of entering a market for household i = 1...N. Furthermore, assume that the profitability of the activity is determined by a model akin to that of equation 6.1. The binary model to be estimated is then:

$$\text{Prob } (q_i = 1) =$$
$$F (\alpha_0 + \alpha_1 \mathbf{L}_i + \alpha_2 \mathbf{F}_i + \alpha_3 \mathbf{K}_i + \alpha_4 \mathbf{V}_i) \quad (6.3)$$

where F is a cumulative probability function closely related to 6.1. This model can be estimated by logit or probit, if the error term follows a logistic or normal distribution, respectively, as has been discussed in section 5.3 in the context of the land tenure insecurity and land investment regressions and more generally in chapter 3. Such model thus estimates the probability that a household undertakes a certain activity given the household's endowments, preferences and the prevailing prices.

With the nature of the effects of war in northern Mozambique and with the available household survey data, it is not possible to account directly for the legacy of the war on q in equation 6.1. However, the effects of the war are reflected in the scale of the right hand side variables and in their expected significance, as discussed in the previous section. More war-affected, more isolated and more risk averse households are expected to choose particularly restricted activity portfolios while better endowed and less risk averse households specialise in fewer activities thus exploiting their comparative advantage and economies of scale in an increasing market economy.

The regression results reported below were calculated using the survey commands from Stata 6 (StataCorp. 1999). The coefficients reported indicate the effect each independent variable has on the dependent variable, given all other effects accounted for by the regression.

6.5 The Expected Determinants of Post-War Activity Choices

The analysis so far has focussed on the structural equations which determine portfolio diversification under post-war conditions. The general case between two risky but otherwise similar coping strategies was considered. It was found that war affected the labour allocation between activities by changing the riskiness and the covariance of returns, the subjective wage and asset position of the household, production technologies, transaction costs and market prices, as well as social institutions determining market access and activity opportunities. Overall, it was expected that the post-war period would see an increase in cash cropping and a reduction in off-farm survival activities with an ambiguous effect on food cropping and on entrepreneurial activities.

This section will develop these arguments in more detail, by focussing on observable changes in household and market conditions in the post-war period and postulating specific and testable hypotheses mapping these conditions to household activity choices. The hypotheses will assign complementary interpretations to the variable q in equation A.20. In particular, the analysis will address the household choice between on- and off-farm activities, between subsistence and market participation, and between food and cash

crop adoption. In addition, a measure of household spatial diversification will be developed which will summarise the number of field plots tended. Finally, the variable q will be interpreted as a household's level of social exchange, which is expected to have a particular significance in the post-war period.

From figures 6.4 and 6.3, it is apparent that a variety of household decisions affect total household activity portfolios. However, risk, technology, the subjective household wage, and institutions are difficult to measure as part of a household survey while current assets may be endogenously determined. In the analysis below, the regression variables have instead been grouped into land, household, asset and technology, social capital, and market variables. Note that each variable in these reduced form regressions may represent varying structural influences. For instance, female-headed households may be discriminated against by their communities and such households may be more risk averse, with the war potentially affecting both of these characteristics. The discussion in this section will thus follow the format of the previous sections while grouping variables in the regressions according to their economic interpretation and survey-based design.

On-Farm versus Off-Farm Activities

The most basic production choice any peasant household faces is what share (denoted 1 - q) of its labour to allocate to on-farm (or agricultural) activities and what share (denoted q as in equation A.11) of its labour to allocate to off-farm (or non-agricultural) activities. In the extreme, a war-affected peasant household may operate in complete autarky and is forced to specialise in on-farm activities at point d' in figure 6.3. However, in practice most peasant households have some degree of choice over what type of production to undertake as they face partial markets for some non-agricultural outputs, depending on their household endowments.

As the section presenting the summary statistics below will show, off-farm activities in the immediate post-war period are still only a small share of total rural output. An increase in activity diversification thus implies an increase in q and thus in the dependent variables SHAREON, which measures the share of net household income in 1995 from agricultural activities.

In addition, the total degree of income diversification is assessed using the income diversification index (called DIVERS02 below). DIVERS02 measures the effective number of household activities where each activity is weighted by its contribution to total household income in 1995. DIVERS02 is based on the Herfindahl-Hirschman concentration index and is defined as:

$$DIVERS02 = 1 / (\sum q_i^2), i = 1...N \quad (6.4)$$

where q_i is the share of income from activity i in total household income and N is the maximum number of income activities (Laakso and Taagepera 1979: 4, Paroush 1992, Rhoades 1993). If each activity contributes equally to household income, this implies that DIVERS02 $\geq$ 1 and that DIVERS02 equals the total number of household income activities. Note that DIVERS02 is sensitive to the level of aggregation of income sources. DIVERS02 thus measures the degree to which households have moved from point d" in figure 6.3 towards more desirable points along the efficient frontier a"b"c". Note that the analysis below uses the variable DIVERS12, which is the natural log of DIVERS02.

No survey variable directly captures risk (V in equation A.3) or risk attitudes (U in equation A.17) as had been forewarned in the introduction to this chapter. However, female-headed and refugee households may have experienced the highest level of risk during the war and may therefore be closest to the survival threshold, i.e. they value their own labour (W in equation A.16) highly. These two variables can thus be interpreted from a risk experience and risk aversion point of view. Both groups of households are thus expected to engage in fewer off-farm activities.

Further sources of risk can occur through severe environmental constraints reducing the profitability of agriculture, through weak social relations, through poor infrastructure preventing information flows, and through thin labour and crop output markets. Risk may be more closely correlated within a village if the health infrastructure is poor (which in turn is directly related to the war). A higher incidence of illness at the household level or in the village will thus reduce q.

Household characteristics also define a household's available labour supply W. Households with more workers, with fewer dependent members, with fewer days off sick or less time spent collecting firewood and water have a higher effective labour supply. The ratio of females over males may also affect the household labour supply if women are socially prevented from carrying out certain on- or off-farm tasks. However, total household labour supply should not affect q unless activities have increasing returns to scale. The role of the household size on the variables SHAREON and DIVERS12 is thus ambiguous and may not be significant.

Land is assumed abundant and uniform in the model but in practice different households will face land of different quality. A set of variables will therefore control for land characteristics but these variables may not be significant individually. If they are, it is likely that more, better quality, more easily accessible, more secure, and closer land discourages off-farm activities. A higher village-level yield may be indicative of better farming

conditions (i.e. a higher a_i in equation A.6) and thus suggests a comparative advantage in on-farm activities and a negative effect on q.

Household production technology a_i can also be proxied by the number and the types of production tools households own and by the education of a household. All are expected to have a negative effect on on-farm activities (assuming that tools are suited to off-farm production). Higher assets may also have a positive effect on technology (figure 6.4) and thus favour a move to off-farm activities. The war will have had a strong effect on 1992 assets which reduces the ability of household to move into off-farm activities currently. The 1995 cyclone destroyed many trees, an important asset, and thus would have reduced household participation in off-farm activities.

The war will also have affected social capital. The origin of husband and wife, the local power status of the household, whether the household has ancestors buried locally, and other variables already mentioned such as female-headedness, refugee status, age of the household head, and education level all combine to define a household's social status and ability to conduct transactions reliably. A higher social capital will have positive effects on a_i and negative effects on t_i (in equation A.9) and thus reduce on-farm and increase off-farm activities.

It is therefore expected that less risk averse and better capitalised households facing lower transaction costs will engage in more off-farm activities under post-war circumstances. It is also expected that the total household labour supply and land assets are not the key determinants of post-war off-farm activities.

Market Participation

The most important non-market activity for most households is the production of home-consumed food crops. To a smaller extent, social exchange, gifts and NGO donations complement this non-market income. Market income, on the other hand, consist of food and cash crop sales, entrepreneurial activities and off-farm wage labour. In this analysis, the share of non-market income is denoted 1 q (and captured by the variable SHARESUB) and the share of market income q. Furthermore the variable STATUS14 summarises the status of the household by its final crop market participation decisions in 1994-95.

The decision by a household to participate in formal markets depends very closely on individual transaction costs (de Janvry et al 1991) and thus on household endowments, village-level factors and how these are affected by both, as discussed in the context of equation A.9. The decision to participate in an output market is not the same as the decision of how much to sell in such a market as the former may entail a fixed transaction

cost, for example in identifying a market, investing in such an activity, or in enforcing the payment (Goetz 1992: 445-6). The scale of the fixed transaction costs will be higher if a household does not participate in any market than if a household considers joining an additional market.

In addition, the scale of fixed costs of joining a food crop market are lower than that for joining a cash crop market as the former does not involve additional investments or technologies. For example, the opportunity cost of growing inedible cash crops and, after the harvest, finding no buyer is larger than the opportunity cost of not being able to sell surplus edible crops. These effects change the perception that households have of their expected revenues (equation A.10) and the riskiness of output market participation (equation A.3).

War is likely to raise the scale of the transaction costs (equation A.9) involved in joining a market, as few public or private investments will have survived the war which could have lowered transaction costs for households. The decision to participate in a market is thus more significant and less easy to resolve in a war context than in a normal peace economy.

In particular, a strongly war-affected household must face three important decisions in regard to formal output markets. These are whether to exit perfect autarky at all (i.e. only growing food crops and engaging in social networks), what degree of market participation to undertake (i.e. what value to set for q), and what type of income portfolio to pursue given that q is positive. The last question includes the issue of whether to adopt cash crops, thus entering a more risky activity and a very specific market. This section will address the first two issues while the next section will address the third issue.

Market participation in a fractured post-war market is likely to be more risky than home-consumed food production (thus motivating the shape of a"b"c"d" in figure 6.3). This is particularly true to the extent that households need to convert their market-earned cash income into food in another market thus making the household dependent on at least two markets for realising the utility inherent in tradable output. Irrespective of the level of s_1 and s_2 and as long as s_{12} is not unity, there will be scope for portfolio risk reduction through activity diversification (equation A.4). However, a high level of household-specific fixed transaction costs may prevent households from participating in a market, even if there is some benefit in doing so. Hence the decision to participate in markets will be driven by household- and community-specific fixed transaction costs, in addition to the actual level of risks and returns inherent in either activity.

Specifically, the fixed transaction costs of market participation depend on activity, household and village characteristics. Land, household assets and household production

techniques may affect if a household has a comparative advantage in overcoming the fixed costs of starting a specific activity thus easing that households' entry into a market.

The opportunity costs of labour in searching (female-headedness, female ratio, dependency ratio), the costs of information gathering (education and age of household head), and the trust and enforcement options available to the household (refugee status, household power status, origin of head and his wife, ancestors' burial place) thus determine household-specific transaction costs (Fafchamps 1999: 70-4, 94, Lyon 2000). The war will have increased these transaction costs, as discussed in chapters 2 to 3 and above. As education levels are low as a result of the war, that variable may not be a significant determinant of fixed transaction costs in the regression. The ratio of female to male household members may also not be significant in the post-war period if the war induces a convergence of gender-specific roles in the workforce, as was true in Europe during both world wars.

Furthermore, community characteristics influence local transport costs (state of infrastructure) and the market density (labour and output market density). Increased war damage to infrastructure increases the level of transaction costs households face which in turn increase price and output variance. Thus entire communities may not participate in some or all activities if transaction costs in those communities have been significantly increased by the war. The analysis below will consider the joint effects of all three sets of variables (activity, household and community characteristics) in analysing the determinants of household market participation.

Cash Crop Adoption

The adoption of cash crops differs from the adoption of market participation in that a shift towards cash crop production is more risky than a marginal increase in food crop production intended for marketing. The adoption of cash crops in the post-war period is thus likely to depend relatively more on the determinants of risk at the household level and the abilities and willingness of households to deal with such risk.[54]

Cash crops are defined to be inedible, unprocessed crops such as cotton, raw cashew and tobacco though this analysis focuses on cotton as it can be grown on an annual basis. Cashew trees on the other hand are a long-term investment but may also yield small returns even with no current investment. Tobacco cannot be grown in the whole sample area thus

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[54] Besley and Case (1993), Feder, Just and Zilberman (1985), and von Braun, Bouis and Kennedy (1994) discuss crop adoption in times of peace while Guhuray and Ruiz (1997), Longley (1997), and Sperling (1997a, 1997b) look at these issues in the context of war.

making cotton the most interesting crop for this analysis. In particular, the focus is on the decision to adopt cash crops, not on the final outcome of income derived from growing cotton. The variable of analysis is thus whether households plant any cotton, which implies $q > 0$ in the model above or COTTON89 = 1 in the analysis below.

Cotton is probably more risky (i.e. has a larger s_i) than food crops in the post-war period, as argued above. More risk averse households are thus less likely to be adopters of cotton. In addition, cotton probably has a high covariance of risk with food crops (s_{ij}) as even cotton typically only utilises a low-intensity package of inputs in northern Mozambique thus making exogenous and spatially covariant factors key determinants of overall output of all crops. The war is partly responsible for the low intensity inputs as it increased the transaction costs (t_i) for cotton companies and extensionists, reduced credit markets and asset holdings, and prevented farmers from practicing cotton growing during the war thus depreciating skills.

Hence smaller households can be expected to be less likely adopters of cotton while larger households have more opportunities for risk coping, for example by spreading their labour supply across several CRS activities or by borrowing more cheaply. Better informed, more able and better endowed households are also more likely to adopt cotton, for a given degree of risk aversion (Feder et al 1985: 260-1). Female-headed households and refugee households may also be more risk averse, thus have a higher subjective valuation of labour (W) and hence be less likely to grow cotton.

However, with the war-induced destruction of credit markets, households with significant liquidity constraints are expected to be unable to start off-farm entrepreneurial activities and thus they have to grow some cotton to build up their assets. The sign on the household asset variables is thus ambiguous overall and may be insignificant.

The relative benefits of cotton versus food production may help determine the household choice to adopt cotton. Productive alternative technologies, for example well-suited food crop technology such as local food crop mills, will reduce the relative benefit of cotton adoption. Similarly, the village level maize yield may be an important determinant of COTTON89. Larger local labour markets increase adoption rates to the extent that cotton is more labour intensive (e.g. cotton requires frequent weeding) and that there are few complementary labour-saving technologies or inputs (e.g. herbicides) available in the post-war period.

In the post-war period, location matters very much for the adoption of cotton, as the war accentuated infrastructural problems inherent in the northern Mozambique economy. More favourable post-war conditions at the village-level reduce transaction costs and risks and

thus increase cotton adoption. This effect is particularly strong where more educated farmers can work in more dynamic, modern or technologically advanced environments, suggesting a significant interaction term between household education and local trading infrastructure.

Spatial and Social Activity Diversification

Households with few market-based diversification opportunities (i.e. those facing multiple market breakdown) can still adjust their agricultural techniques to maximise their utility. One such non-market and non-monetary indicator of household diversification is PLOT32, which measures the degree of spatial diversification of farm households or farm fragmentation.[55] During a war there are advantages to splitting household land holdings into several fields even in the presence of land abundance, for example to reduce the exposure of the household crop assets to attacks and to reduce the spatial risks of production (Blarel et al 1992, Bruce 1993: 45-6, McPherson 1982). On the other hand, households may be able to enjoy some economies of scale, especially when working in groups on a larger field. It may also be easier to protect the crop from petty crime, as some crops are quite vulnerable to theft (e.g. cashew nuts).

In particular, more war-affected households, more risk averse and more isolated households may have more effective plots (i.e. a higher degree of plot diversification). The effective number of plots will be negatively affected by household size to reap economies of scale. The available household techniques and the nature of the land cultivated are likely to be significant determinants of PLOT32 but their sign is ambiguous a priori.

Another measure of non-market household diversification is the degree of social exchange (REMT4). This is defined as the sum of the absolute value of remittances and social exchange both given and received between January and September 1995 (the dataset for the remaining three months of 1995 is incomplete).[56] REMT4 captures the broader degree of dependence of households on this source of income, irrespective of whether the household actually received some such resources in that year. In other words, this variable

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[55] Formally, PLOT32 is defined as the natural log of the weighted Herfindahl-Hirschman index of plot diversification. The HHI is defined as in equation 6.4 where q_i is the share of plot i's area of the total cultivated area per household and N is the total number of plots farmed per household. This index is weighted by the area cultivated per household to allow comparisons across households irrespective of farm size. Taking the natural log results in an indicator which is almost normally distributed.

[56] REMT4 measures the sum of the absolute values as the actual flows given and received may cancel out, thus underestimating the degree of social exchange. If only the amounts given or received had been measured then a regression using either indicator would focus more on explaining the direction and not the intensity of exchange.

measures the value households attach to social exchange or the intensity with which they conduct such exchange. The value of this variable relative to total household income is quite low though it could theoretically be larger than the net household income (see also below). However, the utility households derive from the ability to draw on these payments especially in moments of unexpected crisis such as illness can be very high (Coate and Ravallion 1993).

Thus REMT4 measures in part the reliance of households on household remittances. The choice by a household to migrate entirely to a new area is one of the most extreme and risky war responses a household can undertake (figure 6.4). In part its riskiness results from the loss of social, intellectual or physical assets for example related to kin-structures, knowledge of local agronomic conditions and access to land tenure. In part, a war-affected area has lower rates of information transmission thus increasing the imperfection of knowledge concerning the migration destination. In addition, the events which induce migration are likely to be highly correlated across space therefore reducing the benefit of migration, especially if many households migrate to the same location (e.g. the nearest safe town).

The process of migration is costly itself, thus further reducing the asset base of the migrating household (which often only undertakes migration after much of its asset base has already been depleted) and making a return migration increasingly unlikely. The degree of endogeneity of the war-time migration decision may also affect the opportunity to return post-war. That is, an enforced migration to an urban area during the war may imply an easier return and easier land access in the area of origin while a previous exit from a generally safe area may make the return of a household more difficult in terms of regaining local social capital.

This is why many households in northern Mozambique chose instead to engage in partial migration, sending some household members to other locations to earn some money or to be able to assist otherwise in moments of crisis. Such household division is effectively an investment in the option for future assistance from the receiving household, at the expense of foregoing current output by the sending household (in times of crisis, this marginal output may be negative thus creating an unambiguously positive benefit from reducing the household size).

A related form of assistance in Nampula province takes the form of a culturally institutionalised gift exchange especially among widely dispersed relatives (Kottak 1998). In interviews, households did not necessarily regard these exchanges as such but instead stressed that they were gifts to please their hosts. However, households frequently also

reported drawing on non-household relatives for help with short-term consumption loans or donations in times of crisis, for example during the war or due to serious illness. These exchanges are thus likely to serve both consumption and investment purposes.

Two conflicting forces are likely to determine the level of social exchange for war-affected households. On the one hand, more isolated households face higher absolute risks, are more vulnerable to risk, and have fewer available coping strategies. It could thus be expected that these households have a high share of social exchange. On the other hand, more isolated households have fewer opportunities for social exchange especially with households whose risks and opportunities are uncorrelated with their own. Overcoming isolation is costly and inhibits social exchange. Isolated households can hence be expected to conduct most social exchange with households located closer to their own and to use this exchange to insure against idiosyncratic risks.

This suggests that idiosyncratic risks at the household level create a precautionary demand for social exchange while village-level institutions, that reduce transaction costs, facilitate such exchanges. Smaller, female-headed, refugee, ill, illiterate and powerless households in villages with better infrastructure and markets may thus conduct more exchange than larger, male-headed, long-established and more powerful households. Especially, consumption-oriented exchange, perhaps as part of non-obligatory cultural or religious ceremonies, may be driven by a household's wealth (or ability), rather than by its poverty (or needs). Given that social activities do not directly depend on land, land variables are most likely to be insignificant unless they capture household risks in which case these variables may have a positive sign.

6.6 Results and Discussion

This section will review some summary statistics concerning post-war activity diversification before analysing the regression evidence on this topic. It will be found that strongly war-affected households have to choose their coping strategies from a small set of feasible activities but that across the whole sample there is still a large degree of variance, especially in regard to market participation. Households choose their coping strategies based on individual risk, life cycle, asset and village-level characteristics, which differ from some of the motivations suggested by alternative farm household models. Very poor households may act rationally to specialise in very risky activities while very poor households also face sever obstacles to escape their poverty traps.

Household decisions concerning joining a market and the degree of market participation have different determinants and a similar argument may apply to the household decision to

adopt and grow cash crops. Non-market coping strategies are also important though social exchange is not feasible for those households most constrained to participate in markets. In fact, the determinants of social exchange and market exchange are surprisingly similar.

Finally, the analysis indicates many feasible policy interventions to assist peasant household post-war reconstruction. Village-level public goods are important but the broad range of negative war effects indicates that policy interventions should not be overly concentrated but address a range of constraints.

Summary Statistics

As shown in figure 6.5, households are very dependent on subsistence food crop activities for their income, with 59% of total household income being derived from such activities. On average, food crop and cash crop marketing yield 6% and 17% of household income, respectively, suggesting that cash crops have only a small share of total income but they account for three quarters of all crop marketing income. Entrepreneurial, wage and social income only account for 10%, 6% and 2% of all household income, respectively.

The mean share of on-farm income (SHAREON) in total income is thus 82% while the mean share of subsistence or non-market income (SHARESUB) of total income is 61%. This suggests that household in northern Mozambique in 1995 had not yet fully emerged from the war economy, with a low degree of income diversification and high income shares for food crop and subsistence activities.

Figure 6.6 compares these findings to those from 28 other farm surveys from Sub-Saharan African countries, which on average report lower on-farm and higher off-farm income shares. Interestingly, the share of social income is also higher in the other surveys, suggesting that war may also reduce a household's capacity to generate social income if the household's capacity to generate off-farm income had been damaged. Other authors report household income shares from off-farm activities in African countries of between 30% and 50% occasionally reaching 90% (Ellis 1998, Reardon 1997, von Braun and Pandya-Lorch 1991). It is thus apparent that the share of off-farm income in the post-war FSP survey is unusually low.

Figure 6.7 shows how volatile household output market participation decisions in post-war northern Mozambique are. The FSP survey recorded crop sales for the two agricultural years 1993-94 (through a recall question) and 1994-95. The actual values recorded for the earlier year may be inaccurate but the variable is likely to describe correctly if households sold any amounts of food or cash crops in that year.

43% of all households did not change their market participation status in that period while 20% of all households either added another type of crop or specialised in cash crops and 38% reduced the number of types of crops sold or even resumed a pure subsistence status. In fact, the total share of households marketing some cash crops dropped from 63% to 54% while the share of pure subsistence households increased from 13% to 21% in one year. These figures show that households adjust their market participation in the face of a variety of changing constraints from year to year and that households differentiate in their market participation decisions between food and cash crop markets, as argued by de Janvry, Fafchamps and Sadoulet (1991).

Figure 6.8 shows the distribution of households by dominant income activities (TYPE31 and TYPE22) and by crop market participation status (STATUS12) and summarises the mean household income per capita in US$ (INCOME05) by each of these categories. As defined by TYPE31, 56% of all households undertake only on-farm (or only very insignificant off-farm) income activities while measured by TYPE22 this share is 35%. The latter variable also indicates the breadth of activity choices. About one third of all households engage in food or food and cash crops only while another third engages in food crops and off-farm activities, and the last third pursues food crops, cash crops and off-farm activities.

The final panel of figure 6.8 demonstrates the even spread of households across all crop market participation categories in 1994-95, namely no crop market participation, food crop sales only, food and cash crop sales, and cash crop sales only (STATUS12). The first two categories have mean income per capita in 1995 of 21 to 29 US$ while the other two categories have per capita incomes of 47 to 48 US$ in 1995.

Figure 6.8 also implies that activity choices have strong welfare implications, thus supporting the view that there are risk-return trade-offs between different types of activities. Households only growing food crops have a much lower mean income per capita (34 US$) than households also growing cash crops (53 US$) but the former have a lower variance of income than the latter. The lowest mean income is obtained by households growing food crops and undertaking off-farm activities, with a mean of 21 US$ and a low corresponding standard error. Households growing both types of crops have a higher mean income and higher variance of income than households growing both types of crops and doing off-farm activities. This suggests that undertaking off-farm activities (the majority of which are entrepreneurial activities as shown in figure 6.5) helps to reduce the riskiness of income but also reduces the mean expected income.

Similarly, comparing the groups not growing cash crops with those which do (irrespective of their off-farm activity status), it is clear that cash croppers have much higher mean incomes though the variance of their incomes can also be higher. This result suggests the hypothesis that adopting cash crops has positive welfare implications, which will be analysed in more detail in chapter 7.

Entrepreneurial income in northern Mozambique appears to involve low risks and low returns. The FSP survey measured the types and the number of activities households undertook. It was found that most households undertook no or one activity in each of the four relevant rounds of data collection though a few households undertake up to three activities. Activities across these rounds included making alcoholic drinks (34% of all cases), making crafts (20%), trading grains and other goods (17%), tailoring (6%), carpentry (5%), metalworking (4%), healing (3%), and 22 other types of activities with lower frequencies.

Activity levels are lowest during the harvest season and highest during the commercialisation of maize and cotton, when households have the highest cash availability. This suggests that locally and agriculturally generated purchasing power drives the demand for local entrepreneurial products and services, which is also a key factor elsewhere in Sub-Saharan Africa (Delgado and Siamwalla 1999: 134). From a supply point of view, these results indicate that entrepreneurial activities require some liquidity which is only available at key points of the agricultural cycle.

Delgado and Siamwalla hypothesise that households pursue social income activities as a deliberate attempt to diversify their income base beyond these endogenous, local determinants of off-farm income (1999: 134). They consequently find that the correlation coefficient between off-farm income and social income is low (0.17) and insignificant. In the FSP sample, the corresponding correlation coefficient is even lower (-0.08) and also insignificant, which supports their hypothesis.

However, the correlation coefficient between on-farm and social income is 0.18 and highly significant thus reducing the value of social income as a risk reducing coping strategy, given the dominance of on-farm income in the average activity portfolio. This pattern of correlation can therefore explain why household social income only accounts for such a small share of total income in northern Mozambique, unlike elsewhere in Sub-Saharan Africa.

Finally, figure 6.9 summarises the plot diversification and social exchange variables introduced above. The two final indicators are PLOT32 and REMT4, which are both derived from the other indicators shown in the figure and which are both almost normally

distributed. PLOT12 shows that households farm between 0.1 and 13.2 plots per hectare, which is an indicator independent of farm size (unlike PLOT95 and PLOT02). PLOT32 is the natural log of PLOT12 so that a higher value of PLOT32 indicates a higher degree of spatial diversification (as will be discussed below).

REMT3 shows that each household undertakes on average 1.66 US$ of social exchange per capita in the period January to September 1995, with a median level of 0.98 US$ per capita. The mean annual level of social exchange given and received is thus approximately equal to 13% of mean annual food expenditure indicating that social exchange is not a dominant activity for most households although it may have a strong welfare impact for marginal households. REMT4 is the natural log of this indicator, which has a smaller sample size as 6% of the FSP sample household do not engage in any social exchange in that period.

These summary statistics suggest five conclusions about household activity choices and income patterns in post-war northern Mozambique. First, activity diversification and off-farm income is comparatively low even by African standards. Second, household output market participation is highly volatile over time and market participation decisions are made on a crop-by-crop and season-by-season basis. Third, adopting cash crops may entail financial benefits but also significant risks. Fourth, entrepreneurial and social activities only pay small returns given their low capital intensities. Fifth, the dependence of entrepreneurial and social activities on local linkages and their correlation with on-farm income components may make them unsuitable for income diversification.

On-Farm versus Off-Farm Activities

This section will analyse the determinants of the on-farm income share of total household income (SHAREON, see figure 6.5) and the related indicator DIVERS12 (see equation 6.4 above). DIVERS12 is based on the shares of income which make up the six positive values in figure 6.5. The variable shows that on average households undertake just over 2 types of income activities. The maximum number of types of income activities undertaken is 4.63 (which is a weighted value and hence not an integer). The mean and standard deviation of DIVERS12 are 0.70 and 0.29, respectively, with DIVERS12 having approximately a normal distribution.

The correlation coefficient of these two dependent variables is -0.40 and highly significant, thus confirming that more on-farm producing households are more specialised. The relationship between SHAREON and DIVERS12 has in fact an inverted u-shape with households pursuing few and many off-farm activities likely to engage in fewer activities than households with an even mix of on- and off-farm activities.

The regression results for SHAREON and DIVERS12 are reported in figures 6.10 and 6.11. Both regressions are highly significant and have a good fit with R^2 values of 0.59 and 0.50, respectively. The DIVERS12 regression broadly replicates the findings of the SHAREON regression, suggesting that the results are robust. Both regressions also confirm most hypotheses formulated above although there are a few unexpected results.

Larger households engage in fewer overall activities with a larger share of the income deriving from on-farm activities. On the one hand, larger households could be expected to divide their labour supply among more activities thus spreading their risk. On the other hand, there may be economies of scale in subsistence agriculture, especially with weak labour markets which cannot substitute for on-farm labour shortages. In addition, if off-farm activities are asset- and not labour-constrained, larger households may prefer to undertake more on-farm income activities.

Surprisingly, households with older heads have a higher share of household income derived from on-farm activities, although this share increases at a decreasing rate. Two processes may explain this observation. Either older households are more risk averse and thus less likely to take up off-farm activities. However, this explanation does not fit well with the life cycle behaviour of rural households where comparable younger households with young children would be expected to be most vulnerable and risk averse. Alternatively, older heads engage in more cash cropping rather than food cropping thus leaving their on-farm share of income unchanged. One may expect older head to be better placed to undertake entrepreneurial activities requiring experience, assets and contacts. This issue will be addressed again below when analysing the determinants of SHARESUB.

Other household characteristics results worth noting are that neither refugee (REFUGEE1) nor female-headed (FEMHEAD1) households nor those containing more females (FEMALE2) differ systematically in their share of on-farm income activities or their total number of income activities. The education for mothers and its squared term (EDUMUM1, EDUMUM2) are not jointly significant, either, suggesting that gender-related issues do not determine off-farm income opportunities. This is in contrast to evidence from Ghana (Abdulai and Delgado 1999: 128) and appears to be related to the generally lower levels of overall and of off-farm income in Mozambique, which implies that non-gender factors are more important determinants of SHAREON.

The expected effect of household education (EDUMAX3, EDUMAX4) in both regressions is quadratic with the sample being roughly equally divided between those for whom education has a positive and negative effect on SHAREON and DIVERS12. This shows yet again that very low levels of household education do not have the expected

effects on household production, with only above average educated households reducing their dependence on on-farm income and on few income activities.

This latter result complements a finding from an arguably very different environment in an area in India with rapid technical progress where fast growth increased both the rates of return to schooling and the household investment and participation in schooling, inducing a virtuous cycle of growth (Foster and Rosenzweig 1996b). In post-war Mozambique, the evidence from this and related regressions presented in this thesis suggest instead that an opposite cycle of no or even negative technical progress has resulted in very low returns to education (as far as can be ascertained from the available data) and has induced households to reduce their education investments in the war- and post-war periods. From a policy perspective, it will not be easy to break such cycle of low returns, low household investment and low participation. This issue will be discussed further below and in chapter 7.

Overall, household characteristics appear to be significant determinants of household activity choices, probably via their effects on the subjective household wage and household risk attitudes, as was also found in a study in Bangladesh (Shahabuddin et al 1986).

The household land characteristics broadly conform to the expected signs.[57] Larger farms have a higher on-farm share of income. This contradicts findings from for example Burkina Faso where land did not drive diversification (Reardon et al 1992). However, the relative fluidity of land coupled with war-induced constraints to land access appear to raise the importance of land for the determination of activity choices. The farm size effect may also reinforce the household size effect noted above, as larger households also farm more land in total (chapter 4).

Note that the share of land lacking rain (RAIN4) has a significant effect on SHAREON, with households reducing their agricultural activities in response to a lack of rain. Northern Mozambique does experience a degree of variation in rainfall both across time (which is less predictable) and across space (which is more predictable). The observed response to the lack of rain is likely to come from the latter source, with households closer to the coast (where there are fewer mountains) and in the far interior being more susceptible to low rainfall (chapter 3).

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[57] Tests of endogeneity did not find evidence of AREA35 or TENURE1 being endogenous in this regression (data not shown).

Three asset variables have unexpected signs in the two regressions. First, the unexpected sign of CYCLONE2 in the DIVERS12 regression is due to the familiar cyclone effect on trees, thus CYCLONE2 is more a proxy for tree ownership than for genuine non-tree asset damage. Second, the positive coefficient of ANIMAL5 in the SHAREON regression suggests that having more livestock helps to increase agricultural income activities, not off-farm activities. This may be related to the synergies derived from livestock ownership (especially in the post-war absence of commercial farm inputs like fertilisers) and to the war-induced absence of credit markets for off-farm activities, which implies that livestock plays no role as a collateral in credit transactions. Third, having more stored crops infested with pests and bugs (PEST13) raises on-farm activities. This is best explained by considering that a large share of household consumption is derived from own farm production, so that it is difficult to substitute storage losses with more off-farm activities, especially while food output markets are thin.

The social capital variables are entirely insignificant, suggesting that they do not play an important role in the choice of on- versus off-farm activities and the degree of specialisation. This is slightly surprising as investments in social institutions are expected to be a key response by households to high post-war levels of uncertainty. However, their insignificance may derive from three sources.

First, the share of social income in total income is very small thus reducing the role of social institutions in explaining income shares. Second, social institutions may be less important than anticipated if the costs of engaging in social exchange are related to those of conducting trade generally. Being a local political leader, for instance, may not affect the choice of income activities much if all forms of off-farm transactions are similarly expensive to undertake. Third, the proxies for social institutions included in the FSP survey may only measure such institutions imperfectly. This is a difficult obstacle to measure and to overcome once the data has been collected. Future studies of post-war reconstruction may wish to pay more attention to constructing appropriate proxies in a context where they may play an important role.

While the social capital variables are not very important, the village level variables are individually and jointly significant. Higher prices for hungry season home-produced food crops (PRICE35) raise the share of on-farm production as expected. While the labour market variable LABOUR3 is not significant in the current specification, re-estimating the model without the infrastructure variable INFRA4 or without the LABOUR3 variable yields a significant coefficient for the other variable with the expected sign in each case (data not shown). The correlation coefficient for INFRA4 and LABOUR3 is -0.28 but a

VIF analysis does not appear to suggest a problem of multicollinearity so that the current specification was maintained. Overall, these results indicate that villages reporting infrastructure problems also have weaker labour markets thus one variable masks the other in the reported regression.

This conclusion corresponds with evidence from interviews conducted with government officials and farmers in several remote districts in Nampula province, in which the link between flexible labour markets and low transport costs was emphasised. Most striking was the evidence from the coastal district of Moma where a bridge, which connected the village serving as the district capital with the main east-west transport corridor in Nampula, had been built shortly before I visited the district. Interviewees in this drought-prone district reported significantly higher availability of casual labour (including visiting relatives and migrant workers) looking for supplementary income near the district capital.

The evidence presented in this section refutes the two initial hypotheses. First, the directly war-determined variables such as refugee status are not significant determinants of household activity choices in the post-war period. This may be related to the massive negative impact of the war on almost all rural households, making differentiations of direct effects very hard to recognise in the dataset.

Second, social institutions generally have no impact on these choices, even though these variables are important determinants of other household decisions (e.g. investments in land quality). This is likely to be a result of the transaction costs for social activities being very similar to those of market-based activities, thus making "social insurance activities" less of a substitute for households excluded from market activities. As a conjecture, it may be possible that social activities are more useful for households which face only commodity-specific market failure. For households facing market failure across a whole range of products and services, i.e. for economically isolated or almost autarkic households, social contacts may not offer a significant alternative income source in the post-war, rural African context.

Instead, the evidence corresponds with findings from peace-time economies which indicate that activity choices crucially depend on comparative advantage as defined by household risk-bearing, skill and asset characteristics (Foster and Rosenzweig 1996a). In the post-war context of northern Mozambique, these characteristics are in fact even more important as the relative isolation from market forces raises the role of the subjective valuation of household labour. Thus a less market-intensive war-affected environment actually enhances the importance of household characteristics in the choice of income-generating tasks.

Nevertheless, the Asian economies, as discussed by Foster and Rosenzweig (1996a), have very different transaction costs even for the rural poor. In an African context, lowering transaction costs will therefore have strong positive effects on off-farm earnings of agricultural households (Abdulai and Delgado 1999: 129). In a post-war economy, furthermore, transaction costs may be higher still than in north Ghana and they can probably be lowered proportionately more than in most other economies.

In figure 6.3, this means that household market participation decisions which help move the household back from a position such as b' and b" to b include changes to household endowments and to village endowments alike. In northern Mozambique, it is then the combination of household characteristics and village transaction costs which combine to jointly determine the household activity choice between on- and off-farm activities. In the long-term, this mix of household and village characteristics will help to determine if a war-affected household and indeed a war-affected region will be able to reconstruct and escape the war-induced, locally covariant poverty traps such as that described by a'b'c'd'.

Autarky versus Crop Market Participation

The discussion above addressed the importance of activity- (or commodity-), household- and market-level transaction costs in the household decision to participate at all in crop output markets. This issue will be analysed further in these paragraphs through an analysis of the variable STATUS14. This variable codes zero for households not participating in any crop markets (whose share in the population is 21% as shown in figure 6.8) and one for all other households.

A logit regression (see equation 6.3 above) of STATUS14 can therefore help to understand what determines the household decision to leave autarky. Following Cramer and Ridder (1991), a binary and not a multiple-category variable was adopted for this analysis to derive the essential difference between no market participation on the one hand and some form of market participation on the other hand. In the next section the variable SHARESUB, which summarises the share of household income derived from subsistence activities, will be used to determine the continuous decision as to how much market activity to undertake.

The STATUS14 regression shown in figure 6.12 is highly significant (note that the coefficients are reported as odds ratios as explained in chapter 3). Of the household characteristics, only the dependency ratio DEPEND94 and the education variables EDUMAX3 and EDUMAX4 significantly affect the household decision to leave autarky.

Households with a higher dependency ratio (such as those households with young children in the middle of the life cycle) have strongly reduced probability of crop market

participation, indicating a life-cycle dependent and household-specific propensity to participate in crop markets. This will be related to the increased consumption-labour ratio of these households, which implies that households have only a smaller marketable surplus. Crop market participation may thus be a secondary activity for households, only feasible once household consumption have been satisfied with subsistence activities. This is particularly likely in the face of weak food markets so that monetary income earned is not a reliable saving instrument for satisfying nutritional requirements if food markets cannot be taken for granted.

A higher household human capital increases market participation (EDUMAX3 EDUMAX4). This effect is quadratic and the maximum household market participation is reached at 5.7 years of effective education (i.e. adjusted for literacy), which is only surpassed by about 17% of all sample households. These education variables may also be a proxy for past household asset constraints so that previously better off households were able to send their children to school and subsequently to move out of subsistence agriculture. Nevertheless this result also shows that some knowledge of Portuguese and mathematics may be crucial for the participation in output markets and that primary education can deliver some such benefits even if students do not complete the entire primary curriculum. In a review of recent evidence on the effects of education in the rural economy, a similar effect of education was noted thus making a distinction between an apparently non-existent link from education to farm output and an apparently existing link from education to farm activity choices in Africa (Taylor and Yunez-Naude 2000).

While refugee and female-headed households are less likely to be crop market participants, these effects are not significant when controlling for the household dependency ratio. In addition, the age of the household head and the whole household, the gender balance, health status and environmental time constraints all fail to affect significantly the primary market participation decision by the household. While this does not suggest that household characteristics are not important determinants of household transaction costs, it does point to other factors playing a more important role in shaping these.

Total farm size in 1994-95 (AREACF94) is one such highly significant factor. A t-test does not reject at any reasonable level of significance the hypothesis that AREACF94 is determined exogenously (see chapter 3 for the details of the test methodology). This seems an intuitive result given that total land endowments are less variable across time than the household area cultivated (appendix A.2). A similar result but with a larger coefficient obtains when using the total land per capita in 1994-95 variable AREA15 (data not shown).

Households with a larger total land endowment are hence more likely to participate in crop output markets.

This result implies that there are fixed transaction costs of market participation (Goetz 1992). Households with larger land endowments may have lower production costs, a comparative advantage in farming, or lower transaction costs of land acquisition (e.g. due to unobserved social capital), all of which in turn also allow households with larger farms to participate more readily in crop output markets.

This result also suggests that factors determining farm size (as discussed in chapter 4) have important further effects for the type of activities households undertake in the post-war period. In a competitive model of household production with functioning markets, one would expect either that all farms are of the same and optimal size or that size is irrelevant for production choices. However, while household size has no effect on crop market participation, the total land endowment is significant thus emphasising the degree of divergence of peasant household production in the post-war period from the competitive model. The likely sources of this divergence appear to be economies of scale in production, as mentioned above, and market imperfections which can be better internalised by larger scale farms. War-affected households may thus be doubly constrained in their reconstruction efforts. First they have less land for farming and second they have less access to crop markets, with the former effect reinforcing the latter.

A lower soil fertility (AREAFER6) and a longer distance to the household fields (DISTANC3, DISTANC9) both reduce crop market participation significantly, though the latter effect is diminishing with very long distances to the fields. Interestingly, the RAIN4 and TENURE1 variables, which capture risks related to rain shortages and tenure insecurity, are not significant, indicating that the decision to join crop markets, though flexible across agricultural years, is not predominantly a response to short-term risks but more a response to changing transaction costs at all levels (activity, household and location).

The probability of crop market participation is reduced by owning more agricultural tools per household (TOOL01), increased by owning a larger range of agricultural tools (TOOL02), and reduced by having a widespread pest problem in the crop store (PEST11). These results emphasise the role of household technology in determining household activity choices and indicate that accumulating a range of tools can overcome labour shortages. Households with a range of tools can undertake more activities even when isolated from other households, with whom they would otherwise have had to exchange labour or tools. Such labour exchange in the form of group labour is common in northern

Mozambique where it is used to overcome labour and tool shortages and incentive problems, as interviewees regularly confirmed.

The ownership of livestock at the end of the war (ANIMAL5) is a positive determinant of current crop market activity, suggesting possible asset constraints in moving into market-oriented cash- and food cropping, as will be discussed further below. The variable also indicates a strong and long-lasting war legacy for rural households, as livestock holdings were one of the major targets during the conflict (chapter 3). Households which had been subjected to asset destruction during the war were thus damaged in their ability to rejoin crop markets for many years to come even after the cessation of violence.

While households with locally buried ancestors (ANCEST1) are less likely to participate in crop markets, all household heads in a position of power or authority (AUTH12) participate in output markets. This variable is excluded from the regression due to its ability to predict success perfectly. This result is not unexpected given the increased level of information, trust and bargaining power which their position entails. These act to reduce household-specific transaction costs significantly and allow these households to conduct trade more profitably. Such position of authority then helps to insure its holders against the adverse effects of war on markets. This also implies that such exogenous distribution of power will contribute to a worsening of asset accumulation and income distribution unless non-authority households either succeed in gaining similar compensatory institutions or complementary market institutions develop quickly to benefit other households.

The labour market variable LABOUR3 has a small and significant coefficient so that more intense labour markets reduce crop market participation by farm households. This again points to the specific nature of labour markets in early post-war northern Mozambique where very poor households often demand casual employment from better-off farmers as a form of social security. In interviews, better-off farmers cited this social obligation as a disincentive to work as they felt unable to reject such requests but did not feel they gained a net benefit from these labour services. Note that in the villages sampled by the FSP survey a mean of 6 hours of work was recorded as having been hired in per capita in 1995 (LABOUR4), which indicates the small degree of rural wage labour in northern Mozambique.

The rural labour market therefore serves some redistribution purpose in northern Mozambique so that a more dense labour market does not affect the probability of market participation positively by making more labour available to farmers keen to hire-in more workers as would have been expected in a standard peasant household model. Instead, labour markets are culturally, spatially and quantitatively restricted and serve predominantly

local needs. Except for the change in transaction costs associated with some recent road and bridge-building projects, rural labour markets in northern Mozambique thus appear to be locally and endogenously constrained by cultural norms and purchasing power. This is in distinct contrast to some output markets such as cotton, which are directly connected with exogenous economic events, and can potentially induce stronger and faster economic change in rural institutions.

It is not clear from the survey data if this form of labour market organisation has predominantly cultural origins or if, which appears plausible, the induced isolation of the war has made labour markets so thin that they ceased to function in a non-cultural ("social obligation") context. This in turn may have induced the cultural norms still in existence in the years 1995-99, when social expectations induced casual labour hiring. Note that this form of labour exchange is distinct from group labour occasionally practiced in some parts of northern Mozambique, which is entirely voluntary, mutual and typically does not include payment.

These findings contrast with those by Cramer and Pontara from southern Mozambique which emphasise the importance of off-farm wage labour for rural development (Cramer and Pontara 1998).[58] The difference in findings in part results from the location of the studies (with the South having more wage labour opportunities and a lower on-farm agricultural potential) and from a difference in methodology, with the FSP data being arguably more representative and reliable due to the design and scale of the studies.

Higher purchased food prices (PRICE14, PRICE15) significantly lowered the probability of households participating in crop markets. This suggests that the comparative advantage of households lies in the production of subsistence food crops and not cash crops as otherwise households facing higher prices for purchased food such as dried fish and salt would have pursued more market oriented production to raise the revenue intended for market consumption.

The significance and size of the maize yield (YIELDL7) coefficient indicates that villages with a greater agricultural potential induce higher crop market participation. This can be interpreted as evidence that the transaction costs of entering markets is relatively lower in such areas. Further support for varying transaction costs by location are the important role of the village categorical variables ALDXXX which are jointly and individually highly

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[58] Also note the ensuing debate recorded in Pitcher (1999) and Cramer and Pontara (1999).

significant and whose significance is in line with the expectation that the war had strong but differential impacts at the village level.

In terms of the theoretical debates of section 6.3, this regression analysis indicates the importance of Chayanov-style life-cycle effects and hence of the subjective wage rate as well as the crop- and household-specific transaction costs for determining crop market participation. The dependency rate and education are significant for the former effect while farm size, assets and political power are significant for the latter effect. All these variables are strongly war-affected and hence war has accentuated the degree of market non-participation in rural Mozambique.

Furthermore, the importance of the variables such as education, farm size, asset endowments and political power status indicate that current and future income inequality may drive market participation which in turn may deepen income inequality. Households not able to participate in markets may thus be left behind in a market-based pattern of post-war reconstruction.[59]

A similar effect has been noted in an Indian study where more wealthy households found it easier to absorb risk therefore allowing them to undertake riskier project and to earn higher income (Rosenzweig and Binswanger 1993: 75). Such a poverty trap for less well endowed households may then counteract the potential efficiency gains of a small farm size. The net income effects of household endowments and farm efficiency cannot be assessed fully with the FSP data (e.g. as the asset and yield data are incomplete) but further research on these issues in the African and rural post-war contexts would appear justified.

Degree of Market Participation

The degree of market participation is measured by the variable SHARESUB, which summarises the share of net household income derived from subsistence activities in 1995 (figure 6.5). Its weighted mean is 61%, it follows a nearly normal distribution, and its determinants are shown in figure 6.13. The regression is highly significant and has a good fit with an R^2 of 0.46. A variance inflation factor (VIF) analysis does not suggest a presence of significant multicollinearity.

Overall, the determinants of the degree of market participation differ significantly from those for the basic decision of whether to participate in any markets at all, as was expected. For instance, the scale effect operates through household size and not through farm size,

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[59] This issue is also elaborated in Brück, FitzGerald and Grigsby (2000).

with MEMND11 and MEMND12 being jointly and highly significant but total land endowment not being individually significant. Very large and very small households hence engage in more subsistence activities.

The age of the household head also has a positive albeit diminishing effect on the share of subsistence income (AGEHEAD3, AGEHEAD4). Female-headed households, whose market participation does not differ systematically from that of other households, on average have a share of subsistence income 11 percentage points higher than other households (FEMHEAD1). Taking these two results together, it seems that female-headed households enter crop markets as do other households but that they sell significant less as a share of total income while participating in those markets. This in particular suggests that public policy aimed to raise the market income of very poor households (and female-headed households are poorer on average than other households as shown in chapter 7) should not primarily focus on market participation rates but on the intensity of market participation.

Households experiencing an acute rainfall shortage (RAIN4) reduce their share of subsistence income, probably because some market income opportunities are not correlated with climatic changes and thus allow households to diversify their income portfolio and reduce aggregate risks. In particular, households experiencing a lack of rain have a share of income derived from entrepreneurial activities of 14.2%, compared to 8.4% for those not experiencing a lack of rain.

A similar argument applies to households worrying about their land tenure security (TENURE1), which had not been a determinant of STATUS14.[60] Worried households have a share of subsistence income ten percentage points lower than the share of subsistence income of household not worried about land tenure. Worried households also have an average share of income derived from entrepreneurial activities of 12.8% compared to 6.9% for those not worried about land tenure insecurity. Both results show how the degree of market involvement is much more affected by the experience of relative risks than the choice of whether to participate in crop output markets, as discussed before.

However, households with a serious pest infection in their stored crop (PEST13) increase their share of income from subsistence activities. This may be a precautionary response,

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[60] A test of endogeneity did not find evidence of TENURE1 being endogenous in this regression (data not shown).

increasing savings in the form of stored agricultural goods in the face of lower returns to achieve a similar final amount of available crops for consumption (cf. Renkow 1990).

Households respond to more local mills being available (MILL11) by increasing their subsistence share of income, probably as they mainly mill own consumption food crops. The DONA1 variable measures if a household had recently received some government or NGO aid but its main purpose is to control for related asset effects. The variables TOOL01 and TOOL02 are not significant and have been excluded from the regression. It thus appears that on-farm household technology is not a key determinant of SHARESUB.

The total value of household assets at the end of the war (VASSET3) is significant and has a negative effect on SHARESUB while ANIMAL5 is insignificant and not included in the regression. However, the elasticity of SHARESUB with respect to VASSET3 is only -0.03, suggesting that past assets do not have a large effect on the degree of current market involvement by households, especially when compared to the effects of past livestock on current market participation decisions.

Having ancestors buried locally (ANCEST1) lowers the probability of crop market participation and thus also increases the share of income derived from subsistence activities. This may be an indicator of the non-economic reliance of households on local customs and society. This is supported by evidence gathered through interviews where many interviewees emphasised the role of local traditions that prevented them from migrating during and since the war, due to security or economic pressures. It thus seems possible that with traditional culture being remarkably well preserved during the war (and perhaps in part because of the war) some rural households do not only act in accordance with either a profit or security first or other economic motive but that their economic decisions (such as the degree of market participation) are also strongly shaped by cultural obligations. A genuine examination of the interdependence of cultural and economic motives for making household production decisions may require a more anthropological approach to fieldwork but the significance of variables such as ANCEST1 suggests that some such issues are indeed relevant.

Villages where many households record serious infrastructure problems and hence high transaction costs (INFRA4) have subsistence income shares some 30 percentage points higher than other villages. This variable thus establishes a link with the previous regression, in that transaction cost are important both for the discrete decision to participate in markets and for the continuous degree of market involvement.

A higher village-level maize yield (YIELDL7) raises the income share from subsistence activities by raising the returns to agricultural food crops. The corresponding value for the

village level cotton yields (YIELDL8) was excluded from the regression to avoid problems of multicollinearity as the monocropped yields for cotton and maize are highly correlated.

A surprising finding is that the coefficients of PRICE33 and PRICE35 (the home-produced food price indices including maize and cassava prices in early and late 1995) are significant and positive. The elasticity of SHARESUB with respect to PRICE35 is about 0.3, which implies that a 3% increase in food prices raises the household share of subsistence income by 1%.

This could be seen as evidence that farm households in post-war northern Mozambique are very sensitive to high food prices, reacting to price changes by moving away from market activities and retreating into subsistence production of those crops. If farmers were less sensitive to price fluctuations and had more confidence in output markets, they could increase their production of marketable and marketed crops thus deriving positive income effects from high food prices.

Nevertheless households react negatively to rises in food prices, given the already high share of subsistence food production (59% as shown in figure 6.5) and the small share of marketed food crop revenue in total income (6%). In addition, households are less likely to be able to predict food price changes accurately in the post-war period, thus making a large share of changes in food prices unexpected. Moreover, with high transaction costs, thin markets and low input use, food price variability will be higher post-war than in peace-times.[61] This will further strengthen the substitution effect versus the income effect of food price changes and induce farmers into further subsistence. Finally, a range of significant village variables ALDXXX indicate the importance of further, unspecified locational effects for the household decision to participate in crop markets.

In summary, the discrete decision to participate in crop markets differs from the continuous decision over the extent of participation. The latter is affected by scale (of the household size but not of the farm size) and by household composition (e.g. via the gender of the household head). Environmental and social risks induce households to engage more in market activities, probably because those risks are less correlated with the original risks and thus offer scope for activity diversification. Households are therefore definitely increasing their q and move from a point such as c' or even d' to b" in figure 6.3 where they experience more risks but also higher returns. Finally, social and village level variables

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[61] Adding a food price variability index (e.g. PRICEV2) to the regression reduces the significance of the infrastructure variable, suggesting that poor infrastructure raises food price variability (data not shown).

also strongly affect household market participation decisions. It is likely that the war increased the importance of these factors and that they will only slowly diminish in importance in the post-war northern Mozambican context.

Cash Crop Adoption

The dependent variable COTTON89 is based on the area households dedicated to cotton growing in 1995-96. For households not growing any cotton COTTON89 thus codes zero while for all other households it codes one. About half of all sample households grow cotton which is a reflection of the sample design, not of the actual distribution of cotton adoption across the whole of northern Mozambique. The FSP sample has a slight bias towards areas more easily accessible by road in the post-war period. The slight bias in the selection of the sample towards more easily accessible areas thus underestimates the impact of the war on the decision to adopt cash crops by the average smallholder in northern Mozambique. Recall from chapter 3 that the FSP survey had been initiated to improve an understanding of the cotton belt of northern Mozambique. The institutional arrangements of the cotton belt are explained in chapter 3.5 and by Strasberg (1997).

The FSP survey did not collect reliable data on the first ever adoption of cotton for each household so that it was not possible to use duration analysis to understand why households chose to start growing cotton at a given point. However, many households were not able to grow cotton during the war thus calling into question the importance of past cotton growing for current cotton status. The determinants of COTTON89 have been analysed in a logit regression (see equation 6.3 above) which is significant with a p-value of 0.011 as reported in figure 6.14.

The discussion of cotton adoption in the post-war period in section 6.5 predicted that household risk attitudes and risk bearing capacities and the nature of post-war institutions would be the main determinants of cotton adoption in northern Mozambique. Assets were seen to have an ambivalent role in this process as cotton adoption may be asset constrained but as cotton production may also help households overcome larger asset constraints to undertake some types of off-farm, entrepreneurial activities.

As figure 6.14 shows, a number of household characteristics indeed affect the probability of a household adopting cotton in 1995. No female-headed household grew cotton in 1995, making this a perfect predictor of non-adoption (unlike refugee status which was not significant). The number of male household residents has a quadratic effect on the probability to adopt cotton (MALE1, MALE3), with more than 2.9 male residents increasing this probability. This further emphasises the importance of gender on the adoption process with women being less involved in cash crop decisions than men. This

may also suggest that cash crop adoption is inversely related to the degree of food security concern by the household, which in turn may change with the gender composition and size of the household (Fafchamps 1992a).

A significant life cycle effect occurs through the mean age of the household (AGEHH01, AGEHH02). A higher household age raises the adoption probability up to AGEHH01=24.1 years, beyond which the adoption probability falls again. The first part of this effect may proxy either for experience (with older households being more likely to have grown cotton in the past) or for household endowments (with older households controlling more assets or labour). Households with a higher incidence of illness in 1994 and 1995 (ILLDAYS1, ILLDAYS2) and thus less labour supply are less likely to adopt cotton. Spending more time collecting drinking water in the harvest season (the environmental constraint TIME04) actually raises cotton adoption, which is unexpected.

Overall educational achievements of the household are not significant determinants of cash crop adoption, unlike discussed above. The empirical evidence on education and adoption appears mixed. On the one hand, an Ethiopian study found education to increase the speed and spread of adoption (Weir and Knight 2000). On the other hand, A Ugandan farm household study found a similar absence of overall household educational achievements on crop choices (Appleton and Balihuta 1996: 439). The latter case also dealt with a post-war economy, suggesting that the adoption effects of education are more limited in these cases.

However, EDUMUM1 and EDUMUM2, the effective educational achievements of the mother and its square, are significant. Their effect is to raise adoption up to 2 years of education beyond which adoption probabilities decline. This may imply that some education is important for dealing with the relatively complex institutions of the cotton market and that the gender composition of the household human capital matters as well, though this result should be interpreted cautiously as the education levels of mothers are on average particularly low.

Another variable notable for its insignificance is total farm size. This implies that cotton adoption is not related to the amount of land available for farming per household or per capita. Instead and as expected household labour characteristics are more important. This corresponds with the labour-intensity of cotton production, which requires many rounds of weeding especially if the use of pesticides is as low as it is in Mozambique. This result also corresponds with the finding that farm size did not affect long-term adoption rates of high-yielding variety (HYV) in the Green revolution in India (Feder et al 1985: 270). Unfortunately, it is not possible to confirm with the available FSP data if farm size is related to the reduced speed of adoption of HYVs, as it was in India.

Households with more insecure tenure (TENURE1) have a higher rate of cotton adoption. This effect is related to the low tenure security of cotton fields, as was discussed in chapter 5. Note that TENURE1 is not endogenously determined, as confirmed by a formal test of endogeneity (data not shown). This is intuitively plausible as households cannot readily plant a cotton field with alternative crops, thus making the tenure status of a cotton field exogenous. The other land characteristics are not significant which derives in part from the fact that northern Mozambique is generally quite suitable for cotton growing (making field-level differences in soil quality less pronounced) and from the higher input use for cotton compared to food crops (which compensates for poor soil quality).

As expected, the asset and technology effects have overall ambiguous effects on COTTON89. A higher value of assets held at the end of the war (VASSET5) raises the odds on cotton participation, suggesting that there are some mild asset constraints for entry into cotton cropping. However, the household technology proxies TOOL11, TOOL01 and PEST12 send mixed signals, with households with more tools, with fewer types of tools and with more storage pests being more likely to adopt cotton. This may be due to the fact that cotton need not be stored for long on-farm so that badly pest-infected farmers prefer to grow and sell cotton than to store food crops only on-site.

The absence of a significant variable for past livestock ownership furthermore suggests that there are few synergies between livestock rearing and cotton growing and that credit constraints (which can be overcome more easily while owning livestock) are not that significant for cotton adoption. In fact, the existence of monopoly cotton firms making exclusive interlocked cotton contracts with farmers (see chapter 3) seems either to overcome asset constraints or to displace alternative contractual arrangements between farmers and traders.

Apart from these household characteristics, social capital has a strong positive impact on cash crop adoption. Being a chief or other person of authority (AUTH12) or having local links through the wife (ORIGINF1) increase cash crop adoption in this matrilineal society. The former has a particularly strong effect on cotton adoption (almost as strong as being a female-headed household) thus suggesting that local chiefs either have a genuinely comparative advantage in cotton adoption or that they are in a position of power where they can displace other households as the beneficiaries of the cotton companies' programmes. Unfortunately, this issue was not raised during the field interviews so that it is not clear which interpretation is more appropriate. Either way, income differentiation in northern Mozambique may deepen if such strong exogenous categorical variables shape activity choices and thus income levels in rural areas.

Of the village-level variables, both more intense labour markets (LABOUR5) and output markets (MARKET4) lower the probability of cotton adoption. These are at first sight counterintuitive results but they can be interpreted as supporting the view expressed above that labour markets serve a social security function. Hence households offered more potential employment opportunities are less likely to grow cotton to earn income. In other words, while labour availability is a key determinant of cotton adoption (see the significance of the variables MALE1 and MALE3 above) most households do not use the formal labour market to hire-in labour for working their cotton or other fields.

The market variable may have a diminishing effect on the odds of adopting cotton as cotton in 1995 was not traded on the open market but instead sold to monopsony cotton trading companies at government set prices. Households in areas with well functioning non-cotton crop markets may thus prefer to trade other cash and food crops in such markets than to rely on the precarious institutional arrangements of the cotton sector. The variable MARKET4 may thus indicate a cost of the cotton-specific institutional arrangements, similar to the absence of a significant livestock variable as discussed above. In other words, labour and output markets are substitutes to cotton adoption, which itself should not be seen as a typical market-based activity.

The importance of a household's location is very strongly emphasised through the large positive coefficient for the village-level cotton yield variable YIELDL8. Households in villages with a higher cotton productivity are clearly more inclined to start growing cotton themselves, suggesting that unobserved village-level characteristics (perhaps to do with the institutional arrangements for growing cotton or with agronomic, comparative advantages) and spill-over and learning effects are key determinants of cotton adoption.

Finally, the three sets of variables PRICEXX, PRICEVX and ALDXXX control for further fixed effects, as explained in chapter 3. These variables are highly significant and thus point to the existence of further important but unobserved village-level determinants of cotton adoption.

In conclusion, the adoption of cotton in the post-war period in northern Mozambique (i.e. the move towards a larger q in the above model of figure 6.3) is shaped by the household availability and valuation of labour (as represented by the variable W), by alternative investment opportunities and returns (variable p_i), and by comparative advantage as determined by local climatic (variables s_i and s_{ij}) and institutional conditions (variables t_i and a_i). These findings broadly correspond with the hypotheses outlined above, though a few differences and a few open issues remain.

In particular, few variables reflecting production risks directly shape the decision to adopt cash crops. Most importantly, households with larger degrees of illness and thus less labour supply are less likely to adopt cotton but rainfall and field-level pests (PEST01) are not significant. Instead, the risk attitude and risk bearing capacity of households appears to determine if households are willing to adopt cotton. Female-headed and local political status, for example, almost perfectly predict cotton adoption for almost 10% of the sample. As refugee households do not differ in their cotton adoption behaviour from other households, the war affects household cash crop decisions indirectly through the subjective value households attach to their labour, which will vary with health, household size, social and political status in the community. These indirect effects of war are very difficult for public policy to remove and it is likely that such differences will persist over a long time.

Given these conclusions and the observations from the field interviews, changes in such differences are most likely to come about through changes in transaction costs and in public investments in health and education. One example cited above is the effect on local labour markets through the building of bridges and the subsequent connection of a remote district capital with the national economy. Other examples may be the construction and long-term funding and staffing of rural primary schools or health posts which may induce serious changes to the availability and valuation of labour over time.

The two points of these conjectures are to emphasise, first, that war has impoverished many households not only directly through displacement and asset destruction but indirectly through changes in the valuation of labour and the capacity to bear risks (which is in part related to a reduced asset base). Second, the socio-economic outcome of the war created conditions which are very difficult to overcome at an individual level for isolated farm households. Instead, exogenous economic change will be required to allow at least some households to escape such poverty trap and to start building a more vibrant and interlinked rural economy where future growth may be more self-financing.

On a methodological level, this analysis has shown that the institutional arrangements of cotton production are important determinants of cotton adoption but that they are also very hard to integrate into an analysis of survey data (note though that the regression analysis does incorporate some key institutional cotton arrangements which affected for instance survey sampling). However, as war has strong implications for rural institutions generally and for seed supply systems in particular (Sperling 1997b) and as the Mozambican regulatory framework for cotton tried to account for the high transaction costs in the post-war cotton sector, the joint effects of war and institutions on household choices deserve

more attention in the future analysis of cash crop adoption and the rural diffusion of technological know-how in northern Mozambique.

Plot Diversification

Two non-market indicators of household activity diversification are the degree of plot diversification (PLOT32) and the degree of social exchange including remittances (REMT4). These variables are summarised in figure 6.9 (see above for a brief discussion). Note that the value of these dependent variables depends on the definition of the variables, in particular on the level of aggregation of its components (as with DIVERS02 above), so that comparisons with other surveys or calculations are not possible.

The final regression result for PLOT32 is shown in figure 6.15. The regression is highly significant, has a reasonable fit with an R^2 of 0.39 and has no apparent problem of multicollinearity as determined by VIF analysis. Note that this regression uses the weights WEIGHT3 which are identical to the usual WEIGHT2 except that the former excludes one case which has an implausibly high value for PLOT32 which is most likely the result of a coding error. The main regression results are not sensitive to the choice of weight.

The degree of spatial diversification (or farm fragmentation) is negatively related to the number of females in the household households (FEMALE1, FEMALE3), though the coefficients are not jointly significant. The effect of more male residents (MALE1, MALE3) has a different shape with an inverted u-curve effect peaking at 4.5 male residents which compares with a mean value for MALE1 of 4. This may be due to the different social responsibilities of men and women with women taking more control of food crops of which there are more types and which provide fewer economies of scale. Given the overall significance of these gender and size coefficients, these results indicate that a household labour constraint is an important determinant of plot diversification (Blarel et al 1992: 237).

This finding is supported by interview evidence with various agricultural extension workers and agronomists working in northern Mozambique. These interviews confirmed that planting fields benefited from being done quickly to utilise the best "window of opportunity" appropriate for that field. With more but smaller fields and a limited labour market, households can spread these points in time and thus manage a similar cultivated area with a given amount of labour. The interviewees had mixed views on the economies of scale to be derived from larger fields, especially for food crops. Larger fields may be more risky as crop pests can spread more readily especially in large mono-cropped fields.

The dependency ratio DEPEND95 and the household illness variable ILLDAYS2 have significant positive coefficients, indicating that households with a higher subjective valuation of labour prefer to diversify their plot portfolio, as was predicted by the model. An increasing human capital in the household reduces plot diversification for the majority of households (EDUHH3, EDUHH4), suggesting that better educated households either are better at managing larger fields or are less risk averse.

Although the mean value for PLOT32 is 1.14 for female-headed households compared to 0.36 for male-headed households, the variable FEMHEAD1 is not significant in the regression, confirming again that it is not female-headedness itself which causes these households to act more risk aversely.

Variables capturing the land endowment of households have been excluded from the regression to avoid a problem of endogeneity. Of the soil characteristics variables, high soil fertility (AREAFER5) and high land tenure insecurity (TENURE1) both reduce plot diversification.[62] This suggests that households with better soil have lower field fragmentation, probably because many villages in northern Mozambique have a range of soil qualities to distribute among households and households with many plots are unlikely to have all of them in the favourable areas (e.g. near a river).

The walking distance to land (DISTANC3) is not a significant determinant of plot diversification. In a situation of a land shortage the opposite may have been expected as more land constrained households would have to walk larger distances to obtain marginal plots. Interestingly, rainfall and field pests do not affect plot diversification indicating that these risks may not be overcome by plot diversification.

Households with more tools (TOOL01), livestock (ANIMAL1) and assets (VASSET5) reduce their plot diversification as they are more likely to cope with increases in risk associated with more concentrated land holdings and as they can apply their assets better on such land holdings.

Surprisingly, social capital is hardly significant in this regression, except for the local origin of the wife (ORIGINF1) which lowers spatial diversification. Thus the ability of the household to negotiate where it will farm does not appear to be a key to farm fragmentation in northern Mozambique.

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[62] A test of endogeneity found no evidence of TENURE1 being endogenous in this regression (data not shown).

Village-level variables do matter though with stronger output markets (MARKET8) encouraging field consolidation probably as cash crops can gain larger economies of scale. A higher maize yield (YIELDL7) seems to raise PLOT32 which suggests that in areas of higher agricultural potential there is a larger degree of land fragmentation, perhaps as a result of increased demand for prime land.

Two price variables (PRICE14, PRICE34) and a range of locational variables (ALDXXX) control for further unobserved effects. PRICEV3 measures the variance of home-produced food prices as experienced at the household level and thus captures a major risk for food crop producing and selling households. It has a strong and positive effect on plot diversification thus emphasising the role of risk aversion and risk experience in determining spatial household diversification responses.

Overall, these results confirm the hypothesis that households in the post-war period react strongly to some types of risks by altering their non-market production behaviour. Plot diversification is also a response to life cycle effects and household endowments, with household labour being strongly gender differentiated in its effect on plot diversification. Household assets reduce such diversification while some soil characteristics and social capital are less important than anticipated. Finally, market opportunities help reduce spatial diversification while market risks increase this. Households which are emerging from a position of war-induced isolation are thus clearly using non-market diversification strategies.

These results confirm the results of a comparative study of land fragmentation in Ghana and Rwanda (Blarel et al 1992). The study concluded that low population density areas are more likely to see demand-affected land fragmentation. Relevant factors in that study were soil and agricultural risk characteristics, limited labour markets, and high transaction costs even within village crop markets. These show a strong similarity to the results presented here. The study also addressed the costs of fragmentation. Either plot diversification is technically efficient across all states for each household or it is a deliberate trade-off between risks and returns. The study found the former generally held in the areas analysed. For the case of northern Mozambique, this issue will be analysed in more detail in chapter 7 where the endogenous welfare effects of activity choices will be considered.

Diversification through Social Exchange

The second indicator of non-market diversification is REMT4, the total value of social exchange given and received in January to September 1995 (figure 6.9). This variable hence captures both net donors and net receivers of donations, remittances and social exchange.[63] Remittances account for about one third of this figure. About 6% of all households did not exchange or remit any items of value in that period. The data-set excludes one high value item which appears to be a trade (i.e. market) transaction rather than a gift but the regression is not sensitive to the inclusion of this figure.

The reported regression is highly significant and has a reasonable fit with an R^2 value of 0.37 (figure 6.16). The usual VIF analysis does not suggest the presence of multicollinearity. The result also appears robust to the omission of the zero-exchange households (for whom there are no dependent values as REMT4 is the natural log of REMT3). Re-estimating the regression with REMT2 or REMT3 as the dependent variables also yields significant regressions with broadly similarly signed and significant coefficients (data not shown). Furthermore, the regression could not be estimated using the Heckman technique as no suitable selection variable (which indicated zero social exchange but had no effect on the degree of social exchange for all other households) could be identified. The analysis below therefore focuses on the results reported in figure 6.16.

The theoretical discussion predicted that a higher degree of economic isolation would increase the demand for but reduce the supply of social exchange. If so, variables affecting this isolation should be significant in the REMT4 regression. Household size was thought to have an ambiguous effect on REMT4 but in fact having many women (FEMALE1, FEMALE3) or men (MALE1, MALE3) in the household increases social exchange though both effects are quadratic with minima at 4.0 and 2.7 persons, respectively. This confirms the possible dependence of rural social networks in Mozambique on very large families, as first noted by Garrett and Ruel (1999: 1963).

Interestingly, the age effects differ at the head of household (AGEHEAD3 AGEHEAD4) and at the household (AGEHH01, AGEHH02) levels. Both are quadratic effects but the former is largely declining (except for very old heads) while the latter is increasing at a smaller rate for older households. These effects are not due to the joint inclusion of all four

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63 Platteau discusses in greater detail the many possible forms of social exchange between farm households (1999).

variables as re-estimating the regression with either pair of variables and a VIF analysis of the original specification do not suggest a problem of multicollinearity (data not shown).

The effects of the age of the household head may represent a life-cycle effect where young heads interact with for example their parents, middle-aged heads (by Mozambican standards) focus more on their nuclear family, and older heads again exchange presents, for example with their now adult children. This suggests that intergenerational dependence is a strong determining factor for informal social security mechanisms, with younger and older household heads being more involved in transfers.

The effects of the mean household age could represent the build up of contacts, a form of social capital, which is necessary in conducting exchange. It may also represent the increased ability of the household to send away household members to earn remittance income which households with very young children will be less well placed to do given their already high consumption-labour ratio and thus their high valuation of on-farm labour.

As expected, households with more illness (ILLDAYS2) and with larger environmental time constraints (TIME03) undertake less while households with more maternal education (EDUMUM1, EDUMUM2) undertake more social exchange.

Female-headed households do not differ in their degree of social exchange. As discussed in chapter 7, they are poorer than most households and thus would be expected to have a larger need for such form of support. The insignificance of that variable is likely to reflect their diminished ability to undertake such exchange and perhaps their restricted ability to offer gifts. Social exchange may not be sustainable in the long-term if one side of the exchange is structurally unable to reciprocate the favour. Hence social exchange may be more a form of short-term insurance against uncorrelated risks and a long-term mechanism to build up social capital and reduce transaction costs in preparation for other activities or requirements.

Another key determinant is the natural log of total area per capita in the previous agricultural year (AREA25), which has a positive effect with an elasticity of 0.44. Note that a test of the null hypothesis of exogeneity for AREA25 did not reject that null hypothesis at any reasonable level of significance (data not shown). This is plausible as AREA25 measures total (not cultivated) area per household and does so for the agricultural year 1994-95 which partly precedes the period of analysis covered by REMT4.

Households with a larger land endowment per capita either have larger agricultural surpluses which they can use for exchanges or have better trading networks, information

flows and transport opportunities and thus they may be better placed to visit relatives or to send household members away to earn remittances. Households with more land and more agricultural production may also be more exposed to locally covariant risks and hence have a higher demand for social exchange as an insurance mechanisms (see figure 6.10).

The first explanation (that households with higher agricultural surpluses have more resources to exchange) is also supported by the negative coefficient on AREAFER6, which indicates households with very poor soil quality land. The negative (though diminishing) effect of a higher mean walking distance to the household fields (DISTANC3, DISTANC9) is further support for the importance of household labour supply in determining REMT4.

Having more livestock at the end of the war (ANIMAL1) particularly raises social exchange, as does having more assets after the war (VASSET3) and, somewhat surprisingly, having more pests in the crop storage (PEST11).[64] The latter effect probably proxies for households with a larger degree of agricultural (subsistence) activity while households with more livestock clearly have higher savings and thus more resources for investing in social exchange activities. This may be both for consumption purposes (as stated by farmers in interviews) or for implicit investment or insurance purposes (as revealed implicitly in interviews).

The asset variables do not necessarily suggest that social exchange has a large asset constraint for entry. Instead, better asset-endowed households, while having a smaller incentive to purchase insurance as they can self-insure, can also spend more on purchasing insurance in the first place. Social exchange thus appears to be an insurance mechanism for better-off households. This contrasts with wage-labour, which is demanded by poorer households in times of unexpected income shortfalls (as discussed above).

Households whose husband comes from the local village (ORIGINM1) have much lower social exchange than other households. Therefore, the move of husbands to the village of their wife sometime after their wedding, as is common practice in Macua culture, helps to build long-distance sources of remittance and social income. This tradition should help to overcome the correlation of income within small areas.

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[64] The asset variables are not likely to be endogenously determined as remittance income is only a small part of the social exchange variable REMT4 and as both ANIMAL1 and VASSET3 refer to the household asset stock at the end of the war, three years previously. With the large degree of population displacement and social change in this period, it should not be assumed that having had higher assets then necessarily increases social exchange now.

The output market (MARKET8), maize crop yield (YIELDL7) and home-grown food price (PRICE34) variables have positive, negative and positive coefficients, respectively. The village-level variables do not seem to measure village-level transaction costs for social activities, unlike expected. The MARKET8 and PRICE34 variables instead indicate that more local market activity and higher prices for home-produced food crops raise social exchange, perhaps because households are better off and can afford to participate in such activities.

The yield variable, however, indicates that for a 1% increase in mean village-level maize yields households reduce their social exchange by 1% as well. This suggests that households with potentially larger agricultural surpluses are less engaged in social exchange. The yield variable may thus express the decreasing returns that potentially better-off households derive from such activities. The food price variable (PRICEV3) also has a significant negative coefficient which shows that households facing larger price risks actually undertake less social exchange.

In terms of figure 6.3, these results suggest that better endowed and better off households have activity choices endogenously not available to other households. With more social capital, for given life cycle effects, and especially with more endowments some households can utilise a segment of the post-war frontier a"b"c"d" not available to structurally different households.

The key conclusion is that, unlike expected, poorer households cannot utilise social exchange as an alternative to market- or subsistence-based forms of insurance, even though they might benefit most from such exchange. Social exchange appears to require the existence if not exchange of assets if it is to fulfil more than a symbolic or very short-term, irregular insurance purpose.

In addition to social exchange as a form of insurance households can also use local wage labour, non-wage labour (e.g. from group labour), migration, household formation, other kinship arrangements, and education to insure against risks through the use of human resources (cf. Fafchamps 1992b: 147-9, IAF 1998: ch. 6, Platteau 1999).

One key policy question is how poorer people can be assisted through these systems, especially as the systems themselves can make self-help by poorer households difficult as shown above. One policy option in the post-war period could be to strengthen markets and to encourage poorer households to participate at least somewhat in various markets. However, and as seen above, this requires poor households to overcome several constraints. Thus post-war reconstruction policy should help equip households with human and physical capital and help reduce transaction costs at all levels to make market

participation and endogenous asset accumulation more feasible. Focussing post-war policy on improving social networks is not a substitute for addressing the overall and far-reaching war legacy in northern Mozambique and may even ignore the needs of the poorest households.

6.7 Summary

The objective of this chapter was to analyse the post-war coping strategies by rural farm households in northern Mozambique. These strategies were interpreted as involving the choice of different types of activities, to which households allocate various labour shares. The basic model of peasant household production was extended to include two activities, which involved different risks and returns, and the subjective valuation of labour. This section will summarise six main results from the regression analysis and indicate some general policy implications.

First, it was found that post-war coping strategies include many different market and non-market activities such as on- versus off-farm activities, market autarky or market participation, cash crop adoption, non-market diversification, and social exchange. The war forced households into a high degree of activity specialisation in on-farm, subsistence activities (especially when compared to other African data). In the post-war period, households are diversifying their activities as a response to the varying war legacy and to emerging peace-time opportunities. These post-war coping strategies are characterised by being drawn from an initially small choice set (as shown by the frontier a'b'c'd' in figure 6.3). However, even with a small choice set and a low mean income (see chapter 7) the sample still exhibits a surprisingly high degree of variance in activity choices and especially in market participation rates which fluctuate across households and across seasons.

Second, determinants of post-war diversification are primarily the indirect war effects which include risk (as expected) but also household life cycle position, household endowments and transaction costs at the household and village levels. The strong role of life cycle effects indicates the relevance of Chayanov-style models for the study of war-affected African peasant households, especially via the negative effect of war on the marginal value of effort. The estimated determinants are consistent with model proposed initially. However, they indicate a stronger emphasis on household and village characteristics in the determination of activity choices than standard farm household models would have suggested.

Third, near the absolute survival threshold (i.e. near the V axis in quadrant II in figure 6.3) households may become risk takers by specialising in fewer activities and completely

reducing their asset base to survive into the next season. This is primarily the result of the war-induced destruction of many alternative activity options such as asset endowments and markets and the subsequent fall of many households into various poverty traps. Even if conditions improve after the war, households will face long-term, real consequences of having once been faced with starvation. That is, past events and choices have strong effects on future outcomes for poor, war-affected peasant households.

Fourth, there is a difference between the determinants of a categorical decision to participate in output markets and the determinants of the continuous degree of market participation. The former is more affected by household life cycle, endowment and scale effects while the latter is strongly affected by the household risk experiences, social capital and village level variables. For instance, female-headed households have the same market participation pattern but a smaller market income share than male-headed households. This pattern may extend to cash crop adoption though the data was insufficient to study the degree of cash crop adoption distinctly from the decision to adopt cash crops.

Fifth, peasant households practice various non-market forms of activity diversification and these can be expected to be important during the war. The regression analysis focussed on spatial diversification and social exchange as two such examples. Surprisingly, social exchange is quite limited after the war, in part due to the widespread absolute poverty in the sample area. Its determinants are similar to those of output market participation. This casts doubt on the participation and benefits of social exchange for the poorest households.

Finally, village level effects were found to be extremely important throughout the regression analysis. Not all of these effects could be captured through individual variables thus leaving village categorical variables as important determinants of activity choices. From a policy perspective, this implies that the government and donors can assist household coping strategies by providing public goods to enhance market participation and diversification opportunities. Other policy options that derive from these results include re-capitalising war-affected households, enhancing human capital, and reducing rural transaction costs to affect the whole range of diversification determinants.

In addition, the differences in the determinants of activity diversification indicate the importance of location-specific war effects. Post-war public policy should therefore recognise the importance of local and individual differences in the experience of war and aim to decentralise its interventions as different villages or districts may face different constraints to expanding production and trade.

Figure 6.5: Sources of Income

% of Net Household Income in 1995 (INCOME02)		Non-Market Income	Market Income	Total
On-Farm Income	Food Crop Income	59	6	65
	Cash Crop Income	n.a.	17	17
	Sub-Total	59	23	82†
Off-Farm Income	Entrepreneurial Income	n.a.	10	10
	Social and Wage Income	2	6	8
	Sub-Total	2	16	18
Total		61‡	39	100

† This is the mean value of total household income derived from on-farm activities (SHAREON).

‡ This is the mean value of total household income derived from subsistence activities (SHARESUB).

The FSP survey only accounted for cash crop income and entrepreneurial income earned in formal or informal market transactions. Note that social income refers to remittances, transfers and donations, which are non-market income sources, while wage income is a market-earned form of income. Data is weighted.

Source: FSP data and own calculations (010124a).

Figure 6.6: Household Income Shares in Sub-Saharan Africa

% of Total Income	On-Farm Income		Off-Farm Income		Social Income	
	FSP	**SSA**	**FSP**	**SSA**	**FSP**	**SSA**
Maximum Survey	100	86	0	8	0	4
Mean of All Surveys	82	63	16	28	2	8
Median Survey	88	63	12	20	0	16
Minimum Survey	18	37	82	51	45	11

On-farm income includes food and cash crop income from home consumption and from crop sales. Off-farm income includes entrepreneurial and wage income. Social income includes remittances, transfers and donations. The three categories of income sum to give total income.

The data reported under the headings "SSA" and "Mean of All Surveys" derived from 28 samples of farming households from Sub-Saharan Africa (abbreviated SSA) as calculated by Delgado and Siamwalla (1999: 134). Most surveys covered a single agricultural year from within the period 1985-89. The other data under the headings "SSA" refer to the mean values of one survey as defined below. "Maximum Survey", "Median Survey" and "Minimum Survey" refer to the income shares for the uplands area in Gambia in 1985-86, the Natural Region IV in Zimbabwe in 1988-89 and the Sahelian Zone in Senegal in 1988-90, respectively.

The data under the "FSP" headings report the largest, mean, median and smallest value in the sample. Note that the mean income shares reported under the "FSP" headings correspond to those in figure 6.5.

Two notable outliers in the FSP sample include the "minimum" share of on-farm income (18%) and the high share of social income for one household (45%). In fact, 95% of all households have on-farm income shares of at least 44%, which is well above the SSA minimum, and 95% of all households have social income shares of below 8%.

Sources: Delgado and Siamwalla (1999: 134), FSP data and own calculations (010124a).

Figure 6.7: Change in Crop Market Participation Status by Household

Estimated % of Population	Crop Market Participation in 1994-95				
Crop Market Participation in 1993-94	**No Crop Market Participation**	**Sell Food Crops Only**	**Sell Food and Cash Crops**	**Sell Cash Crops Only**	**Total**
No Crop Market Participation	**6.0**	3.7	1.7	1.7	13.1
Sell Food Crops Only	8.7	**8.6**	4.7	2.4	24.3
Sell Food and Cash Crops	0.8	4.6	**15.5**	5.4	26.2
Sell Cash Crops Only	6.0	7.8	10.1	**12.5**	36.4
Total	21.4	24.7	31.9	21.9	100.0

The approximate sums of the diagonal (bold) elements, the upper triangular elements and the lower triangular elements are 42.5%, 19.5% and 37.9%, respectively.

The table is compiled using the variables STATUS11 and STATUS12. The data is weighted.

Source: FSP data and own calculations.

Figure 6.8: Distribution of Households and Income per Capita in 1995

	Observations		INCOME05 (US$)	
	Est. %	**N**	**Mean**	**St Err**
By Type of Dominant Income Activity (TYPE31)				
On-Farm Activities Only	56	181	43.69	4.37
On- and Off-Farm Activities	44	190	32.01	3.95
Total	100	371	37.13	3.61
By Type of Dominant Income Activity (TYPE22)				
Food Crops only	11	29	34.17	3.50
Food Crops and Off-Farm Activities	34	82	21.12	3.12
Food and Cash Crops	23	102	53.10	7.47
Food and Cash Crops and Off-Farm Activities	32	158	43.57	3.02
Total	100	371	37.13	3.61
By Type of Crop Market Participation (STATUS12)				
No Crop Market Participation	21	48	20.66	3.25
Sell Food Crops Only	25	62	28.90	2.97
Sell Food and Cash Crops	32	163	47.00	5.58
Sell Cash Crops Only	22	98	48.09	4.79
Total	100	371	37.13	3.61

TYPE31 and TYPE22 are not directly comparable as the distribution of households across categories is sensitive to the definition used for each category. Note that 5.1% of all households report strictly zero off-farm income and that the smallest positive share of off-farm income over total income is 0.008%. This implies that some arbitrary cut-off point for determining "dominant" income activities has to be set. This is typically 5% in this analysis. The differences between TYPE31 and TYPE22 derive from different levels of aggregation of the income components, resulting in the same household falling above and below the threshold in different calculations.

The data is weighted. The population proportions in the column "Est. %" have been adjusted to reflect the survey design. "N" reflects the unweighted number of observations per category.

Source: FSP data and own calculations (010124a).

Figure 6.9: Indicators of Spatial and Social Activity Diversification

Variable	Definition	Mean	St Err	Min	Max	N	Weight
PLOT95	# Cultivated Plots per Household in 1995	3.90	0.16	1	10	371	WEIGHT3
PLOT02	Index of Plot Diversification	3.19	0.10	1	7	371	WEIGHT3
PLOT12	Weighted Index (i.e. Effective # Plots per Hectare)	1.82	0.12	0.1	13.2	371	WEIGHT3
PLOT32	Natural Log of Weighted Index†	0.37	0.03	-2.5	2.6	371	WEIGHT3
REMT2	Social Exchange in US$ per Household	12.59	1.13	0	170.7	371	WEIGHT2
REMT3	Social Exchange in US$ per Capita	1.66	0.16	0	20.2	371	WEIGHT2
REMT4	Natural Log of Social Exchange per Capita†	0.003	0.07	-4.0	3.0	349	WEIGHT2

† These are the dependent variables of the regression analysis.

Source: FSP data and own calculations.

Figure 6.10: SHAREON Survey Linear Regression

pweight: WEIGHT2
Strata: CATEG1
PSU: ALD

Number of obs = 371
Number of strata = 4
Number of PSUs = 43
Population size = 32539.53
F(38, 2) = 3450.72
Prob > F = 0.0003
R-squared = 0.5895

SHAREON	Coef.	St Err	t	P>|t|	(95% Conf.	Interval)
MEMND11	-.0175303	.0118692	-1.477	0.148	-.041538	.0064773
MEMND12	.0024204	.0009244	2.618	0.013	.0005507	.0042901
MEMD11	.0125307	.0126305	0.992	0.327	.0130168	.0380782
MEMD12	.0025772	.0022725	1.134	0.264	-.0020194	.0071739
AGEHEAD3	.006284	.0050466	1.245	0.220	-.0039236	.0164916
AGEHEAD4	-.0000475	.0000536	-0.886	0.381	-.000156	.0000609
ILLDAYS1	.0001988	.0001155	1.722	0.093	.0000348	.0004325
EDUMAX3	.0339539	.0102777	3.304	0.002	.0131654	.0547425
EDUMAX4	.0043813	.0011937	-3.670	0.001	.0067957	.0019668
EDUMUM1	.0176925	.0125629	1.408	0.167	.0077184	.0431034
EDUMUM2	.0044985	.0026637	-1.689	0.099	-.0098862	.0008893
AREA35	.1348631	.0211524	6.376	0.000	.0920783	.177648
DISTANC3	-.001767	.000738	-2.394	0.022	-.0032598	-.0002742
DISTANC9	8.61e-06	4.37e-06	1.971	0.056	-2.25e-07	.0000174
RAIN4	-.0573291	.0246265	-2.328	0.025	.1071409	-.0075173
TENURE1	-.0846296	.0244551	-3.461	0.001	-.1340946	-.0351645
AREAFER5	-.0367615	.0232397	-1.582	0.122	.0837682	.0102452
TOOL01	.0039323	.0025538	-1.540	0.132	.0090979	.0012332
MILL11	.0136944	.0036493	3.753	0.001	.006313	.0210758
PEST13	.0313504	.0146427	2.141	0.039	.0017328	.060968
ANIMAL5	.0735934	.0199542	3.688	0.001	.0332322	.1139547
VASSET3	.0000986	.0000304	-3.240	0.002	-.0001601	-.000037
AUTH12	.0480518	.0303493	1.583	0.121	.0133354	.109439
INFRA4	.2123507	.0261925	8.107	0.000	.1593713	.2653301
LABOUR3	.0103357	.0145806	-0.709	0.483	-.0398278	.0191564
MARKET8	.0200332	.0116077	1.726	0.092	-.0034455	.0435119
YIELDL7	.074847	.0247589	3.023	0.004	.0247674	.1249265
PRICE15	.0971776	.0373487	-2.602	0.013	-.1727226	-.0216327
PRICE24	.0846178	.0405244	2.088	0.043	.0026494	.1665862
PRICE35	.1714816	.0263662	6.504	0.000	.1181509	.2248123
ALD111	-.0507845	.0453515	-1.120	0.270	-.1425167	.0409477
ALD112	(dropped)					
ALD113	(dropped)					
ALD114	-.0732669	.0390354	-1.877	0.068	-.1522235	.0056897
ALD121	-.1461745	.0244581	-5.977	0.000	-.1956458	-.0967033
ALD122	-.0271135	.0355936	-0.762	0.451	-.0991083	.0448812
ALD123	(dropped)					
ALD214	-.0333665	.029371	-1.136	0.263	-.0927749	.026042
ALD215	(dropped)					
ALD221	.0938319	.0479186	-1.958	0.057	.1907564	.0030926
ALD231	.0613586	.0244168	2.513	0.016	.011971	.1107461
ALD232	(dropped)					
ALD312	.2388966	.0546979	4.368	0.000	.1282597	.3495335
ALD313	(dropped)					
ALD321	.0708184	.0612714	1.156	0.255	-.0531148	.1947516
ALD332	-.124287	.036416	-3.413	0.002	.1979454	-.0506286
_cons	.0306183	.2308753	0.133	0.895	-.4363712	.4976077

SHAREON: share of total household income derived from on-farm agricultural activities in 1995. All pairs of quadratic coefficients are jointly significant at the 90% level at least, except for the EDUMUM1-EDUMUM2 pair, which is not jointly significant. Note the result of the adjusted Wald test of zero coefficients for the four variables EDUMAX3 to EDUMUM2: F(4, 36) = 4.54, Prob > F = 0.0045. Command: svyreg SHAREON MEMND11 MEMND12 MEMD11 MEMD12 AGEHEAD3 AGEHEAD4 ILLDAYS1 EDUMAX3 EDUMAX4 EDUMUM1 EDUMUM2 AREA35 DISTANC3 DISTANC9 RAIN4 TENURE1 AREAFER5 TOOL01 MILL11 PEST13 ANIMAL5 VASSET3 AUTH12 INFRA4 LABOUR3 MARKET8 YIELDL7 PRICE15 PRICE24 PRICE35 ALD1* ALD2* ALD3*.

Source: FSP data and own calculations (010125a).

Figure 6.11: DIVERS12 Survey Linear Regression

pweight: WEIGHT2
Strata: CATEG1
PSU: ALD

Number of obs = 371
Number of strata = 4
Number of PSUs = 43
Population size = 32539.53
F(34, 6) = 36.90
Prob > F = 0.0001
R-squared = 0.5025

DIVERS12	Coef.	St Err	t	P>|t|	(95% Conf.	Interval)
MEMND11	.0852234	.0220828	3.859	0.000	.0405568	.12989
MEMND12	-.0061906	.0016749	-3.696	0.001	.0095783	-.0028028
AGEHEAD3	-.0161051	.008896	-1.810	0.078	-.034099	.0018889
AGEHEAD4	.0001251	.0000995	1.257	0.216	-.0000762	.0003263
TIME01	.005855	.0024747	2.366	0.023	.0008493	.0108606
EDUMAX3	-.0299439	.0199615	-1.500	0.142	-.0703198	.0104319
EDUMAX4	.0047372	.0021419	2.212	0.033	.0004047	.0090697
EDUMUM1	-.0042321	.0227087	-0.186	0.853	.0501647	.0417005
EDUMUM2	.0051077	.0042629	1.198	0.238	.0035149	.0137303
AREAC94	-.0249291	.0130446	1.911	0.063	-.0513143	.0014562
DISTANC3	.0025761	.0010501	2.453	0.019	.000452	.0047002
DISTANC9	-.0000202	7.29E-06	-2.766	0.009	-.0000349	-5.41E-06
RAIN4	.0996125	.054536	1.827	0.075	-.010697	.2099219
TENURE3	.0619891	.023172	-2.675	0.011	-.1088588	-.0151194
AREAFER6	.0607893	.0280029	2.171	0.036	.0041481	.1174306
TOOL11	.0580868	.0224673	2.585	0.014	.0126425	.1035312
VASSET5	.0177518	.0066242	2.680	0.011	.0043531	.0311504
CYCLONE2	.1168527	.039135	2.986	0.005	.0376947	.1960107
INFRA4	-.3018207	.0682542	-4.422	0.000	-.4398778	-.1637636
LABOUR3	-.0733402	.025974	-2.824	0.007	-.1258775	-.0208029
MARKET7	.0742033	.0396532	-1.871	0.069	.1544094	.0060029
YIELDL8	.1606854	.0408094	3.937	0.000	.0781406	.2432303
PRICE15	.1021368	.0302578	3.376	0.002	.0409347	.1633389
PRICE35	.2557135	.0712598	-3.588	0.001	.3998501	.1115769
ALD111	.0083754	.1215243	0.069	0.945	-.2374306	.2541815
ALD112	(DROPPED)					
ALD113	(DROPPED)					
ALD114	.0262317	.1272321	-0.206	0.838	.2835829	.2311196
ALD121	.0678617	.065657	1.034	0.308	-.064942	.2006655
ALD122	(DROPPED)					
ALD123	(DROPPED)					
ALD214	(DROPPED)					
ALD215	(DROPPED)					
ALD221	.0875614	.0552202	-1.586	0.121	.1992548	.024132
ALD231	-.1207636	.0698529	-1.729	0.092	.2620544	.0205271
ALD232	.0060757	.0375767	-0.162	0.872	-.0820817	.0699303
ALD312	-.413874	.102371	-4.043	0.000	.6209389	-.2068091
ALD313	.0387955	.0804002	-0.483	0.632	.2014202	.1238293
ALD321	.0648971	.1058136	0.613	0.543	-.149131	.2789252
ALD332	.0807038	.0640296	1.260	0.215	.0488082	.2102159
_cons	1.184228	.4120073	2.874	0.007	.3508644	2.017591

DIVERS12: natural log of the effective number of income sources per household in 1995 (i.e. ln of a Herfindahl-Hirschman Index where HHI = 1 / $\sum q_i^2$). All pairs of quadratic coefficients are jointly significant at the 90% level at least, except for the EDUMUM1-EDUMUM2 variables, which are not jointly significant. Note the result of the adjusted Wald test of zero coefficients for the four variables EDUMAX3 to EDUMUM2: F(4, 36) = 2.95, Prob > F = 0.033. Command: svyreg DIVERS12 MEMND11 MEMND12 AGEHEAD3 AGEHEAD4 TIME01 EDUMAX3 EDUMAX4 EDUMUM1 EDUMUM2 AREAC94 DISTANC3 DISTANC9 RAIN4 TENURE3 AREAFER6 TOOL11 VASSET5 CYCLONE2 INFRA4 LABOUR3 MARKET7 YIELDL8 PRICE15 PRICE35 ALD1* ALD2* ALD3*.

Source: FSP data and own calculations (010125b).

Figure 6.12: STATUS14 Survey Logistic Regression

pweight: WEIGHT2
Strata: CATEG1
PSU: ALD

Number of obs = 350
Number of strata = 4
Number of PSUs = 40
Population size = 31187.45
F(28, 9) = 9.01
Prob > F = 0.0008

STATUS14	Odds Ratio	St Err	t	P>|t|	(95% Conf.	Interval)
DEPEND94	.0287958	.0524622	-1.947	0.059	.0007156	1.158814
EDUMAX3	7.590794	3.4112	4.510	0.000	3.05121	18.88436
EDUMAX4	.8362344	.0368466	-4.059	0.000	.7647477	.9144036
AREACF94	2.574034	.5561985	4.376	0.000	1.660706	3.989659
AREAFER6	.1577242	.1405665	-2.072	0.045	.0258776	.9613319
DISTANC3	.8584758	.0369266	-3.548	0.001	.7867588	.93673
DISTANC9	1.000807	.0002892	2.792	0.008	1.000221	1.001394
TOOL01	.8089222	.0505451	-3.394	0.002	.7126413	.9182111
TOOL02	2.133092	.3857646	4.189	0.000	1.478158	3.078211
PEST11	.0985065	.0822063	-2.777	0.009	.0181311	.5351889
ANIMAL5	37.14033	41.74628	3.216	0.003	3.80036	362.9666
ANCEST1	.0626775	.03911	-4.439	0.000	.0176811	.2221847
LABOUR3	.1352365	.075941	-3.563	0.001	.0433005	.4223716
YIELDL7	121.6222	107.1831	5.448	0.000	20.36063	726.4981
PRICE14	.0171836	.0332159	-2.102	0.043	.0003408	.86633
PRICE15	.0131806	.0175737	-3.247	0.003	.0008822	.1969207
ALD111	.7713355	1.550567	-0.129	0.898	.0130812	45.48199
ALD114	1.115601	1.186605	0.103	0.919	.1290209	9.646235
ALD121	162.0436	134.7856	6.117	0.000	29.9918	875.5097
ALD123	108.9385	88.13457	5.798	0.000	21.11519	562.0403
ALD214	97.52673	216.203	2.066	0.046	1.087768	8744.02
ALD215	1.788877	2.851237	0.365	0.717	.0705856	45.33616
ALD221	.1309925	.214853	-1.239	0.223	.0047052	3.646801
ALD231	1.189642	1.686851	0.122	0.903	.0670659	21.10237
ALD312	2.737442	4.129853	0.667	0.509	.1283918	58.365
ALD313	54.29381	65.03203	3.335	0.002	4.783631	616.2301
ALD321	.1761884	.2013963	-1.519	0.138	.0173448	1.78972
ALD332	.0029133	.004347	-3.913	0.000	.0001413	.0600633

STATUS14: crop market participation status of a household in 1994-95 with STATUS14=1 indicating some crop market participation. ALD113, ALD122, ALD232 and ALD214 dropped due to collinearity. ALD112 was dropped and 21 observations were not used. Zero failures and 2 successes are completely determined. ALD112~=0 and AUTH12~=1 would each predict success (i.e. market participation) perfectly. Adjusted Wald test of jointly zero coefficients for the variables EDUMAX3 and EDUMAX4: F(2, 35) = 11.01, Prob > F = 0.000. Adjusted Wald test of jointly zero coefficients for the variables DISTANC3 and DISTANC9: F(2, 35) = 11.20, Prob > F = 0.000. Command: svylogit STATUS14 DEPEND94 EDUMAX3 EDUMAX4 AREACF94 AREAFER6 DISTANC3 DISTANC9 TOOL01 TOOL02 PEST11 ANIMAL5 ANCEST1 LABOUR3 YIELDL7 PRICE14 PRICE15 ALD1* ALD2* ALD3*, or.

Source: FSP data and own calculations (010129b, 010607a).

Figure 6.13: SHARESUB Survey Linear Regression

pweight: WEIGHT2
Strata: CATEG1
PSU: ALD

Number of obs = 371
Number of strata = 4
Number of PSUs = 43
Population size = 32539.53
F(32, 8) = 255.34
Prob > F = 0.0000
R-squared = 0.4602

SHARESUB	Coef.	St Err	t	P>|t|	(95% Conf.	Interval)
MEMND11	-.0620192	.014571	-4.256	0.000	-.0914917	-.0325466
MEMND12	.005219	.0009563	5.457	0.000	.0032847	.0071534
AGEHEAD3	.0054016	.0064104	0.843	0.405	.0075646	.0183678
AGEHEAD4	-.0000262	.0000698	-0.375	0.710	-.0001674	.0001151
FEMHEAD1	.1060473	.0551032	1.925	0.062	-.0054095	.2175041
DISTANC3	.002181	.0008438	-2.585	0.014	-.0038878	-.0004743
DISTANC9	.0000156	5.18E-06	3.008	0.005	5.10E-06	.000026
RAIN4	-.0959057	.0212148	-4.521	0.000	.1388167	-.0529947
TENURE1	-.1028891	.037022	-2.779	0.008	.1777732	.0280051
MILL11	.0108649	.0053901	2.016	0.051	.0000376	.0217674
PEST13	.0345854	.0162093	2.134	0.039	.0017989	.0673718
DONA1	.069358	.031295	2.216	0.033	.0060578	.1326581
VASSET3	-.0001499	.0000218	-6.870	0.000	-.000194	-.0001058
ANCEST1	.0875478	.0361663	2.421	0.020	.0143946	.1607009
ORIGINM1	-.0721725	.032152	-2.245	0.031	.1372061	-.0071388
INFRA4	.3000989	.0950152	3.158	0.003	.1079125	.4922854
YIELDL7	.1259888	.0515399	2.444	0.019	.0217395	.2302382
PRICE15	.0482654	.0260804	-1.851	0.072	-.1010179	.0044872
PRICE33	.1072565	.0550026	1.950	0.058	-.0039967	.2185097
PRICE35	.2440533	.0410486	5.945	0.000	.1610247	.327082
ALD111	-.0391956	.0409281	-0.958	0.344	-.1219804	.0435892
ALD112	-.2499654	.1052864	-2.374	0.023	.4629272	.0370036
ALD113	(DROPPED)					
ALD114	(DROPPED)					
ALD121	-.1738759	.1001921	-1.735	0.091	.3765335	.0287817
ALD122	-.0038679	.0928867	-0.042	0.967	-.191749	.1840133
ALD123	(DROPPED)					
ALD214	-.3142226	.0849659	-3.698	0.001	-.4860824	.1423628
ALD215	-.0839465	.0652356	-1.287	0.206	-.215898	.048005
ALD221	-.1436878	.0974528	-1.474	0.148	-.3408047	.0534292
ALD231	-.1358108	.0361795	-3.754	0.001	.2089907	-.0626308
ALD232	-.2390645	.0904007	-2.644	0.012	-.4219172	-.0562117
ALD312	.1165941	.0632936	1.842	0.073	-.0114292	.2446175
ALD313	-.2766398	.1012645	-2.732	0.009	-.4814666	-.0718131
ALD321	(DROPPED)					
ALD332	-.3427917	.0532544	-6.437	0.000	-.4505088	-.2350746
_cons	-.4481974	.3850826	-1.164	0.252	-1.2271	.3307056

SHARESUB: share of net household income derived from subsistence activities in 1995. Adjusted Wald test of jointly zero coefficients for the variables MENND11 and MEMND12: F(2, 38) = 19.70, Prob > F = 0.000. Adjusted Wald test of jointly zero coefficients for the variables AGEHEAD3 and AGEHEAD4: F(2, 38) = 5.49, Prob > F = 0.008. Adjusted Wald test of jointly zero coefficients for the variables DISTANC3 and DISTANC9: F(2, 38) = 4.87, Prob > F = 0.013. Command: svyreg SHARESUB MEMND11 MEMND12 AGEHEAD3 AGEHEAD4 FEMHEAD1 DISTANC3 DISTANC9 RAIN4 TENURE1 MILL11 PEST13 DONA1 VASSET3 ANCEST1 ORIGINM1 INFRA4 YIELDL7 PRICE15 PRICE33 PRICE35 ALD1* ALD2* ALD3*.

Source: FSP data and own calculations (010129a).

Figure 6.14: COTTON89 Survey Logistic Regression

pweight: WEIGHT2
Strata: CATEG1
PSU: ALD

Number of obs = 371
Number of strata = 4
Number of PSUs = 43
Population size = 32539.53
F(36, 4) = 12.91
Prob > F = 0.0113

COTTON89	Odds Ratio	St Err	t	P>|t|	(95% Conf.	Interval)
MALE1	.5597388	.2839412	-1.144	0.260	.2006197	1.561699
MALE3	1.105997	.0575611	1.936	0.060	.9954874	1.228774
AGEHH01	1.376024	.1910292	2.299	0.027	1.039141	1.822123
AGEHH02	.9934084	.0025573	-2.569	0.014	.9882492	.9985945
ILLDAYS1	.9912164	.0025246	-3.464	0.001	.9861231	.996336
ILLDAYS2	.9652124	.0108998	-3.135	0.003	.9434153	.9875132
TIME04	1.016706	.0079705	2.113	0.041	1.000712	1.032957
EDUMUM1	3.129616	1.266483	2.819	0.008	1.380401	7.095397
EDUMUM2	.7496746	.0727275	-2.970	0.005	.6161027	.9122049
TENURE1	2.379682	1.047205	1.970	0.056	.9771257	5.795455
TOOL11	3.776268	2.350207	2.135	0.039	1.072389	13.29759
TOOL02	.6044232	.1297627	-2.345	0.024	.3915159	.93311
PEST12	2.372034	1.138485	1.800	0.080	.8984659	6.26239
VASSET5	1.251959	.1216474	2.313	0.026	1.028574	1.523858
AUTH12	17.15189	14.81306	3.291	0.002	2.989876	98.39452
ORIGINF1	2.372534	1.140233	1.798	0.080	.8975012	6.271768
LABOUR5	.1016133	.0766145	-3.033	0.004	.0221116	.4669607
MARKET4	.999751	.0000997	-2.497	0.017	.9995494	.9999527
YIELDL8	483.6045	617.5431	4.841	0.000	36.53878	6400.688
PRICE14	.0272843	.0445939	-2.204	0.034	.0010004	.7441429
PRICE23	.0173761	.0245084	-2.873	0.007	.0010022	.3012781
PRICE33	706.3688	906.6695	5.111	0.000	52.66148	9474.797
PRICEV1	.1058543	.0928204	-2.561	0.014	.0179651	.6237183
PRICEV2	5268.844	21070.95	2.143	0.038	1.616885	1.72E
ALD111	1.696154	1.48256	0.604	0.549	.2894961	9.937744
ALD114	.6141628	.7819324	-0.383	0.704	.0467603	8.066583
ALD121	.0018552	.0029422	-3.966	0.000	.000075	.0458694
ALD123	.0173304	.0217999	-3.224	0.003	.0013609	.2206996
ALD215	1.129094	1.371738	0.100	0.921	.096718	13.18114
ALD221	.0040708	.0082824	-2.705	0.010	.0000664	.2494332
ALD231	6.770843	6.193095	2.091	0.043	1.064525	43.06552
ALD232	.0524096	.0732251	-2.110	0.041	.0031051	.8845955
ALD312	.0510358	.0641789	-2.366	0.023	.0040106	.6494431
ALD313	.0089072	.0169644	-2.479	0.018	.0001891	.4195626
ALD321	.6448328	1.109613	-0.255	0.800	.0198537	20.94363
ALD332	.014928	.0146558	-4.283	0.000	.0020492	.1087489

COTTON89: does a household grow cotton in 1995 (where 1 codes yes)? ALD112, ALD113, ALD122 and ALD214 dropped due to collinearity. Zero failures and one success are completely determined. FEMHEAD1~=0 would predict failure (i.e. cotton adoption) perfectly. Adjusted Wald test of jointly zero coefficients for the variables MALE1 and MALE3: f(2, 38) = 5.72, Prob > F = 0.007. Adjusted Wald test of jointly zero coefficients for the variables AGEHH01 and AGEHH02: F(2, 38) = 4.65, Prob > F = 0.016. Adjusted Wald test of jointly zero coefficients for the variables EDUMUM1 and EDUMUM2: F(2, 38) = 4.30, Prob > F = 0.021. Command: svylogit COTTON89 MALE1 MALE3 AGEHH01 AGEHH02 ILLDAYS1 ILLDAYS2 TIME04 EDUMUM1 EDUMUM2 TENURE1 TOOL11 TOOL02 PEST12 VASSET5 AUTH12 ORIGINF1 LABOUR5 MARKET4 YIELDL8 PRICE14 PRICE23 PRICE33 PRICEV1 PRICEV2 ALD1* ALD2* ALD3*, or.

Source: FSP data and own calculations (010131a).

Figure 6.15: PLOT32 Survey Linear Regression

pweight: WEIGHT3
Strata: CATEG1
Psu: ALD

Number of obs = 371
Number of strata = 4
Number of PSUs = 43
Population size = 32434.11
F(34, 6) = 80.23
Prob > F = 0.0000
R-squared = 0.3924

PLOT32	Coef.	St Err	t	P>|t|	(95% Conf.	Interval)
FEMALE1	.1625669	.0847035	-1.919	0.062	.3338959	.0087622
FEMALE3	.0147468	.0084677	1.742	0.089	-.0023807	.0318744
MALE1	.1018678	.0519252	1.962	0.057	.0031609	.2068964
MALE3	-.0112937	.0045526	-2.481	0.018	.0205022	-.0020852
DEPEND94	.4757412	.2133143	2.230	0.032	.0442724	.9072101
ILLDAYS2	.0036647	.0016294	2.249	0.030	.0003689	.0069604
TIME03	-.007672	.0038465	-1.995	0.053	.0154524	.0001084
EDUHH3	-.3347204	.1537147	-2.178	0.036	-.6456378	-.023803
EDUHH4	.1332859	.0478315	2.787	0.008	.0365376	.2300343
AREAFER5	-.2757984	.1036334	-2.661	0.011	-.4854167	-.06618
TENURE1	-.1144616	.0641894	-1.783	0.082	-.2442969	.0153737
TOOL01	-.0442351	.0203263	-2.176	0.036	-.0853489	-.0031212
TOOL02	.0777572	.0435451	1.786	0.082	-.0103211	.1658355
ANIMAL1	-.0338432	.0183732	-1.842	0.073	-.0710064	.00332
VASSET5	-.0414716	.0171049	-2.425	0.020	-.0760695	-.0068737
ORIGINF1	-.1212458	.0703722	-1.723	0.093	-.2635869	.0210953
MARKET8	-.1725465	.064982	-2.655	0.011	-.3039849	-.0411081
YIELDL7	.5598447	.1990986	2.812	0.008	.1571298	.9625595
PRICE14	.6917875	.199938	3.460	0.001	.2873748	1.0962
PRICE34	-.5916754	.2233774	-2.649	0.012	-1.043499	-.1398519
PRICEV3	1.643143	.736299	2.232	0.031	.1538375	3.132448
ALD111	.205873	.2040212	1.009	0.319	-.2067988	.6185447
ALD112	.017506	.1238662	0.141	0.888	-.2330371	.268049
ALD113	(DROPPED)					
ALD114	.0664956	.2013503	0.330	0.743	-.3407738	.4737649
ALD121	(DROPPED)					
ALD122	.1408495	.1724742	0.817	0.419	-.2080124	.4897115
ALD123	-.6362232	.4834455	-1.316	0.196	-1.614084	.3416376
ALD214	.4567095	.1891	2.415	0.021	.0742187	.8392003
ALD215	(DROPPED)					
ALD221	.884655	.3493551	2.532	0.015	.1780176	1.591292
ALD231	.4549796	.1221893	3.724	0.001	.2078284	.7021308
ALD232	.3332782	.1573084	2.119	0.041	.015092	.6514645
ALD312	-.4913146	.8176324	-0.601	0.551	-2.145132	1.162503
ALD313	-.2091772	.2925614	-0.715	0.479	-.8009386	.3825842
ALD321	1.042982	.2701278	3.861	0.000	.496597	1.589367
ALD332	.3309121	.138541	2.389	0.022	.0506864	.6111378
_cons	1.538881	.7403682	-2.079	0.044	-3.036417	-.0413452

PLOT32: the natural log of the effective number of plots per hectare per household in 1995. Adjusted Wald test of jointly zero coefficients for the four variables FEMALE1 to MALE3: F(4, 36) = 2.80, Prob > F = 0.040. Adjusted Wald test of jointly zero coefficients for the variables FEMALE1 and FEMALE3: F(2, 38) = 1.81, Prob > F = 0.178. Adjusted Wald test of jointly zero coefficients for the variables MALE1 and MALE3: F(2, 38) = 4.00, Prob > F = 0.027. Adjusted Wald test of jointly zero coefficients for the variables EDUHH3 and EDUHH4: F(2, 38) = 5.30, Prob > F = 0.009. Command: svyreg PLOT32 FEMALE1 FEMALE3 MALE1 MALE3 DEPEND94 ILLDAYS2 TIME03 EDUHH3 EDUHH4 AREAFER5 TENURE1 TOOL01 TOOL02 ANIMAL1 VASSET5 ORIGINF1 MARKET8 YIELDL7 PRICE14 PRICE34 PRICEV3 ALD1* ALD2* ALD3*.

Source: FSP data and own calculations (010201a).

Figure 6.16: REMT4 Survey Linear Regression

pweight: WEIGHT2
Strata: CATEG1
PSU: ALD

Number of obs = 349
Number of strata = 4
Number of PSUs = 43
Population size = 30505.29
F(37, 3) = 739.68
Prob > F = 0.0001
R-squared = 0.3721

REMT4	Coef.	St Err	t	P>|t|	(95% Conf.	Interval)
FEMALE1	-.1528568	.1025797	-1.490	0.144	.3603437	.0546302
FEMALE3	.0281111	.0097408	2.886	0.006	.0084084	.0478138
MALE1	-.2183613	.0838649	-2.604	0.013	-.387994	.0487286
MALE3	.027045	.0071104	3.804	0.000	.0126628	.0414271
AGEHEAD3	.067267	.0245598	-2.739	0.009	-.1169439	-.0175901
AGEHEAD4	.0006875	.0002109	3.259	0.002	.0002608	.0011141
AGEHH01	.0751504	.0264236	2.844	0.007	.0217035	.1285972
AGEHH02	-.0007288	.0004521	-1.612	0.115	-.0016432	.0001856
ILLDAYS2	-.0075396	.0016817	-4.483	0.000	-.0109411	-.004138
TIME03	-.0092342	.0041648	-2.217	0.033	-.0176584	.0008101
EDUMUM1	.183457	.1201554	1.527	0.135	-.0595801	.4264942
EDUMUM2	-.0772304	.0330157	-2.339	0.025	-.144011	.0104497
AREA25	.4406405	.0948022	4.648	0.000	.248885	.632396
AREAFER6	-.3099117	.1590303	-1.949	0.059	-.6315809	.0117575
DISTANC3	-.0237604	.0095276	-2.494	0.017	-.0430319	-.004489
DISTANC9	.0001368	.0000433	3.160	0.003	.0000492	.0002243
ANIMAL1	.025918	.0099952	2.593	0.013	.0057007	.0461352
PEST11	.3757106	.1651812	2.275	0.029	.0416002	.7098211
VASSET3	.0005363	.0002054	2.611	0.013	.0001208	.0009518
ORIGINM1	-.5455783	.1819756	-2.998	0.005	-.9136587	.1774978
MARKET8	.297438	.0796022	3.737	0.001	.1364274	.4584485
YIELDL7	-1.088182	.2113873	-5.148	0.000	-1.515753	-.6606107
PRICE34	.5642734	.3203648	1.761	0.086	-.0837255	1.212272
PRICEV3	-1.930588	.7571604	-2.550	0.015	-3.462089	.3990861
ALD111	.2642883	.285374	0.926	0.360	-.3129351	.8415117
ALD112	.3887507	.1439718	2.700	0.010	.0975403	.6799611
ALD113	(DROPPED)					
ALD114	.8589053	.2397054	-3.583	0.001	-1.343755	.3740554
ALD121	(DROPPED)					
ALD122	-.1099731	.1672159	-0.658	0.515	-.4481993	.228253
ALD123	.9248078	.5520748	1.675	0.102	-.1918689	2.041485
ALD214	-1.055936	.3444332	-3.066	0.004	-1.752618	-.3592542
ALD215	(DROPPED)					
ALD221	.274787	.5125865	0.536	0.595	-.762017	1.311591
ALD231	.3463101	.1669918	2.074	0.045	.0085372	.6840829
ALD232	-.2444901	.1860446	-1.314	0.196	-.6208008	.1318206
ALD312	1.32119	1.011853	1.306	0.199	.7254757	3.367857
ALD313	.6358047	.4339728	1.465	0.151	.241988	1.513597
ALD321	-.3982447	.2584977	-1.541	0.131	-.9211056	.1246162
ALD332	-.0218833	.1732487	-0.126	0.900	.3723118	.3285453
_cons	5.816203	.965142	6.026	0.000	3.864019	7.768387

REMT4: the natural log of the total value of gifts and remittances given and received in US$ per capita per household in the period January to September 1995. Adjusted Wald test of jointly zero coefficients for the four variables FEMALE1 to MALE3: F(4, 36) = 12.15, Prob > F = 0.000. Adjusted Wald test of jointly zero coefficients for the variables FEMALE1 and FEMALE3: F(2, 38) = 13.50, Prob > F = 0.000. Adjusted Wald test of jointly zero coefficients for the variables MALE1 and MALE3: F(2, 38) = 18.51, Prob > F = 0.027. Adjusted Wald test of jointly zero coefficients for the variables AGEHEAD3 and AGEHEAD4: F(2, 38) = 6.18, Prob > F = 0.005. Adjusted Wald test of jointly zero coefficients for the variables EDUMUM1 and EDUMUM2: F(2, 38) = 5.23, Prob > F = 0.010. Adjusted Wald test of jointly zero coefficients for the variables DISTANC3 and DISTANC9: F(2, 38) = 6.63, Prob > F = 0.003. Command: svyreg REMT4 FEMALE1 FEMALE3 MALE1 MALE3 AGEHEAD3 AGEHEAD4 AGEHH01 AGEHH02 ILLDAYS2 TIME03 EDUMUM1 EDUMUM2 AREA25 AREAFER6 DISTANC3 DISTANC9 ANIMAL1 PEST11 VASSET3 ORIGINM1 MARKET8 YIELDL7 PRICE34 PRICEV3 ALD1* ALD2* ALD3*.

Source: FSP data and own calculations (010201b, model4).

Chapter 7: Household Welfare

7.1 Introduction

The objective of this chapter is to analysis the determinants of household poverty in post-war, rural northern Mozambique. Such analysis has three benefits. First, it will identify the relative importance of the war's effects on household labour supply, assets and village institutions for post-war poverty, thus providing a further insight into how internal war shapes post-war poverty outcomes. Second, the analysis can contribute to ongoing policy debates in Mozambique over the nature of post-war rural "emergency" versus "development" policies, the importance of education versus land (i.e. human versus physical capital), and the significance of household on-farm versus off-farm income sources for alleviating rural poverty.[65] Third, this chapter will use instrumental variable techniques to assess the welfare effects of endogenous household choices for land use and income activities.

The main hypothesis is that the war legacy continues to affect household welfare significantly in the post-war period through a variety of effects. In particular, it is expected that the war has a stronger negative effect on household income than on household food consumption. Households are expected to exhibit a war-induced labour surplus so that increasing household assets (especially including land) and improving market access will yield large increases in household welfare. The former may help induce increases in food consumption while the latter will also be important for increasing income. Alleviating both constraints would require an integrated approach to rural post-war reconstruction policy, with initially little emphasis on human capital formation. If these hypotheses prove to be correct, then policy in the post-war years should aim to overcome the war-induced supply constraints which in turn would increase the returns to education and the benefits of cash crop adoption.

The analysis presented here will make further use of the FSP dataset introduced above. It is a useful tool for this analysis as it combines evidence on household activity choices with household welfare outcomes from a war-affected area in northern Mozambique. Unfortunately, the data enumerated in the FSP survey on household crop storage and household calorie intake, which would have provided further evidence of savings

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[65] These three issues are discussed in the Mozambican context by Lopes and Sacerdoti (1991), Ratilal (1990), World Bank (1993) and White (1994), by IAF (1998), Rose, Strasberg, Jeje and Tschirley (1999), Tschirley and Benfica (2000) and Tschirley and Weber (1994), and by Cramer and Pontara (1998) and Pitcher (1999), respectively.

behaviour and welfare outcomes, could not be used due to significant inconsistencies in data enumeration (cf. chapter 3 and Strasberg 1997: 187-8).

The analysis will commence in section 7.2 with a theoretical discussion of the effects of war on household welfare. Section 7.3 will consider different indicators of household welfare, discuss data issues and derive an econometric specification of a household welfare equation. Section 7.4 will summarise the expected determinants of household welfare in such an equation.

The subsequent section will review the results of a bivariate poverty profile, address whether the data should be pooled and discuss in detail the determinants of household welfare, including the effects of endogenous activity choices on welfare. Section 7.6 will conclude the chapter. All figures and empirical results are summarised at the end of the chapter. Appendices A.4 and A.5 contain a discussion of the variability of welfare indicators and of the inequality in assets and welfare across households, which complements the main analysis presented here.

7.2 War and Household Welfare

Definitions of Key Terms

Household poverty is the lack of command over market and non-market goods and services at the household level (Ravallion 1996a: 201) while household welfare is a positive function of a household's command over such resources. Welfare in this chapter is therefore linked closely to notions of income and consumption, in particular of food and non-durable goods and services (Atkinson 1989).

The definition of household welfare employed here disregards for empirical reasons the consumption of services derived from durables (which are likely to be small as households have only a low asset stock in the post-war period) as also discussed in chapter 3. This view of welfare also disregards any externalities of consumption as well as the effects of illness and death, which are likely to be significant after a war but which are difficult to combine with monetary aggregates in a welfare indicators at the household level.

The welfare indicators used in this chapter differ from welfare indicators such as the human development index (HDI) which also includes indicators of educational attainment and health status (UNDP 1998b). In the analysis below, education and health are instead determinants of welfare outcomes as households can influence their education and health status to some extent. The income and consumption outcomes at the household level thus implicitly contain the effects of nutrition, health, education, asset endowments, climatic and market risks as well as institutional arrangements.

The indicator of food consumption will allow an initial discussion of the determinants of household level food security. Food security refers to the reliable and sufficient flow (via home production, markets or social exchange) of calories and other components of nutrition appropriate for a healthy, active and productive life of a household, where the requirements are in turn affected by its members' age, gender, metabolic efficiency and activity levels.[66] Food security is hence a broader term than food consumption but with the available agricultural household surveys, food consumption is the best available estimate of food security for post-war northern Mozambique.

Given the available cross-sectional data, the main focus must be on current poverty and welfare. It would require panel data to understand whether a household experiences transitory poverty (i.e. if permanent income was above the poverty line but current income was below it) or chronic poverty (i.e. if permanent income was below the poverty line Atkinson 1989, Morduch 1994). The data may be able to indicate some forms of structural poverty, where poverty is caused by socio-economic exogenous constraints such as female-headed or refugee status or a life-cycle induced high dependency ratio. Other indicators in the analysis may point to poverty being stochastic so that random exogenous events such as a drought force a household below the poverty line (especially with significant borrowing constraints).

Links between War and Household Welfare

The determinants of household poverty and food security are an important concern of economic research and public policy in their own rights. However, poverty and food security are also closely linked for a number of reasons, especially in war-affected rural economies.

First, households which operate in severely war affected markets or even economic isolation (see chapter 2) and which thus practice pure subsistence agriculture retain all agricultural production for future home consumption. In the basic model of the theory chapter and in the absence of storage losses, the latter equals total food production so that poverty and food security are identical for pure subsistence households. In practice, rural households in northern Mozambique have a degree of subsistence production and a significant share of households practices pure subsistence (chapter 6), which is in part a

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[66] The definition of food security is discussed by Alderman and Garcia (1994: 487), Anand and Harris (1992), Behrman and Deolalikar (1988: 654-6), Maxwell (1996), Maxwell and Wiebe (1998: 7-10), Reardon and Matlon (1989: 118-9), Sahn (1989a: 3), and Strauss (1990).

direct result of the war. For a pure subsistence household, therefore, a model of either production or consumption would analyse poverty and food security simultaneously.

Second, both household production and food security are important contributors to household utility as discussed in the basic model of chapter 2. Agricultural production in the basic model determines available food resources which in turn determine current food actually consumed, which must lie above a given survival threshold. For very poor households close to the threshold it is not the total level of income or its variability which will be the key determinants of its welfare but the proximity to the absolute survival threshold (de Janvry et al 1991, Fafchamps 1999: 66). As seen in chapter 6, this has strong implications for household behaviour, for example concerning the decision to adopt cash crops or to alter production technology. This is particularly important for war-affected households who are more likely to face a binding nutrition constraint. So for the modelling of post-war household welfare, it is important to analyse the determinants of both general welfare and food security explicitly.

Third, it has often been assumed that low income equals low food expenditure which equals low nutritional intake.[67] This view is supported by some evidence of a high elasticity of nutrient intake with respect to income or expenditure. However, some of these studies estimate food expenditure for only a few food categories and then convert their results using possibly biased food-to-nutrient conversion factors thus deriving high nutrient elasticities from food expenditure elasticities. This has led to, for example, the World Bank proposing policies which are aimed at creating food security by raising the average incomes of the poor and malnourished.

However, food has many dimensions and purposes including nutrition, taste, appearance, status, convenience, processing etc. For example, households in northern Mozambique have been observed to spend extra income on dried fish to improve the flavour of their otherwise very monotonous diets (Tschirley and Weber 1994). This implies that high food-income elasticities can be consistent with low nutrient-income elasticities as households with higher income primarily increase spending on dimensions of food other than nutrition. This further strengthens the argument that the determinants of food security and income may actually diverge in practice.

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[67] As discussed by Behrman and Deolalikar (1987: 497, 1988: 653-4), Garrett and Ruel (1999: 1963), and Strauss and Thomas (1995).

Such analysis focuses on the differential effects of different production outputs for household utility. While in figure 2.2 a household only considers a trade-off between leisure and one output, different outputs may in practice have different effects on the utility curves of quadrant II. Furthermore, if the determinants of food security and income actually diverge, then another dichotomy will have been introduced into the basic model. In practice, this would imply that policies aimed at increasing income may not increase food security. In Mozambique, this debate has concerned itself with the food security effects of cotton adoption, which will be analysed below.

Fourth, one explanation for the poverty-food security relationship derives from the sources of risk a household is exposed to as a result of its portfolio of activities (chapter 6). As a household engages in fewer subsistence activities, the determinants of poverty and food security increasingly diverge (Bouis and Haddad 1990, Kennedy and Bouis 1993, Kennedy and Cogill 1987). For example, cash-cropping households rely on both crop and food markets to convert their production into nutrition consumption. However, food markets may not work well at either the national or local level, especially with war destruction and a high degree of economic isolation (chapter 2).

Even abstracting from seasonality and crop risk, a household with a high level of production may thus have little food security and vice versa. According to Behrman and Deolalikar, risk is an important determinant of household activity choices but its effect on household food security has not been studied in much detail in the literature (1988: 639). The analysis below will thus help address this gap, especially for the context of a post-war economy.

The implications of these observations is that while the determinants of income and food security may converge for pure subsistence households, this convergence cannot be taken for granted for households facing re-emerging markets. Utility especially for households threatened with survival depends on both food security (as represented by the good X and X_{min} in figure 2.2) and income (as is not directly reflected except through X in that figure) as each captures different elements of household well-being. The analysis of this chapter therefore also helps to develop the theoretical framework of chapter 2 as suitable for the analysis of post-war poverty outcomes. In addition, it is important for the design of poverty alleviation policies to recognise that higher income may not necessarily lead to higher food security, especially when considering the strong impact of the war on household activity choices.

The subsequent paragraphs will analyse some components of the household model which are relevant for the determination of household welfare. The choice of these components

will be familiar because the significant determinants of household production choices concerning land and activities are expected to also affect welfare in the reduced form model. In addition, the direct effects of such choices on household welfare will be analysed later in this chapter. In particular, the discussion in subsequent paragraphs will emphasise the role of the war in determining income and consumption, bearing in mind that their determinants need not be equivalent.

Household Utility

Households utility depends on the consumption of food and other goods and services which may include freedom and security. Households in this model are risk averse, which expresses itself through the shape of the utility function, including a minimum positive level of consumption necessary for achieving positive utility (figure 2.2 and Brück 1996). It is not possible to directly observe household or individual utility so that household income, total consumption and food consumption will be used instead as indicators of household welfare.

War does not directly affect the utility function of the household (chapter 2). Instead, the level of utility achieved by a household is reduced indirectly through the effects discussed below. Lower consumption or the consumption of inferior goods thus reduce utility but leave the utility function unchanged. One example is imported yellow maize which was the main form of food aid during the war in Mozambique even though white maize was preferred locally (Dorosh et al 1995, Tschirley et al 1996). As soon as sufficient white maize was again produced locally, consumers purchased this instead of the yellow maize. It therefore appears that demand patterns are less affected by war than, say, income generation patterns, for example through changing gender roles in production and the changing rural-urban and intra-rural output mix in a post-war economy.

War may not significantly change the minimum nutritional requirements which represent the survival threshold, either, although some endogenous adaptation to lower calorie intake is possible. In addition, households may exhibit an increased rate of time preference during war (i.e. larger impatience). The utility of being alive now may increase in times of war if intergenerational linkages in households are weakened, for example due to refugee movements or lethal attacks. This undermines a basic motive for household formation (chapter 2) and implies that there are fewer purposes in building up assets and planning a bequest, for instance of land (chapter 4). A war-induced increase in the household discount rate causes an indirect reduction in household assets (cf. Glomm and Palumbo 1993) and hence an indirect reduction in the level of income.

Household Labour

This section discusses further effects of the war legacy on household labour and thus poverty, building on section 2.3.[68] In summary, war reduces household labour availability but the end of a war only partially reverses this constraint. Moreover, the war legacy has negative effects on the productivity of labour and on human capital. These effects reduce the valuation of household leisure during a war and may push a household closer to its survival constraint. In addition, they may deepen the war-induced poverty trap and weaken the post-war supply constraint. Household labour characteristics are thus crucially affected by war and these will in turn affect household welfare in the post-war period.

The maximum amount of labour available for work within the household is diminished as some household members are drafted into an army, maimed or killed by war action, or cannot work productively as the household must constantly look out for further attacks. In addition, war indirectly increases the general incidence of morbidity and mortality in the population. These effects of war reduce the effective labour input into production so that household production shifts back towards the origin along the production function.

However, this is not equivalent to a scale reduction of household production if the negative effects on labour are not proportional to the household's initial demographic characteristics and if it affects the household's consumption-production ratio. This occurs especially with a high degree of morbidity and agriculturally unproductive sentry duty as these household members still must be fed even while they do not contribute to agricultural production. Such war-induced increase in the consumption-production ratio in the household thus increases the valuation of household labour as in the life-cycle effects in the Chayanov model of chapter 2.

In the post-war period, the direct reduction of war-induced mortality ceases suddenly but indirect effects (e.g. through the weakened health system) persist. The consumption-production ratio changes also take many years to reverse. The composition of household labour and the valuation of this labour in the peasant household is thus war-affected for many years after the ceasefire. A well-known example of this war legacy is the unequal gender composition of the population in post-war Europe.

These gradual post-war changes imply that households, which may slowly move away from the survival constraint for other reasons, value leisure more highly in the post-war period.

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[68] The role of household composition and household weights in the calculation and inter-household comparison of welfare indicators is discussed in chapter 3 and in section 7.3.

This weakens the supply response in the post-war period as well as creating a bias in the estimation of monetary or calorie-based household welfare indicators which do not measure the value of leisure per se.

The war-induced changes in the valuation of leisure also explain the low level of education attained in northern Mozambique, which does not only result from the reduced supply of educational opportunities. With a binding survival constraint and war-time household production opportunities which do not directly depend on past household educational achievements, households have a low demand for education during the war. With a long-lasting war, this then implies a very low level of education in the post-war period and thus reduced household income opportunities, which in turn increases household welfare vulnerability.

In addition, the effect of (especially food) consumption on health and productivity of the peasant household is likely to increase during a war (Dasgupta and Ray 1986, 1987, Kennedy and Bouis 1993, Singh et al 1986a: 38-9, ch. 5). Household health is produced by the consumption of food, non-food goods and leisure, by household health spending, and by community health spending. Health in turn positively affects productivity which in turn can create more resources required for maintaining household health. The ability to hire-in labour may compensate for household ill-health but such labour markets are also reduced during war. These arguments suggest that war further deepens the poverty trap of war-affected households.

Empirically, this effect is difficult to measure with the FSP survey, which has good data on agricultural household choices but less useful data on health indicators. These efficiency wage considerations can therefore not be fully integrated into the model although the FSP data does contain some variables which help to control for household ill health.

Household Assets

As argued in chapters 2 to 6, war affects different types of assets including land, and hence the household labour-capital ratio, in different ways, hence creating varying intensities of war vulnerabilities for assets and activities. To the extent that household production is a function of a given capital-labour ratio per activity, the war destruction or dislocation of assets will reduce household production but also household technological efficiency.

In particular, the war legacy reduces the technical efficiency of the household agricultural production function by destroying tools, disrupting the production process with random attacks, and reducing the level of technical advice a threatened and under-funded extension service can provide. This will shift the production function downwards so that for a given

labour input, less crops are harvested. Such lower labour productivity may induce the household to increase its labour supply, relative to its asset endowment, to ensure that its minimum consumption target is still attainable. This alters its optimal production technology and crop mix and thus induce a shift away from market activities and into subsistence activities (chapter 6).

Similarly, the war legacy reduces the technical efficiency of the household storage function by exposing the stored produce to random attacks and preventing households from learning or applying the best storage techniques. This will shift the storage function downwards so that for a given amount put into storage, a smaller amount will be available when taken out of the depot. Households can circumvent this additional constraint by increasing its area planted thus putting more into storage, by increasing its market participation to bypass crop storage, or by shifting to other activities which require less crop storage (e.g. social exchange or famine foods).

Assets are a key component of constructing a household livelihood especially by enabling non-food and off-farm activities which may require a minimum asset level before they can be started or which may have increasing returns to scale (Dercon 1996b). Poor households with few assets, even if not facing a credit constraint, will consume (nearly) all their current income (Zeldes 1989). The lower a household's asset endowment, the larger are its consumption fluctuations and the chance of an occasional severe consumption shortfall (i.e. a "famine") to below the usual survival constraint (Deaton 1990). With credit constraints and an unequal distribution of assets, asset-poor households may find themselves facing a poverty trap situation as less asset constrained households can invest in higher return activities thus increasing the asset and income inequality further (Ravallion 1996b).

Some war actions create asset poverty almost randomly, as there may be little pattern in the direct destruction of household assets during the war. After a long war, households may actually face an equalised distribution of assets but, for the same reason, they will have few opportunities to increase their asset holdings initially. Apart from the activity choices this induces (chapter 6), low household endowments imply lower but more variable returns and therefore lower household welfare. The increased variability of household income may result in some households being poor in some years while other households (irrespective of the variability of their incomes) may be poor in all years. However, cross-sectional survey data cannot differentiate between such transient and structural poverty.

In addition, these large consumption risks facing war-affected households in the post-war period will induce some precautionary savings, even if the rate of return is negative

(Deaton 1992). This applies particularly to savings in the form of agricultural produce (which was why figure 2.2 contains a storage function in quadrant I), which is increasingly important in an environment in which households have few opportunities for reducing climatic risks through increased input application or for trading outputs in the market. The war therefore increases the household demand for savings in terms of on-farm storage.

With endogenous survival, many of these predictions concerning the destruction and dislocation of assets during and after a war are sharpened (Gersovitz 1983, Glomm and Palumbo 1993). Assume that mortality is inversely related to the stock of health, where health depreciates but can be augmented by consumption. Changes in income can be expected to affect the optimal inter-temporal allocation of consumption and savings and the depletion of the given initial wealth stock. Three main results obtain from such considerations.

First, with borrowing constraints and endogenous survival, consumption in each period does not equal permanent income, as would have been expected in the standard life cycle model. Instead, the increased utility of being alive versus being dead is an incentive to move some consumption into the present. If war increases this impatience, as household heads may for example not expect the household itself to continue to exist beyond the death of the household head, there will be less investment and a smaller household endowment even in the absence of direct war effects.

Second, income elasticities of demand for nutrients can be lower than unity. With endogenous survival, it makes sense to spread additional current income across several periods to try to maintain one's survival chances beyond the next time period. Nevertheless at the margin of the survival constraint, very poor agents will allocate increasing amounts of their wealth to current consumption to ensure survival into the next period, even if survival then will be threatened. For such poor households, assets will be low or depleted in the long-term and the stock of assets will have little impact on current welfare.

Third, with an endogenous survival constraint, households will have a higher demand for health services at the same time as the supply of these services is reduced by the war and the productivity of health spending is lower. This deterioration in health spending productivity may be due to a number of factors: Rises in health costs, attacks on health posts, a lack of a distribution system for medicines, and the preferential use of medicines for the treatment of injured soldiers.

War is thus like an extreme peak season for the public health system, especially when considering the indirect effects of war on survival-determining factors such as disease, sanitation, drinking water etc. Health depreciation is likely to worsen during and maybe

even after times of war especially for directly war-affected individuals, like soldiers or refugees in a refugee-camp. Individuals need to pay more attention to their health in times of war to ensure a constant rate of survival even if they have fewer resources to do this, their resources have less productivity in the health production function, and while public health services are much curtailed. It can thus be expected that households with more ill health have a lower welfare both directly (as ill health is unpleasant itself) and indirectly (through the reduced labour market participation while being ill).

These three effects of an endogenous survival constraint in a simple model of consumption indicate how war can cause an indirect depletion of assets over and above any direct reductions in capital holdings as a result of fighting or any indirect portfolio effects of war on asset holdings. The main indirect effects of war operate on the probability of mortality and on the marginal productivity of health. Further direct effects of war may be changes in the rate of health depreciation and in the utility of being alive. These war-time effects then shape the starting position of the post-war period and may lead to the creation and persistence of post-war poverty traps, as will be discussed further below.

Markets and Social Institutions

In addition to the role of assets in maintaining technical efficiency, widening coping strategies, and building precautionary savings, assets also permit a household to improve its social capital and thus its capabilities, i.e. its ability to conduct a meaningful life and to enhance its decision making (Bebbington 1999, Sen 1985, 1997). Social capital is another important determinant of poverty as rural African households hold diversified activity portfolios which are dependent on and interlinked with other actors both via market and non-market interactions (Heyer 1989, 1996). Social capital can capture some of these linkage channels and effects as well as and can help express a household's capabilities. War directly undermines social capital as war dislocates people and institutions, depreciating contacts, trust, and other components of social capital. This will lead to a further, war-induced reduction in output and thus welfare. In practice, it is difficult to measure social capital but it may be related to a number of indicators reviewed in more detail below.

One key institution for peasant households concerns land tenure. However, there is little formal analysis and even less evidence of how increased land tenure security affects household welfare and food security (cf. chapters 4 and 5 and Maxwell and Wiebe 1998: 2, 21-2). On one hand, it is argued that land is not a key determinant of household welfare in Sub-Saharan Africa (Lipton 1985). On the other hand, it is argued that land is a key determinant of welfare in some areas (Deininger and Binswanger 1999, World Bank 2000). It seems likely that war does affect land tenure arrangements, especially if local issues and

local participants play a large role in the conflict, as was the case in northern Mozambique (Geffray 1991). The nature of these effects is ambiguous a priori. Some households may gain while other households may loose tenure security, cultivated area or physical investments in land infrastructure (e.g. irrigation). Much depends on the political affiliations of the household and perhaps on the random effects of attacks.

Market institutions also matter to peasant households as they define a household's ability to convert output into consumption goods. The variance of activity returns, transaction costs, and the terms of trade all affect a household's decision to participate in markets (chapter 6) and therefore its output, consumption and welfare. The effect of market risk on poverty depends in part on the share of the poor in society and thus on the choice of the social welfare function (Ravallion 1988). In very poor societies, for instance, an increase in market risk implies that relatively few households will be pushed by chance above the poverty line. In other words, in such societies, there is less transient poverty and more structural poverty, so that a reduction in poverty will have less welfare enhancing effects than, say, an increase in endowments of the poor (especially when considering the headcount index of poverty which gives equal weight to all poor households below the poverty line).

Given these considerations, war has a negative effect on poverty through both an increase in risk and a reduction in assets. However, given that Mozambique is a very poor society, the war-induced increase in risk may not have been as important in reducing household welfare as the loss of assets. In one important instance, however, this does not apply. Households very close to the absolute survival constraint would suffer huge welfare losses from an increase in risk even if the expected income was constant. Therefore, the more severely a household was affected by the war, the more important the distribution of the returns of its activities are to the survival of that household. Conversely, for very poor households a reduction in risk is welfare enhancing if such reduction reduces the risk of starvation.

Finally, household social income (chapter 6) depends at least in part on market and non-market institutions and low transaction costs.[69] During the war, risks are highly covariant across large areas and travelling or trading was very dangerous and costly. Therefore social exchange would have been strongly suppressed during the war. In the post-war period, households facing lower market transaction costs and retaining larger kin networks across larger spaces could thus generate higher social income. In the long-term, however, such

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[69] See for example Dercon (2000), Fafchamps and Minten (1999), Lyon (2000), and Platteau (1999).

activities may become unprofitable as local output markets intensify and offer higher returns at lower transaction costs. The determinants of social institutions enabling social exchange thus have an ambiguous effect on household welfare, depending on the stage of the post-war transformation a household and its village and social kin network is in.

7.3 Econometric and Data Considerations

Given the above discussion of the definition of household welfare, this section will consider the suitability of household income and household expenditure as household welfare indicators. This section will also derive an econometric specification of a welfare (i.e. income or expenditure) function and will review some data issues relevant to this econometric analysis, building on chapter 3.

The Choice of Welfare Indicator: Income versus Expenditure

A number of issues may help determine the appropriate choice of welfare indicator given the available data.[70] Household income, expenditure or consumption measure a household's ability to obtain goods and services. All indicators typically fail to include leisure, the use of public goods and free public sector services, common property resources and the quality of life (Datt and Jolliffe 1999: 9, Ravallion 1996b: 1331). The income variable may measure their use for production purposes more directly than the consumption variable as the amount of leisure also helps to determine income (but not consumption) while some agricultural production processes depend on the use of "free" common property resources or public goods and thus value these resources explicitly.

Household income may overestimate household welfare if storage losses are significant, if households are rationed in their purchase of consumption goods, or if households save a significant share of income. However, household income may also underestimate household welfare if borrowing is feasible or if households frequently share in the consumption activities of other households (i.e. if social income is underreported). Note that household expenditure and consumption may also differ if the latter involves durables from which consumption may be derived over several periods.

The literature on welfare indicators considers that income measures a (potential) welfare opportunity while consumption measures a (realised) welfare achievement, so that the latter is sometimes preferred to the former as an indicator. Furthermore, consumption typically

fluctuates less than income due to a household's comparative advantage in smoothing consumption rather than income over time where consumption smoothing activities include savings, loans and non-market transfers (Case 1995, Rosenzweig and Binswanger 1993, Rosenzweig and Wolpin 1993).

However, poor households may smooth income instead of consumption (Morduch 1994, 1995), in particular households affected by war with few opportunities for consumption smoothing (chapter 6). In fact, even with no borrowing constraints poor households with no assets will consume all their current income (Fafchamps 1999: 19, Zeldes 1989). The problem of income variability is thus not as great in the immediate post-war period as it is for peace-time households with better access to financial markets. Also, as in the post-war period storage losses are lower and there is less product market rationing than there had been in the war period, income is a valid welfare indicator. Finally, food expenditure is a useful welfare indicator especially if households are similar with regard to activities, prices and the times of visit of the enumerators (Anand and Harris 1990: 327, Ravallion 1988: 1178).

Overall, estimating all three indicators is useful as it is a good check on the robustness of the results, bearing in mind that the determinants of income will not exactly equal the determinants of expenditure or of food expenditure (Appleton 1995: 5).

Data Issues Relevant to the Calculation of the Welfare Indicators

Given these considerations, it seems suitable to consider both income and consumption in the post-war period and to compare their determinants. Three suitable welfare indicators can be calculated using the FSP survey, namely net household income, total household consumption, and household food consumption. Consumption will be measured below by household market expenditure excluding durables and the value of home-produced and home-consumed agricultural production (called subsistence consumption) valued at seasonal market prices.[71]

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[70] The choice between different welfare indicators is also discussed by Anand and Harris (1990: 311), Atkinson (1989, 1991), Deaton and Grosh (1998), Deaton and Muellbauer (1980), Deaton and Zaidi (1999), Lipton and Ravallion (1995), and Ravallion (1992: 13-5).

[71] Gifts received from outside the household are included in this definition as they could potentially form a large share of income for households in distress or for households experiencing a significant income surplus (i.e. if social insurance exists). This approach risks a degree of double counting of income (Deaton and Zaidi 1999: 34). However, given the careful enumeration process (which excluded for example intra-household gifts), given that unlimited gift exchange is not feasible with high post-war transaction costs, and given the potential importance of gifts in the post-war economy this approach seemed preferable.

Household income data includes various sources of income (chapter 6). It is only available for the calendar year 1995 and not by round of data collection. The measurement error for agricultural household income is possibly lower in the FSP survey used here than in IAF (or other standard LSM surveys) as the former was conceived as an agricultural survey and thus contains an extremely detailed questionnaire enumerating agricultural production (see also chapter 3 and IAF 1998: 182, MAP/MSU Research Team 1996). Livestock production and livestock consumption is not a very well enumerated part of the survey. However, as the mean stock of large animals is extremely low due to the war, livestock production does not contribute a very large share to household income or consumption.

Payments for marketed goods or services may be in cash or in kind. Total net (gross) household income represents the sum of these components after (before) input costs have been deducted. Income and expenditure data were converted into US$ at the prevailing exchange rate in each reference period (e.g. round of data collection) so that all indicators are real 1995 values.[72] The household income variables measure, in US$, gross household income (INCOME01), net household income (INCOME02), the natural log of net household income (INCOME03), net household income per capita (INCOME05) and the natural log of net household income per capita (INCOME04).

It can be difficult to identify household expenditure for peasant households as part of the food expenditure may be used to pay workers, to seed fields or to feed animals (Deaton 1997: 28-9). The FSP survey appears to have captured transactions affecting hired workers and purchased inputs well, though they are not very common in northern Mozambique.

Expenditure data from the FSP survey is available per round of data collection for the round two to five and for the whole of 1995. In addition, imputed values for household subsistence consumption were added to the 1995 annual expenditure values thus deriving a measure of total 1995 household consumption. The expenditure data was enumerated using a very disaggregated list in an environment where most households only consume a small number of products so that the expenditure data can be expected to be very accurate (Deaton 1997: 27, Tschirley et al 2000). A careful use of recall period further strengthens the quality of the welfare indicators (chapter 3).

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[72] The exchange rates used to calculate real values in the FSP survey for rounds 1 to 5 are 5500, 7006, 7979, 9702 and 11097 Mt/US$, respectively, while the official exchange rates on 31/12/1994, 31/12/1995 and 31/12/1996 are 6553, 10776 and 11307 Mt/US$, respectively (Instituto Nacional de Estatística 1997: 82). There was only a small divergence between the official and the actual metical-dollar exchange rate during that period (Andersson and Sjöö 1998, International Monetary Fund 1998, Ubide 1997).

The expenditure data divides into the categories food, non-food, semi-durable and durable expenditures. The consumption of durables (which are items with a life-span longer than the reference period) is not equivalent to the expenditure on durables for a given period which is why the durable component of expenditure has been excluded from the analysis below (Anand and Harris 1990: 301, 308).[73] Household consumption also does not include rent or imputed rent as this would be difficult to calculate in rural areas where most building materials are collected from common property resources and where there is no rental market for property which can establish reference values. Other Mozambican household surveys are thus likely to overestimate rural consumption or provide a biased estimate of the value of housing in rural versus urban areas (cf. IAF 1998: 13, 16).

Household expenditures have been weighted by Paasche price indices according to a method suggested by Deaton and Zaidi (1999: equation 2.6). The final expenditure variables are total expenditure per household (EXP36WI), the natural log of total expenditure per household (EXP36WIL), total expenditure per capita (EXP36PC), and the natural log of total expenditure per capita (EXP36PCL). These variables refer to 1995 and are expressed in US$.

The collection of survey data at the household level may hide a large intra-household variation of welfare.[74] For example, food price changes may induce the reallocation of food resources within household away from women and children to men, depending on the bargaining power of individuals. However, many allocation decisions are taken at the household level, for example concerning total consumption expenditures and food crop cultivation. Children may not choose their level of nutritional intake freely and are strongly dependent on the total availability of resources at the household level. The estimation of welfare at the household level can then be seen as a baseline, which may be worsened by an unfavourable intra-household allocation of resources.

In addition, there are strong practical reasons to support the modelling of data at the household or per capita level (as opposed to the genuine individual level) as most household survey data (including the FSP survey) is obtained from one member of each household who may not report each individual's consumption accurately. Instead, data is collected concerning the household composition which will allow, in the analysis below, some adjustments to be made for nutritional requirements and for labour supply.

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[73] The durable component of total household expenditure is 2% in 1995.

The aggregation to the household level may also cancel out some of the unobservable variable bias resulting from the lack of data on activity levels. It is likely that each household has some members with above average and some members with below average activity levels so that a household's aggregate calorie requirements can be more accurately estimated than each individual's requirements. This does not hold, however, for genetic factors which may for example influence metabolic efficiency. These are likely to be correlated across household members (especially for smaller households where most household members are relatives).

The choice of weight for household size in the welfare indicator must always be arbitrary, yet some such weight must be chosen.[75] Estimating regressions on genuine per-household data would imply strong economies of scale which may not exist in practice. Also it would make comparisons across households with different age, gender and size compositions impossible. Weighting household members by their perceived consumption requirements or labour contributions (as in ACE and ALE models, respectively) assumes subjective weights for age and gender, which may not be applicable in practice, either.

This analysis thus follows the recommendation of Deaton and Zeaton (1999: 49) and divides all welfare indicators by total number of resident household members. This is feasible as the age and gender structure is less variable across households than household size. Furthermore, in very poor economies the scope of economies of scale in consumption is smaller, for example because housing is a negligible (if any) part of consumption while the food share is very high.

Finally, the main dependent variables below will be expressed in their natural log form. Most importantly, this yields a distribution of the indicators which is nearly normal. It also allows some coefficients of independent variables themselves expressed in log form to be interpreted as elasticities. Note that the log specification implies that, for example, returns to assets are proportionately equal, i.e. the rate is constant, across households (Appleton 1995: 13).

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[74] As has been discussed by Behrman and Deolalikar (1988: 659), Deaton (1997: 24), Ravallion (1992: 43-4), Strauss and Thomas (1995: 1905), and Svedberg (1990).

[75] For a discussion of equivalence scales in welfare econometrics, see chapter 3 and Atkinson (1991), Datt and Jolliffe (1999: 21), De Vos and Zaidi (1997), Deaton (1997: ch. 4.3), Deaton and Muellbauer (1980: 191-5, 1986), Deaton and Zaidi (1999: 48-54), Lanjouw and Ravallion (1995: 1415-6), Nelson (1993), and Ravallion (1992: 15-21).

An Econometric Specification

The main assumptions of the basic model of chapter 2 hold in this context as well. Households value consumption smoothed over time but they dislike effort and risk. Household utility is dependent on output consumed and leisure. The household maximises utility subject to a production function and time and budget constraints for given assets, prices and community endowments.

The imperfect nature of markets (e.g. in the labour market) and the interdependency of household production, labour supply and nutrition decisions imply that the separability property of the household model does not hold and that household welfare is a function of all exogenous (but not of endogenous) prices and assets. Furthermore, the high transaction costs, the low population density and the low level of technology suggest that a variety of location-specific exogenous factors will co-determine household income, consumption and hence utility.

Ideally, household utility maximisation would be modelled directly. However, as actual utility is immeasurable and therefore unobservable for the purpose of a household survey, an indirect indicator must be used. Such left hand side indicator could be monetary values of income, expenditure, and consumption for the analysis of poverty, and calorie consumption and calories in storage for the analysis of food security. The level of analysis will be the household consequently abstracting from intra-household allocation issues, which are not well captured by the post-war FSP data.

Chapter 2 had outlined in principle how household labour characteristics, physical and social assets, technologies and village-level characteristics could determine production levels and thus consumption or welfare in the post-war period. Chapters 4 to 6 then analysed this process in more detail for land and activity choices and confirmed the relevance of these factors for production outcomes. These discussions suggest that, for given assets, prices and community endowments, the determinants of household welfare can be specified by the following reduced-form equation:[76]

$$y_i = \alpha_0 + \alpha_1 \mathbf{L}_i + \alpha_2 \mathbf{F}_i + \alpha_3 \mathbf{K}_i + \alpha_4 \mathbf{V}_i + e_i \qquad (7.1)$$

where y_i is a suitable welfare indicator (e.g. the natural log of household consumption) for household $i = 1 \ldots N$, $\mathbf{L}_i$, $\mathbf{F}_i$, $\mathbf{K}_i$, and $\mathbf{V}_i$ are vectors representing household, land, asset and village-level endowments and characteristics, respectively, and where e_i is a normally

distributed error term which is not correlated with the exogenous variables therefore yielding unbiased and consistent estimates for the coefficients α_h for households i = 1...N and coefficients h = 0...4.

There are several advantages in directly estimating the indicators of household welfare using equation 7.1, which justify adopting this approach in the econometric analysis below. First, this approach uses the maximum information on the distribution of the indicator. Second, the indicator can be estimated consistently under quite weak assumptions about the distribution of the error term. Third, the direct estimation of the indicator avoids strong distributional assumptions which would be required for estimating non-linear limited-dependent models as discussed below. Fourth, in very poor societies only very few households may be above the poverty line, making inferences from such data less reliable.

However, there are also a number of disadvantages to this direct approach. First, there can be substantial errors, especially if the survey uses a biased sample selection technique or if the calculation of the estimator variable is flawed. Second, this approach assumes constant parameters across a range of cases. For example, the poor and non-poor are assumed to behave alike. Both of these issues are reviewed in more detail below.

The above specification is often extended for the analysis of household welfare relative to some pre-determined poverty line as follows:[77]

$$s_i = 1 \text{ if } y_i \leq z \qquad (7.2)$$
$$s_i = 0 \text{ otherwise}$$

where s_i is a categorical poverty indicator for household i = 1...N and z is a poverty line, for example as represented by the survival constraint X_{min} in figures 2.2 and 2.3. Conceptually, the poverty line could be set above X_{min}. In the poverty analysis below, an arbitrary poverty line will be chosen which simply divides the sample into two similarly sized groups. The binary specification then is:

$$\text{Prob}(s_i = 1) = F\{z - (\alpha_0 + \alpha_1 \mathbf{L}_i + \alpha_2 \mathbf{F}_i + \alpha_3 \mathbf{K}_i + \alpha_4 \mathbf{V}_i)\} \qquad (7.3)$$

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[76] See also chapter 3 and Behrman and Deolalikar (1988), Datt and Jolliffe (1999), Deaton (1997), Deaton and Grosh (1998), Deaton and Muellbauer (1980), Deaton and Zaidi (1999), Glewwe (1991), Ravallion (1992), Ravallion (1988), and Sahn and Alderman (1997) for a discussion of such specification.

[77] For a further discussion of this approach, see Alderman and Garcia (1994), Bardhan (1984), Datt and Jolliffe (1999), Gaiha (1988), Grootaert (1997: 172-4), and Ravallion (1994, 1996b).

where F is a cumulative probability function. This equation can be estimated by logit or probit, if the error term follows a logistic or normal distribution, respectively (as first discussed for equations 3.1 and 4.2c' above).

An alternative formulation of this second step of the analysis is to calculate:

$$p_{n,i} = \{\max (1 - c_i / z), 0)\}^n \qquad (7.4)$$

where $p_{n,i}$ is the poverty measure for household i = 1...N and n is a non-negative parameter so that the headcount index, the poverty gap index, and the squared poverty gap index can be obtained for n = 0, 1, and 2, respectively. A higher n implies a higher inequality aversion (i.e. a higher aversion to a large distance between actual welfare y_i and the poverty line z). Combining equation 7.1 and 7.4 is useful because in such approach the estimated coefficients for equation 7.1 are independent from the poverty line. However, this approach is not followed below as equations 7.3 and 7.4 do not use full information on the distribution of the household welfare indicator as these values have been converted to a binary variable. On the other hand, not using the full set of information is acceptable if poor households differ structurally from-non poor households, for example if their returns to assets as well as their asset ownership diverge substantially. This issue will be discussed in more detail in the section below.

The calculation of a share of the population below a poverty line is most meaningful for nationally or regionally representative surveys. However, the FSP survey is not strictly speaking representative of a given political area thus calculating the incidence of poverty is not very informative. This analysis is also dependent on the actual definition of what is effectively a subjective poverty line. Nevertheless sensitivity analysis could reveal if the results hold across different lines or are specific to one definition of poverty.

None of these techniques can distinguish between structurally and transiently poor households. Inter-temporal data would be needed to achieve such identification. Finally, non-monetary measures of welfare would provide useful complements to this type of poverty analysis (Ravallion 1996b: 1330-1, Sen 1985), but the available surveys for the period and location of interest do not provide estimates of life expectancy, infant mortality or literacy which could be used to assess other meanings of poverty in the immediate post-war period.

7.4 Expected Determinants of Household Welfare

This section will summarise the expected determinants of post-war household welfare (figure 7.1). These hypotheses will be based on the preceding discussion of the effects of war on rural household welfare and on the proposed specifications of the income and

consumption functions. The main determinants of household welfare given the assumptions of the model and the effects of the war will relate to household characteristics, land, technology and various assets, and community variables. There may also be some endogenous variables affecting household welfare (e.g. area cultivated or cash crop adoption) and these possibilities will be discussed as well.

The effects of household size on household welfare depend in part on the degree of rivalry in consumption among household members (Lanjouw and Ravallion 1995). One extreme case is that all consumption is public so that a marginal increase in consumption benefits all household members. Examples of such consumption could be increased security or the provision of tapped drinking water. The other extreme case is that all consumption is private which implies that only one person can benefit from any one consumption activity. Nutrition is almost completely private, except perhaps for pregnant and breastfeeding mothers and to the extent that one person enjoys another being well fed (parents e.g. may be altruistic towards their children).

In addition, there may be synergies from larger household size, both in production and in consumption. Working in groups can be more productive through improved supervision, pooling of tools and experience, or higher motivation. Food preparation meanwhile can be less wasteful for larger groups. For a given degree of rivalry in production and consumption, returns to scale can thus have an impact on household welfare via household size.

Considering also the additional problems involved in estimating the rivalry and the scale effects of consumption, this analysis cannot attempt to differentiate between the various effects of household composition on household welfare. Instead, these variables will be included both for their role in determining household welfare and to account for differences between households in their composition (cf. Deaton and Zaidi 1999, Glewwe 1991).

Refugee households are more likely to have suffered insecurity, uncertainty and a strong depreciation of all their physical, human and social assets. In particular, refugees may suffer from being considered refugees (a form of "pure discrimination"), for example they may suffer discrimination in the allocation of land, aid and social protection which may be due only to their refugee status. Other variables in this framework already account for the other disadvantages refugees face but "pure discrimination" reduce refugees' welfare, making this coefficient negative and significant. Female-headed households similarly may suffer from lower endowments and from "pure gender bias" thus also suggesting a negative and significant coefficient for female-headed households.

Older heads of households are likely to have more experience and respect in the community, enhancing their households' welfare. The age of the head can be signed in this way as it does not affect the composition and therefore the welfare requirements of the household in the same way as the household mean age and gender composition.

A larger degree of illness in the household will have a negative effect on household welfare, especially via the indirect effect on labour productivity as discussed above. In addition, if a household lives in an area where the collection of drinking water and firewood is substantially more time-intensive than for other households elsewhere, then there will be less household labour (especially female labour) available in the peak harvest season, which may negatively affect income and thus welfare.

Household education is likely to be have a positive effect on household welfare generally. However, the mean level of education in rural Nampula is very low (about 2 years of schooling) and the economic benefits from it quite limited in the immediate post-war period so that this variable is most likely insignificant in this particular context. The only exceptions may be a variable measuring the maximum number of years of education per household which is more likely to have passed a critical level, or the education level of the mother, which generally has a larger positive effect on household food consumption than the education of the (generally male) head. These specifications will therefore be tested below as well.

Land may be linked to household welfare through the quality and characteristics of the cultivated land and through the total area farmed per household. These in turn affect household agricultural production, credit opportunities, and (indirectly) household labour availability and thus welfare. These effects are more likely to be significant for the income variable as land may have a more direct impact on household income than on total household consumption. Food consumption, which to a large degree derives from on-farm food production in northern Mozambique, may also show more significant coefficients for the land variables than total household consumption.

The expected effects of land characteristics on household welfare can be summarised as follows. Higher soil quality will increase, more field pests will decrease, easier land access will increase, a longer distance from the household residence to the plot will decrease, and less rain will decrease household welfare. As discussed in chapters 4 and 5, some of these variables will have been strongly affected by the war (especially land access) so that land characteristics and land use are important transmission mechanisms from war to welfare. The area cultivated is an endogenous household choice and will be analysed and listed separately below, together with the welfare effects of other endogenous household choices.

Households in land abundant but peaceful areas will hold capital (especially livestock) for production purposes and as an insurance substitute (Binswanger and McIntire 1987). The discussion above suggests that war-affected households will have low endowments (again, especially of livestock) and that with lower endowments households will have lower welfare. However, a relatively high capital stock may be insufficient to raise welfare if there are high barriers to entry for some capital-intensive activities or if the markets for capital-intensive products are weak.

In other words, post-war asset ownership may be dependent on having a critical level of assets and on being in locations suitable to asset-intensive production. The general expectation is that more assets raise welfare but that it is important to control for location and household market participation choices as well. The cyclone Nadia in March 1995 primarily affected the stock of cashew trees, thus reducing asset levels especially for cashew farming households and hence lowering their welfare. Household food consumption may be less dependent on asset endowments than household income as subsistence food production is not very capital intensive.

Social capital should help to increase household income and consumption, both through productive effects (e.g. a higher social position in the village may improve land and market access and hence permit an increase in agricultural production) and by providing consumption insurance if household requirements unexpectedly exceed actual income. The relative importance of these two effects may then help to determine the significance of the social capital variables in the income and consumption regressions.

War cannot be directly identified with any of the social capital variables but war will have shaped the magnitude of these variables for each household. For example, war may have induced households to move many years ago. Such a household may not have been a refugee household for many years but it will never have the same local social capital as households whose ancestors are buried locally or who were born locally.

Community level variables are expected to be key determinants especially of household income and consumption. Many households in northern Mozambique succeeded in maintaining minimum consumption levels even during the worst phases of the war so that post-war agricultural output is not very dependent on input and output markets (i.e. post-war food production growth is starting from a position of relative isolation and subsistence). Household food consumption may thus be less dependent on markets than total consumption or income. The village level illness variables capture the absence of effective drinking water and health infrastructure. Their impact on welfare should be negative. Higher crop yields in a village denote a larger agricultural potential and should

help to increase household welfare. The price variable indicators reflect changes in inter-seasonal price differences across households. Post-war households are considered to be risk averse so that a higher variable of food crop, non-food crop and consumer good prices should have negative effects on household welfare. The village indicator variables are included in all regressions and control for unobservable effects. These variables are likely to be significant in several locations.

In addition to the area farmed per household (AREA56), other endogenous household activity choices which may have a welfare effect are the share of income derived from on-farm activities (SHAREONL), the degree of income activity diversification (DIVERS12), the household crop market participation status (STATUS14), the share of household income derived from subsistence activities (SHARESUL), the household cotton adoption status (COTTON89), the degree of household plot (i.e. spatial) diversification (PLOT32), and the degree of household social exchange (REMT4), as discussed in chapters 4 to 6.

Figure 7.1 summarises their expected effects on the household welfare indicators. Given the role of off-farm activities in the post-war period and the low asset endowments of households, it is expected that households engaged in more on-farm activities have a higher welfare (which contrasts with the recent literature on the role of rural off-farm labour in northern Mozambique, cf. Tschirley and Benfica 2000). A large degree of activity diversification would then indicate a household closer to the survival constraint which suggests lower income and consumption. Market participating households, households less engaged in subsistence activities and cotton adopters are expected to be better off. These expectations are broadly consistent with the existing literature of the welfare effects of crop commercialisation in northern Mozambique.[78] Finally, spatially and socially diversified households are expected to be worse off as these activities are likely to represent technical and social insurance mechanisms which are likely to be costly.

In summary, it is expected that the war's effects on post-war welfare operate primarily through indirect channels. In fact, some of the most war-affected variables may not be significant determinants in the regressions, though they would be significant in a peace economy (e.g. educational attainments). It is therefore important to consider also the variables that are found to be insignificant in the regressions below.

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[78] The welfare effects of cotton adoption on Mozambique are estimated and discussed by Isaacman (1996), Jeje, Howard, Strasberg and Boughton (1999), MAP/MSU Research Team (1997), Marule, Benfica, Strasberg, Tschirley and Weber (1999), Pitcher (1996a), Strasberg (1997), and Tschirley and Weber (1994).

As summarised in figure 7.1, it is also expected that the determinants of household income and household food consumption in particular will diverge to some degree. For example, some activity choices may lead to higher output but not necessarily to higher food consumption, given the still weak food markets. Household income may be more dependent on labour and asset endowments and markets while food consumption may also depend on increases in area farmed and social capital.

7.5 Empirical Results and Discussion

This section will first review the results of a bivariate poverty profile, which will provide some indications about the actual determinants of welfare and which contrasts with the multivariate results below. The issue of pooling all observations is addressed next and it will be found that this is a valid approach with the current specification and for the available data. The main regression results are then discussed by group of determining variables (i.e. household, land and asset endowments, social capital, and markets). All figures of empirical results are listed at the end of this chapter.[79]

Poverty Profile

One simple way of analysing the determinants of poverty is to calculate a poverty profile, where household welfare indicators are compared across population groups with different characteristics, for example by gender of the household head. This is an unconditional analysis as no other information is utilised in the analysis. For example female-headed households may be poorer than male-headed households but their poverty may be due to women having less education than men, in which case it is not the "female-headedness" of the household which drives its welfare but the low educational achievement. Nevertheless, a simple poverty profile may help identify some variables worth including in the analysis and it can be useful to compare the conclusions from such an analysis with those from a multi-variate poverty regression, where all other observable factors are controlled for.

Figure 7.2 summarises the mean household expenditure per capita for a variety of indicators, and also shows the share of the sample in each sub-group, the headcount index (i.e. the proportion of households below the poverty line) and the poverty gap index (equation 7.4 above). Note that in figure 7.2 the "poverty" line (X_{min} or z in the

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[79] Three of the appendices also contain a discussion of income versus consumption smoothing, of the inequality of household assets and of household welfare outcomes, and of a sensitivity analysis which checks if the determinants of household welfare differ between poorer and less poor households. These appendices are complementary to the discussion of main results.

terminology used above) is set arbitrarily at the median expenditure per capita in 1995, thus dividing the sample broadly into poor and very (or ultra) poor households. This has been done as the absolute poverty line estimated by IAF would not leave enough observations above the line to conduct any meaningful analysis (1998).[80]

Refugee households are expected to be poorer than non-refugee households but their mean expenditure is actually higher and both poverty indices are lower. Female-headed households appear significantly poorer, as expected, but their weighted share in the sample is very low thus making it harder to make further inferences about the factors affecting female-headed households.

Households affected by the cyclone Nadia in early 1995 actually appear to have higher per capita expenditure (and thus lower poverty indicators) than non-affected households. This may be due in part to the definition of this variable, which relies among other things on the destruction of cashew trees. Moreover, as cashew tree growers have higher welfare than non-growers (see below), this means that cyclone-affected households appear better off than non-affected households.

Interestingly, households which subjectively reported a lack of rain in 1995 have average expenditure almost half of other households, such households are almost twice as likely to be poor, and the poverty gap index for these households is over twice as high as for the other households. In fact, this is likely to represent transitory poverty to the extent that mean expected rainfall in the sample area varies between 922 and 1024 mm per annum and is therefore sufficient for rain-fed agriculture in an average year (chapter 3).

The average soil quality of the cultivated household land (where households subjectively graded each plot) appears to be a determinant of household poverty, with poor soil quality associated with headcount ratio of poverty of 0.67 compared to 0.49 for households with better soil. This is not surprising as most households use similar tools and no fertilisers thus making soil quality a key determinant of labour productivity and hence agricultural output and household welfare. The land tenure status of the household (whether the household was worried about tenure and whether it was easy to obtain land locally) do not have a significant impact on poverty (results not reported).

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[80] The IAF daily per capita poverty line including food and non-food requirements for rural Nampula for 1996 (about one year after the FSP survey) is 3359.16 Meticais (IAF 1998: t. 1.12), which equals 0.29 US$ in 1995 prices. This compares with a weighted daily per capita expenditure excluding durables for 1995 of 0.09 US$ in the FSP sample.

The subjectively reported state of the local infrastructure does not appear to affect poverty incidence or severity within the sample. The location by province does, however, matter as average expenditure per capita in Cabo Delgado is 70% of the Nampulan value, the headcount ratio is over 50% higher, and the poverty gap is more than twice as large in Cabo Delgado.

With all these self-reported quality characteristics an element of bias may be introduced if rainfall, soil quality, or infrastructure are reported as having been poor if the harvest was lower than expected or required, although other reasons may also have been important (such as too little labour input, poor management techniques etc). The FSP questionnaire assumed that farm households generally understand the nature of the problems facing them and can differentiate between different types of problems. This view was supported through my own interview evidence where farmers recognised a variety of farm constraints and could generally differentiate clearly between their varying impact. In addition, the regressions below will include a variety of control variables which will at least partially control for household characteristics which are not included in this poverty profile.

Endogenous household activity choices such as farm size measured by cultivated area (chapter 4) and the cotton adoption and crop market participation status of a household (chapter 6) appear to affect poverty significantly. Households with higher cultivated land per capita have a per capita expenditure of US$ 46.74 while households with less land per capita have an expenditure of only US$ 26.32. Cashew adopters are marginally better off than non-adopters while cotton adopters are much better off on average and have lower poverty incidence and severity. Finally, crop market participants have a much lower headcount ratio than non-participants, which was expected.

The type of income strategies households adopt thus appear to be important determinants of their welfare. However, the endogeneity of this decision requires a more careful analysis, and these figures can only be first indications that household coping strategies and welfare outcome are significantly related.

Pooling or Not Pooling?

Previous studies of northern Mozambique have regularly analysed the determinants of welfare by location, typically disaggregating the analysis to the provincial or district level, of

which there are two and three, respectively, in the FSP sample.[81] However, this involves a loss of efficiency for regression analysis as the sample size is restricted in each case. It would thus be preferable to pool the observations from all provinces, if a Chow test of pooling did not reject pooling (chapter 3).

One complication arises in the calculation of the Chow test statistics using Stata 6. The survey commands (which control for survey design including the choice of strata and clusters across provinces and districts) do not provide the data needed to calculate the test statistics. Using the uncorrected values to conduct the Chow tests, the null hypothesis of pooling cannot be rejected for either income or food consumption. Note that the ratios of the error variances of the sub-samples suggest that the null hypothesis of the equality of the error variances cannot be rejected, either, which is necessary for the Chow test to be valid.

The Chow test casts doubt on the appropriateness of pooling for the regression of consumption (EXP36PCL). However, several reasons suggest to maintain the current, pooled specification for EXP36PCL. First, the Chow test did not account for the survey design and weights, thus biasing the test results towards the rejection of pooling (e.g. the fit of the weighted regression is much better than of the unweighted regressions). Second, the large number of control variables for locational effects suggest that the inter-provincial differences are already captured to a large degree. Third, pooling was not rejected for INCOME04, EXP12PCL or for any of the categorical variables whose effects on poverty were reviewed in the poverty profile section above thus casting doubt on the need to find different specifications for EXP36PCL. Fourth, the underlying climatic, geographic, social, and economic characteristics of the sample locations are quite similar so that it appears valid to consider a uniform process to determine welfare in these areas.

The Determinants of Household Welfare

Summary Statistics

The three dependent variables INCOME04, EXP36PCL and EXP12PCL and the residuals of their respective regressions are nearly normally distributed (figure 7.3). The fit and the significance of all three indicators of household welfare is very good, with R^2 values of above 0.72 for the INCOME04 and EXP12PCL regressions and of 0.62 for the EXP36PCL regression. A smaller number of significant coefficients explains the lower R^2 for the latter regression (figures 7.1 and 7.6). All three regressions are significant at the 1%

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[81] Studies using spatially disaggregated welfare data in northern Mozambique include MAP/MSU Research

level at least. Note that the INCOME04 regression uses only 349 observations as REMT4 is included in that specification and as that variable is only defined for 349 households. The estimated coefficients do not appear to be sensitive to the inclusion of the remaining 22 observations (regression output not shown).

A variance inflation factor (VIF) analysis carried out using the "vif" command in Stata 6 (chapter 3) had suggested to drop the ILLDAYS4 variable (measuring health at the village level and thus the availability of local health infrastructure) from the household income equation as it is highly correlated with other village-level variables. All other variables in the regressions do not appear to have problems with high inter-variable correlation coefficients (other than for the squared terms) or with high VIF coefficients. The mean VIF coefficients per regression were also quite low, indicating that the regressions do not suffer from multicollinearity.

Key Regression Results

The determinants of income and expenditure are similar in some regards, as summarised in figure 7.1. Key similarities across all three regressions are the expected negative effects of female-headedness, the expected positive effects of end-of-war assets, area cultivated, crop market participation, and the unexpected negative effects of cotton adoption on all indicators of household welfare. In addition, all regressions find that refugee status and maternal education have no effects on household welfare.

The largest differences between the regressions are that income is more dependent on assets and village-level variables while food consumption is also affected by land characteristics and social institutions. Some determinants of consumption and food consumption are similar, in part because food consumption is such a large share of total consumption.

These findings suggest that the war legacy has negative long-term welfare effects through widowhood and asset destruction, and through its effects on household labour and markets. The large positive coefficients for area farmed indicate that households have a significant war-induced labour surplus which can be applied profitably to extending the extensive margin of the post-war farm, rather than by intensifying production as cotton adoption does not reduce poverty or raise food security. These first findings also suggest that policy in the immediate post-war period should target female-headed households,

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Team (1997), Marule et al (1998), Rose et al (1999), Strasberg (1997), and Tschirley and Weber (1994).

provide significant asset assistance, and re-establish all forms of rural markets rather than target aid at refugee households (as defined by the FSP) or provide inputs to intensify production. These findings also suggest that at very low levels of educational attainment, increasing maternal or female education in the immediate post-war period is at best a long-term poverty reduction strategy.

The following sub-sections will analyse these findings in more detail and discuss the regression results of figures 7.4, 7.5, and 7.6 by group of independent variables.

Household Composition

Given the above discussion of household equivalence scales and weights, the current discussion will not consider in detail the magnitude of the coefficients on household size, mean household age, dependency ratio, and gender composition. Nevertheless all regressions show that larger, older, more dependent, and more female households have lower welfare, which broadly corresponds with expectations (figure 7.1).

The age of the household head (AGEHEAD3, AGEHEAD4) was expected to have a positive effect on household welfare. The regressions show that this is significant for consumption and food consumption. In fact, the effect is exponentially stronger for very old heads for food consumption, thus emphasising the important role of age effects in determining food security in rural northern Mozambique. It appears that the age of the head has an important influence on a household's ability to negotiate the control and distribution of resources for all its members with the rest of the community.[82]

Older household heads on the one hand have more experience but they also have diminishing health and strength. This evidence suggests that war in rural Mozambique induced social coping mechanisms which attached great weight on the age and thus the experience of the head of household. Therefore rural Mozambique just after the war experienced some social organisation (e.g. concerning household formation and the control of resources) similar to those described by Meillassoux (chapter 2 and 1981).

From a policy perspective, this suggests that in the post-war period households with older heads are more food secure than household with younger heads. In fact, a less war-affected but also less socially cohesive and more market dependent society may attach more weight

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[82] In contrast with this finding, another recent household survey from rural Mozambique did not find an effect of the age of the head on household welfare (IAF 1998: 163). This may be due to the fact that the effect observed here is non-linear, suggesting that the mere inclusion of a linear age term may result in the hypothesis of age having an effect being rejected falsely.

to household's health and human capital which may imply that older household heads are at a relative disadvantage in a more market based economy. Households with older heads may thus suffer from reduce food security if older heads have a reduced ability to participate in a more market based economy (due to dated skills and frailty). It could be expected that with increasing market reconstruction and social change households with older heads loose their relative food security.

Unlike expected a priori and unlike suggested by the poverty profile, refugee status (REFUGEE1) has no significant effect on household welfare. These findings concur with a later household survey for Mozambique which only found a significant negative effect of refugee status on household expenditure per capita in the centre of the country (IAF 1998: 164).

This is likely to be the result of the definition of a refugee household in northern Mozambique generally. A "refugee" household was generally one which fled either abroad or to a larger, government-held town. It is even conceivable that households displaced to larger towns may have established valuable social networks while living in urban areas for many years. These households may thus obtain better welfare outcomes than more isolated, non-"refugee" households far removed from urban areas.

However, the majority of war-affected households were internally displaced and did not live in recognised safer urban areas but elsewhere in insecure rural areas. In fact, many households were occasionally and locally displaced but did not migrate away from their usual residence for long periods of time (chapter 3). Some refugee households in urban areas were officially recognised as such by the government and qualified for assistance, thus perhaps making them better qualified for a return to agricultural activities.

In addition, the refugee variable may involve a small degree of long-term sample selection bias, in that only those households likely to benefit from returning to their village in the post-war period were likely to do so. In fact, many households stayed in the urban areas after the war, dramatically altering the rural-urban balance in Mozambique. In addition, there was no enforced repatriation to rural areas, especially for domestically displaced civilian households (some demobilised soldiers and international refugees were brought back to their place of origin after the war).

Overall, it can be expected that a majority of the sample households were refugees in some sense of the word during the war, even if they were not officially recognised or identified themselves as such. The use of this variable for the purpose of identifying poorer households (and thus in government welfare targeting) is therefore not very helpful but no

further variables are available to identify the war-induced displacement experience of sample households.

The female-headed variable FEMHEAD1 is one of the few variables which consistently and significantly predict a change in household welfare across all available indicators. In fact, female-headed households have, on average, 33% less income, 43% less expenditure, and 51% less food expenditure per capita compared to male-headed households.[83] This is in accordance with the hypothesis of a "pure gender bias" as other household endowments and the household gender composition have already been accounted for.

This is also a much stronger effect than that reported by IAF, which finds that female heads have household consumption per capita which is only 13% lower (1998: 163). This may be due to the closer proximity in time to the war of the sample analysed here and due to the small number of female-headed households included in the current sample (1% versus 11% in IAF). In fact, some households in northern Mozambique have absentee husbands earning remittances. In the FSP sample the definition of female-headed households excludes such cases thus deriving much larger coefficients.

Based on the interview evidence, it seems plausible that there is a core group of severely impoverished female-headed households in northern Mozambique who also lack alternative income or consumption generating opportunities. It also seems likely that this core group will be larger after a war than during peaceful years. By defining female-headedness broadly, the gender-discrimination effect is reduced as some so called female-headed households may in fact really be sub-households headed by the wife of an absent husband or by the second wife. In such cases, these (sub-) households have broader income generating options and the poverty associated with such female-headedness will be much lower, if not insignificant.

The various education variables were not expected to determine household welfare significantly, mainly because the past provision of education had been very low due to the war. However, all welfare indicators are positively affected by paternal education, though household income is only affected by education in areas with better infrastructure.

The IAF survey also found that education did not have as strong an effect on household welfare as had been anticipated (1998). When the current FSP model is re-estimated using

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[83] Recall that if the dependent variable Y is measured in natural log form, if the independent variable X takes a binary format and if β is the coefficient of X, then a change in X induces a change with the magnitude $e^{\beta}-1$ in Y (chapter 3).

the IAF education specification, a nearly identical and significant linear coefficient for the highest educational achievement of the household (in years of effective education) can be obtained, suggesting that the underlying educational effects observed in both surveys are very similar. In fact, this analysis suggests that the return to an additional year of effective education for the best educated household member is 5.1% for income, 2.4% for consumption, and 4.9% for food consumption (all per capita).

These values suggest that education has positive but limited benefits in rural post-war areas. In fact, with the devastating effect of war on the education system (chapter 3), the mean values for EDINFRA5 and EDUMAX3 are only 1.0 and 3.6 years of education, respectively. This makes predictions about the likely benefit of significantly expanding education under these circumstances very imprecise and thus cautions against emphasising large education programmes as a suitable poverty alleviation strategy in the immediate post-war period.

In addition, infrastructure is complementary to paternal education in raising household income, suggesting that raising education in strongly war-affected, isolated areas will not reduce income poverty directly. Expressed differently, human capital accumulation in the post-war period requires both a demand for slightly more skilled labour (which in turn requires well functioning labour and complementary markets) and a higher valuation of the future (including future returns to education) by households.

These findings support a cautious interpretation of the benefit of education in poor rural areas. Glewwe for example finds that education is "relatively unimportant" in rural areas generally though he hypothesises that it matters more for cash crop growers, which is akin to the role of infrastructure discussed above (1991: 325). Other authors are more positive about the effects of education for reducing the risk of poverty (Gaiha 1988: 240-1, Grootaert 1997: 185). However, their study areas were not war affected so that the more limited effects of education in northern Mozambique appears to derive from the parallel destruction of the demand for relatively skilled labour and through the destruction of market activity. An additional conclusion corresponding with the broader education literature is that paternal and maternal education have different effects on household welfare, even in the post-war period (Sahn and Alderman 1997, Svedberg 1990).

Finally, the number of days spent ill per household (ILLDAYS2) have a surprising negative effect on household consumption which may be related to the need for households to increase consumption to treat illness. The time constraint variable (TIME02) has the expected negative effect on household income and food consumption.

Land Characteristics

It was expected that exogenous land characteristics affect household income and food consumption in particular (figure 7.1).[84] The poverty profiles pointed to poor soil quality and a lack of rain as determinants of household poverty (figure 7.2). However, the regression analysis indicates that household income and household consumption are not affected by any land characteristics while household food consumption declines with lower soil quality (AREAFER6) and with a lack of rain (RAIN4).

The evidence thus suggests that exogenous environmental constraints may amplify food consumption shortfalls and that a lack of rain is indeed one of the largest sources of risk for agricultural households. In fact, rainfall appears to correlate strongly across households within one village but the correlation across villages seems much weaker as shown in figure 3.22. The small spread of values within each location indicates that neighbouring households experience similar shortfalls of rainfall. It also suggests that a reported lack of rainfall is not an ill-informed excuse for poor output caused by other factors, and that this variable is hence exogenous to short-term household behaviour.

Given this degree of local covariance of rainfall, the predominance of agricultural activities in total household income, and the transaction costs of intensifying remittance and other social income with distant relatives, households facing low rainfall may thus find it extremely difficult to compensate for their income shortfall and therefore voluntarily reduce food consumption more strongly than income. It is thus not the war effect on land characteristics which are important for household welfare but the war-induced and reduced ability of the household to insure against such environmental risks which represents a cost of war to rural households.

Technology and Physical Assets

The war reduced asset endowments for direct and indirect reasons (chapter 2, figure 7.1 and appendix A.5). Households with higher surviving asset endowments can expect to have higher household welfare, though the asset effect on food consumption may be more limited. Two variables show this expected effect on welfare. The number of tools per capita per household (TOOL11) has a positive effect on income while more end-of-war assets (VASSET5 and ASSET13) has a positive effect on all welfare indicators. As

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[84] The effects of cultivated area, which is an endogenous variable, will be discussed in more detail in a separate section below. Note that TENURE1 and INVEST01 are dependent variables in chapters 4 and 5 but they are neither endogenous nor significant determinants of household welfare.

expected, the asset effect is stronger for income than for consumption than for food consumption.[85]

Interestingly, owning some livestock has no significant effect on welfare though livestock can be an important store of wealth in developing countries (Dercon 1996b, Fafchamps et al 1998). The insignificance of this effect in northern Mozambique derives from the absence of a large breeding stock, of regular cattle markets, of veterinary services which could support livestock, of financial markets which may require livestock as collateral, and from the low level of cattle ownership. These factors in turn make a prediction of the possible effects of livestock-rearing difficult using this sample.

Having a large asset endowment at the end of the war may indicate households which avoided the worst direct impact of the war. In addition, such households are likely to have maintained other asset stocks, abilities, contacts etc. This may indicate that helping war-affected households to restock assets in the post-war period may be an effective component of a poverty alleviation and rural growth programme, especially if such assistance is linked with rebuilding market activities and lowering general transaction costs.

Among the other asset variables, the number of types of tools (TOOL2) was expected to proxy for the available household technology, given that households in interviews often emphasised the constraining nature of their narrow range and low quality stock of tools. However, this variable was not significant in any regression, suggesting that perhaps the quality and productivity of tools, which was not measured directly in the FSP survey, was more important than the actual number of types of tools owned. The qualitative interview evidence supports the conclusion that the distribution of high quality tools in the immediate post-war period can help households utilise their war-induced labour surplus in the production of subsistence and perhaps cash crops.

Aid agencies in northern Mozambique repeatedly raised the concern that the limited, free distribution of tools and assets just after the war created disincentives for farmers and for the tool marketing system. However, given the regression and the interview evidence (including discussions with rural traders), the persistence of a tool shortage in northern Mozambique in 1999 (six to seven years after the war and the tool distribution programmes ended) is not caused primarily by disincentive programmes. The welfare loss resulting from the low asset endowments is however significant. The benefits of the distribution of high-

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[85] Re-specifying the INCOME04 regression with the ASSET13 variable yields a coefficient of 0.45, which is highly significant.

quality, hand-held tools and other assets thus appear to outweigh the possible dis-incentive costs of such programme.

This conclusion on agricultural production aid is akin to the one for food aid in Mozambique, which was found to stimulate the growth of a small scale milling industry and maize marketing system (Tschirley et al 1996). It appears as if, with the preceding destruction of assets and markets, the stimulating effect of aid on rural supply mechanisms outweighs the negative effects of aid on incentives and prices. This argument has also been extended to the macro-economic level for Mozambique where it was found that macro-economic aid induced a supply response which outweighed the Dutch disease effects of aid (Brück et al 2000).

Finally, the cyclone dummy CYCLONE2 was significant only for household income, where it had a positive effect. This may initially seem surprising but, as explained in the poverty profile section above, this may be due to the cyclone variable capturing the destruction of cashew trees, which in turn indicate higher household wealth.

Social Capital

Social capital was expected to have positive effects on income and consumption (figure 7.1) as it can help increase production (e.g. by providing land access, extension advice or contacts with crop traders) and consumption (e.g. by facilitating informal social exchange). War is expected to have strong negative effects on social capital, especially through displacement and its effects on local political leaders. Renamo rebels were especially likely to attack Frelimo officials in rural areas, thus making these households very war vulnerable. On the other hand, these political connections may help these households to recover more quickly from the war.

The strongest social capital households can possess is the political position of the household head (AUTH12). AUTH12 measures a long-term effect of social capital as household heads typically maintain their traditional or political influence over many years or even for life, unless the war forced a locally unpopular authority to move location or to step down from his position. In either case, the variable is clearly exogenous at the time of the survey. AUTH12 has a positive coefficient for all indicators and is highly significant for income per capita and food consumption per capita. The latter are higher for households with a political leader as its head by about 38%.

These strong positive effects are likely to result from much reduced transaction costs for these heads as they are well integrated in information flows and decision making. Being a political leader also provides social insurance. The position itself does not require heads

necessarily to possess more assets or be richer but they can claim resources and receive donations from associated leaders and their subjects. In several interviews with various such leaders in Nampula province, it became apparent that these households may not own many more resources but they can draw on the resources of their communities at any time, thus lowering uncertainty.

It is not clear, however, if social capital acts as a substitute for markets in the aftermath of war or if perhaps social capital can further augment the benefits households can derive from market activity. That is, social capital could be a substitute for market activity or a complement for market activity. Households in a privileged political position may already have easier access to markets, being well integrated into information channels, having frequent contacts with other officials and traders, perhaps being able to enforce contracts more easily as well as being able to make more credible commitments to contracts. Therefore, this type of social capital appears to complement, if not enhance, market activities of these households.

The local origin of the two most senior members of the household was expected to have a positive effect on household welfare. However, the two variables coding for the female and male local origins (ORIGINF1 and ORIGINM1, respectively) are insignificant for the income and consumption regressions and have significant negative coefficients in the food consumption regression. Households where both the wife and the husband are from the local area have food consumption per capita which is about 30% less than households where both partners are from other villages.

This indicates the role of inter-village social insurance which is encouraged by the matrilineal Macua culture which covers the entire FSP sample area and much of northern Mozambique (chapter 3). Young couples are encouraged to move to the wife's village some years after the wedding and social obligations between the wife and her relatives are stronger than between the husband and his (male) relatives, thus creating important linkages across villages of different agronomic and climatic risk characteristics. These social patterns help maintain food entitlements especially for households which have experienced some mobility in northern Mozambique.

This also explains how the displacement experience of Macua households in northern Mozambique appeared to have had relatively small welfare effects, as households already had some strong social networks capable of absorbing some degree of mobility and locally covariant risks. The nature of the conflict with its random, local attacks allowed households to cope with the war's negative effects more easily than if the conflict had been a more

technology-intensive and systematic with clear frontlines preventing movement and exchange of goods and labour.

Village-Level Variables and Controls

The village-level variables were expected to have a strong impact on household welfare (figure 7.1), especially on income and consumption through the ability of households to sell produce and purchase non-food items in the market. As discussed above, the variable ILLDAYS4 is highly correlated with other village level variables and has thus been dropped from the specifications. In addition, the infrastructure variable INFRA4 had to be omitted from this category of regressors as it was interacted with some education variables.

The analysis indicates that most market indicators have no effect on household welfare, except that more crop sales per village in 1993-94 (MARKET7) reduce food consumption. The elasticity is -0.18 which seems quite a strong effect and counterintuitive. Perhaps households know that markets are unstable and unpredictable and so choose to sell more food crops and thus forego some of the food consumption instead. Alternatively, households respond to larger crop market activity at the village level in the previous year by planting more cash crops thus reducing their food consumption in the current year. The reason for the sign of this coefficient is therefore not entirely clear.

The log of the cotton yield at the village level in kg/ha (YIELDL8) is significant with a strong positive coefficient in the income regression only. This variable captures some of the underlying differences in natural resource endowments across villages which are common to all households in each location. This allows the regression results to be more comparable across villages and households.

In addition, the variable suggests that improvements in the yield of the main cash crop has important effects on household income but not on household food security.[86] This suggests that the link between cash crop adoption, cash crop yields and household food security may not be very strong. It is possible that such links are particularly weak in the post-war period where yields are very low and there is still some slack labour and high aversion to output uncertainty. Households might thus satisfy their food security requirements before increasing their monetary income surplus, making household food consumption less sensitive to cotton yields.

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[86] Re-estimating the INCOME04 regression with the maize yield variable instead of the cotton yield variable leads to a similar elasticity of yield to income. The strong collinearity of these two variables and their similar

Finally, some price variance variables (PRICEV1 to PRICEV3) and a set of categorical variables which code one for each of the sample villages (ALD111 to ALD332) are included in all three regressions to make the results more comparable across households and to indicate the importance of unobservable village-level effects. PRICEV3 is the only significant price variance variable in any regression and it has a negative effect on household income. Its coefficient indicates that a 4% rise in the variability of inter-seasonal food crop prices reduces income per capita by 1%. This represents a significant welfare loss from the war-affected trading infrastructure which accentuates the variability of crop prices (except for cotton which has a government-set price). The post-war period has generally seen an improved integration of agricultural prices across space at the national and international levels (Jayne and Jones 1997, Tschirley and Santos 1999). However, this does not imply that all localities face uniform prices and that households can cope with output price fluctuations equally.

Some village indicators were omitted from the analysis to avoid multicollinearity and the remaining indicators are jointly significant. Other studies have also found community-level variables to have significant effects on household welfare outcomes, therefore emphasising the need to capture further market and institutional effects on household welfare in future post-war household surveys.[87]

Endogenous Land Choices

As discussed in chapter 4, households in land abundant areas such as northern Mozambique have some control over the size of their cultivated land. In addition, it is expected that this choice of area will have strong effects on household welfare. This section will explore the effects of endogenous area choices on household welfare. It will be found that cultivated land is a significant and large determinant of household welfare, which is in contradiction to other recent findings from Mozambique. Some causes and consequences of this important finding will be discussed.[88]

An augmented regression or Durbin-Wu-Hausman (DWH) test can indicate if a set of OLS estimates is consistent or not (chapter 3, Cong 1999, Davidson and MacKinnon 1993). The DWH test statistic for AREA56 is significant at 1% for the income regression but the

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effects on income thus indicate that the determinants of agricultural productivity are similar across food and cash crops, which is not surprising given the low use of purchased inputs in agricultural production.

[87] See for example Alderman and Garcia (1994), Behrman and Deolalikar (1988, 1989), Singh, Squire and Strauss (1986a), and Thomas and Strauss (1992).

DWH tests do not reject the null hypotheses of exogeneity of AREA56 for the consumption regressions. AREA56 is therefore included in the consumption regressions directly. These results are summarised in figure 7.7. The figure also shows the fit of the first stage regression of AREA56 which is very good with an R^2 value of 0.69 and it shows that the first round instruments are jointly significant below 1%, which is a further test of significance of the instruments (Deaton 1997: 116).

The variable AREA56 is highly significant in all three regressions and its coefficients range from 0.14 in the consumption regression to 0.66 in the income regression. As both welfare and land are measured in natural logs, these values can be interpreted as elasticities. A 10% increase in cultivated land thus leads to an increase of almost 7% in household income per capita. This result is not sensitive to the definition of the area variable on a per household basis as a similarly positive and significant coefficient obtains when using an area per capita specification (data not shown).

This strong coefficient suggests that post-war rural households have a large supply of surplus labour they can employ profitably by extending the area farmed. The extension of the agricultural production margin is thus a key poverty alleviation strategy for a post-war, rural economy with initial land abundance. The advantage of this strategy is that with abundant land households have a degree of choice about their future income growth.

This responsiveness of household income to area farmed appears to depend on three factors. First, the relative land abundance of northern Mozambique (chapter 3) actually makes farm size a decision variable and reduces the cost of extending the area farmed (chapter 4). Not all African countries (or indeed southern Mozambique) face similar land abundance or have land of such high quality. The land abundance is partly due to the war which reduced population density in rural areas and encouraged strong rural-urban migration. With some refugees choosing to stay in urban areas after the war due to the newly found social and economic opportunities there, the rural population density, which historically had been low in northern Mozambique, remained low even after the end of the war.

Second, this geographic isolation is reinforced by strong economic isolation, which means that the population density is reinforced by a war-induced, very low market density in many districts of northern Mozambique. Only those districts served by key long-distance

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[88] Note that TENURE1 and INVEST01 are dependent variables in chapter 5 but they are neither endogenous nor significant determinants of household welfare (data not shown).

transport routes experienced a significant reduction in transaction costs three years after the ceasefire (i.e. at the time of the FSP survey). While the threat of insecurity diminished significantly with the end of the war, the poor state of rural transaction infrastructure meant that the war damage has had a prolonged effect on transaction costs.

Third, the long, destructive nature of the war resulted in households producing below capacity, given their nominal labour endowments, in the immediate post-war period. Most post-war households had very low asset endowments and thus reduced the scale of farm production (chapters 2 and 6). Post-war households also had low effective labour endowments which did not necessarily translate into lower consumption requirements as much labour was used ineffectively during the war on sentry duty, in queuing for aid, in being ill or nursing the ill. In addition, post-war households face high transaction costs and low market opportunities which reduce the incentive to produce a marketable surplus. All these factors combine to keep the scale of war and post-war farm operations smaller than in peace-time, thus creating a slack in war-affected labour supply and farm production.

This is a very different effect of war on production than, for example, was observed in Europe during World War II when production was reaching full capacity and war-time economic policies were concerned with managing potentially large household income (Keynes 1978). The observed agricultural production slack in Mozambique, however, implies that households face incentives to increase farm sizes over the course of the post-war period, as endowments are rebuilt, consumption-labour ratios adjusted, and transaction costs reduced.

However, extending the area cultivated is not only the product of a household decision but may be constrained by asset, market and social constraints (chapter 4). In a perfectly competitive peace-time economy, the allocation of land may not affect household welfare if each household rents-in (-out) the labour (not) needed for household production, in accordance with household comparative advantage and market prices.

Such an assumption of the flexibility of labour markets has been reflected in previous empirical studies of rural household welfare in Mozambique. In fact, it may be that this assumption has driven the subsequent finding that land is not a key determinant of household welfare in rural Mozambique. IAF for example estimates a consumption elasticity of area farmed of 0.05 for northern Mozambique for 1996-97 (1998: 165).

However, IAF is not an agricultural household survey, thus paying less attention to the measurement of, for example, land area and not differentiating clearly between farmed area and total household land. Furthermore, the IAF study did not control for the endogeneity of area which is likely to lead to inconsistency and smaller estimated coefficients. While this

study found the smallest welfare effect of land in the consumption regression, the estimated elasticity using the FSP dataset is still almost three times larger than the IAF elasticity.

Marule uses the same data as this study and finds a positive and significant effect of land owned on household income (1998: 40). However, by not controlling for the endogeneity of the area farmed, he derives coefficients which are about half of those presented here. Marule's results can be replicated with the current data when omitting survey design effects, the more detailed regression specification, and the IV technique used for this analysis. This suggests that by not controlling for the endogeneity of land, the resulting inconsistency of the regression biases the coefficients downwards and thus biases the conclusions derived from the analysis.

In another study, Benfica analyses household survey data from northern and central Mozambique and finds a positive and significant effect of cultivated land on household income in a regression not controlling for endogeneity (1998: 135). His estimated coefficient for land is similar to that of Marule. The much higher coefficients presented in this study suggest that land quantity, rather than land productivity, plays an even more important role in household welfare in northern Mozambique than previously argued, especially given the war's effects on land, assets, human capital and markets. Nevertheless, it is expected that as the effects of the war subside slowly, as markets are rebuilt in Mozambique and as the population density in rural areas increases, the effects noted here will diminish in importance and the experience of peaceful and more developed African countries will become increasingly pertinent to Mozambique.

Overall, the IAF values and even some previous estimates of the land-welfare relationship using FSP data are implausible given that land is the key production input in post-war Mozambican agriculture. The rate of return of land estimated by IAF suggests a much smaller role for land than it really played throughout the conflict and since its end. In part, the previous results are the consequence of employing inappropriate techniques. In part, they may derive from underestimating the negative effects of the war in rural areas and how the end of the war can and did release some surplus resources into the rural economy. These extra resources were mainly in the form of extra labour which then found employment in farming extra land. This relative shortage of labour compared to land also demonstrates empirically how the modified analysis of the Binswanger and McIntyre (BM) model is appropriate for the post-war Mozambican case.

Endogenous Activity Choices

Chapter 6 discussed a range of activity choices and their determinants. This section addresses the welfare effects of these activity choices, which are also summarised in figure 7.1. It will be found that activity choices have strong welfare implications, emphasising the trade-off between the risk characteristics and returns of post-war activities.

Most welfare effects correspond to expectations but cotton has strong negative effects on income, consumption and food consumption, which contradicts previous findings for northern Mozambique and casts doubt on some recent policy advice based on such findings. In addition, some spatial and social diversification activities have surprisingly positive welfare effects, which indicates that war-affected households have found some non-market ways of coping with the negative effects of war.

Figures 7.4, 7.5 and 7.6 show the second stage coefficients for the activity variables and figure 7.7 lists some additional auxiliary parameters. The DWH test results indicate that several activity choices have indeed endogenous welfare effects, though the endogeneity depends on the welfare measure. For household income, the degree of income diversification (DIVERS12) and the cotton adoption status (COTTON89) are endogenous. For household consumption, the share of on-farm income in total income (SHAREONL) and the crop market participation status (STATUS14) are endogenous. For household food consumption, only the share of on-farm income in total income (SHAREONL) is endogenous. The larger number of endogenous indicators for household income is intuitively convincing, as the activity indicators themselves are measures related to income.

Figure 7.7 also shows that the endogenous activity indicators could be well instrumented with first round R^2 values of above 0.53 and with the instruments being jointly significant at 1% or better. The three regressions also contain activity indicators which were found not to be endogenously determined, such as STATUS14, SHARESUL, PLOT32 and REMT4 in the income regression, COTTON89 in the consumption regression, and DIVERS12, STATUS14, COTTON89 and PLOT32 in the food consumption regression.

The significant coefficients indicate a number of interesting effects about the welfare implications of post-war, agricultural activity choices. The discussion of these effects is organised into five themes covering the share of on-farm income, the degree of income diversification, subsistence versus market-based activities, cotton adoption, and non-market (i.e. spatial and social) diversification indices.

First, a higher share of on-farm activities (SHAREONL) raises consumption and food consumption but does not affect household income.[89] Household food security may be better protected by on-farm (i.e. agricultural) activities, rather than households having to depend on weak markets twice - first to earn extra income and then to convert the income into consumable resources. This welfare effect on on-farm activities may of course change with increasingly reliable markets both for labour and for consumer goods and food. In the immediate post-war period, the coefficients may have been larger still, indicating that war-affected households best protect their food security through on-farm work.

For Mozambique, it has been argued that rural food security and poverty alleviation depend on increasing off-farm income diversification.[90] Such view may in part be influenced by the empirical evidence from other Sub-Saharan areas. For example, a study of the determinants and effects of farm income diversification in Burkina Faso finds that on-farm income strongly reduced household income (Reardon et al 1992). This effect in Burkina Faso is related to the better functioning markets and the different nature of the risks encountered by households in the study area, which in turn helps to explain the observed insignificance of on-farm income share for income in northern Mozambique.

Second, the degree of income diversification across different activities (DIVERS12) has a negative effect on income and food consumption, which was expected. This is further evidence of households diversifying their portfolios of activities despite the cost associated with such diversification. In other words, there are large benefits of income specialisation to be gained in rural northern Mozambique. This then also helps to explain the very low yields obtained in post-war Mozambican agriculture, which are in part not due to exogenous input constraints but due to endogenous household choices.[91]

Third, engaging in more subsistence activities (SHARESUL) has a negative effect on household income but not on household consumption or food consumption. Furthermore, being a household participating in at least one crop output market (STATUS14) has positive effects for income, food consumption and especially for consumption. The joint analysis of the degree of on-farm and subsistence income and of the binary decision to

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[89] Note that SHAREONL, DIVERS12, SHARESUL, PLOT32 and REMT4 are all expressed in natural logs so that their coefficients can be interpreted as elasticities.

[90] Recent contributions to this debate include Cramer and Pontara (1998, 1999), O'Laughlin (1996), Pitcher (1999), and Tschirley and Benfica (2000).

[91] For example, the mean monocropped maize yield in the FSP sample is only 319 kg/ha in 1995 compared to a Southern and Eastern African mean maize yield of 1500 kg/ha and a developing country mean maize yield of 2700 kg/ha in 1995-97 (Heisey and Edmeades 1999: 44, 62).

participate in crop markets thus indicates that households forego some income but no loss in consumption by engaging in more subsistence activities. At the same time, households which can participate in some markets strongly benefit from doing so.

Households are thus best off by engaging in a large share of on-farm activities that can contain a significant proportion of subsistence activities and that help to protect household food security. The negative income effect of subsistence activities can then be compensated with a limited involvement in crop markets which give a one-off boost to household welfare. Stated differently, a household emerging from complete, war-induced subsistence production would benefit most from participating in some food crop markets but keeping a large share of on-farm activities. Reducing subsistence activities at the expense of on-farm activities is not worthwhile as it is the fixed benefit of the initial market participation which yields a strong welfare benefit, not the complete dependence on market income.

Fourth and perhaps most surprisingly, the adoption of cotton (COTTON89) significantly reduces household welfare. Households growing some cotton have 27% less income, 14% less consumption and 10% less food consumption per capita than comparable households not growing cotton. These values thus clearly reject the hypothesis that cotton enhances income and perhaps food security for post-war households in northern Mozambique.

This result derives from the fact that this analysis controls also for other activity shares and other market participation decisions, thus isolating the pure cotton effect in welfare, which is negative. The positive effect of cotton adoption observed in the poverty profile above (and in some of the literature on Mozambique's cotton sector) may thus derive from the positive effects of on-farm income activities, of income specialisation, and of crop market participation as discussed above. In a sense, the positive effect of cotton adoption on household income is not doubted by these results. Instead, they question strongly if cotton adoption is an activity which has on balance positive returns, considering that households have alternative income sources.

The net negative effect of cotton adoption for household welfare may be related to households still being unable to insure well against risks as a result of the war. As cotton is a very risky crop, households may thus make complementary income choices which lower household welfare to insure through activity choices against a possible failure of the cotton harvest or the setting of a low cotton price in line with world prices.

In addition, cotton adoption may induce an overall unfavourable intra-household allocation of resources (Dasgupta 1993: 525). It is conceivable that the institutional structures of the cotton companies displace other income activities which may have been equally or better suited to the highly vulnerable welfare and production circumstances of most rural

households. For example, cotton land may have displaced maize land without the household finding appropriate new activities to employ the labour which previously worked on the maize land.

The seasonal balance of labour requirements may also have been unbalanced by cotton production, preventing households from applying their labour to traditional crops if cotton required their labour at key certain moments in the agricultural calendar. Overall, it is difficult to judge from the survey data why cotton adoption has such strong negative welfare effects. However, the key implication is the doubt it casts on previous findings using this dataset which had expressed a cautious optimism as to the welfare effect of cotton adoption.[92] On a methodological level, this finding also cautions against the use of bivariate poverty profiles as a basis for policy recommendations for rural post-war poverty alleviation.

The results presented here also correspond to a study of cash crop farmers in Côte d'Ivoire where cash crop adopters also had a lower poverty incidence in the poverty profile and a higher incidence of poverty in the regression analysis (Grootaert 1997: 189). More generally, the results support the view expressed by von Braun and Pandya-Lorch who note that the welfare and food security effects of cash crop adoption are very location-specific (von Braun and Pandya-Lorch 1991: 44).

Fifth, non-market diversification indices measuring the degree of spatial diversification (PLOT32) and social exchange (REMT4) were expected to have a negative effect on household income but in fact they have a positive or no significant effects. PLOT32 has a positive effect on income and on food consumption which suggests that households adjust their crop choices to the variety of plot opportunities and thus maximise household welfare. This contrasts with the cost of income diversification noted above. This again emphasises how rural households have an advantage in specialising in agricultural activities, though they may apply their agricultural activities across several locations. This strategy can therefore simultaneously reduce risks and improve household welfare.

The degree of social exchange (REMT4) has a small positive effect only on household income but no significant effect on either household expenditure variable. This indicates that households will engage in more social activities as their income increases but that social exchange is not directly, causally related to maintaining total consumption or food

consumption entitlements. It appears that in an economy where absolute poverty is the norm and where covariant risks are still large, households cannot use social exchange to affect their permanent income. The large transaction costs of travelling and transporting gifts (especially of bulky agricultural commodities) across space may further diminish the use of social income as a source of household welfare and insurance.

Instead, the interview evidence also supported the view that social exchange provides small consumption loans and provides an element of leisure and consumption. Households may therefore insure occasional, idiosyncratic shortfalls in income (e.g. in case of individual illness) but social exchange cannot provide long-term insurance from large scale disaster or poverty. Future household survey research may need to account for social income more explicitly in the design of the questionnaire to design better variables and thus a better understanding of these issues.

Overall, the significance of the variety of endogenous variables, including area cultivated, is not surprising when considering that the war in Mozambique greatly reduced the number of economically viable income-generating activities. In more developed economies in times of peace (or alternatively, in economies more akin to the perfect competition model of economic theory) the determinants of income include subjective preferences between portfolio asset class decisions, with instrument (i.e. intra asset class) choices only marginally affecting income. In the post-war context of Mozambique, however, most households are employed within agriculture, irrespective of preferences or comparative advantage. The remaining (i.e. intra-rural or intra-agricultural) activity choices thus have larger than expected effects on household welfare.

War reduces the number of available options (e.g. by making some activities more war-vulnerable or by destroying some markets) and increases the cost of making some choices (e.g. temporary or partial migration may be less feasible with higher information and transaction costs during the war). The remaining available activity options are therefore not necessarily well suited to the preferences and endowments of households, forcing households to pursue activities which they may not do well. Households thus face discontinuous trade-offs and have little information on which to base their choices. In effect, households are not optimising an ideal choice problem but are faced with few

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[92] This includes for example some studies from the FSP such as Jeje, Howard, Strasberg and Boughton (1999), MAP/MSU Research Team (1997), Marule, Benfica, Strasberg, Tschirley and Weber (1999), Strasberg (1997), and Tschirley and Weber (1994).

available and problematic options over which many households may not have clearly defined preferences or for which an optimal solution is not apparent.

The remaining choices between activities, even if they belong to the same class of agricultural activities, thus do not have continuous or smooth effects on household welfare. In a more competitive model with low transaction costs and many divisible options, marginal household choices should only have marginal household welfare effects. However, this evidence suggests that household choices are more important in determining household welfare than previously thought. The war legacy has a crucial role in this process, by creating discontinuities and raising transaction costs, including those affecting the availability of activity choices and the actual choice between them.

In addition, households may be caught, as a result of the war, in poverty traps. Migration with large transaction costs and low endowments to finance such move may not be feasible, forcing households to depend on exogenous interventions to improve their welfare. However, not all exogenous interventions turn out to be welfare enhancing, such as the provision of cotton inputs.

Based on existing data but employing a new methodological approach, this analysis found that cotton adoption per se is welfare reducing. Households would be better off maintaining high on-farm and high subsistence shares of total income as long as some crop market participation was possible.

7.6 Summary

The objective of this chapter was to analysis the determinants of household poverty in post-war, rural northern Mozambique. The emphasis was on uncovering how war can shape the determinants of post-war poverty and how war may create poverty traps from which households cannot easily escape. Methodologically, this chapter contributed to the literature by making the role of conflict in post-war poverty explicit, by simultaneously considering three indicators of household welfare, and by estimating the welfare effects of endogenous land and activity choices.

Household income was found to be more dependent on asset endowments and village-level variables while food consumption is more dependent on land characteristics and social institutions. The key regression results are that female-headed households are poorer however measured, which was expected, but that cotton growers also are poorer than non-growers, which was not expected and which contradicts other studies of northern Mozambique.

In addition, households with more assets, cultivated land and more market participation have higher welfare while the refugee status and maternal education appear to have little effects. The inequality of asset distribution may thus contribute to post-war poverty traps, especially if coupled with weak input and output markets in which to earn surpluses for rebuilding the household asset base. The scale of the positive effect of cultivated area on welfare is larger in this analysis than in other studies, as this analysis did not assume that the area cultivated was fixed and thus exogenous in the post-war period. The policy implications of these findings are quite strong and will be discussed in more detail in chapter 8.

Figure 7.1: Summary Welfare Hypotheses and Outcomes

	Income		Consumption		Food Consumption	
	Expected	Actual	Expected	Actual	Expected	Actual
Household Characteristics						
household composition variables†						
refugee household?	decr		decr		decr	
female-headed household?	decr	decr	decr	decr	decr	decr
age of head	incr		incr	incr	incr	incr
days ill	decr		decr	incr	decr	
environmental time constraint	decr	decr	decr		decr	decr
paternal education	insig	incr	insig	incr/decr	insig	incr
maternal education	insig		insig		incr	
Land Characteristics						
low soil quality?	decr		(decr)		decr	decr
many pests?	decr		(decr)		decr	
easy land access?	incr		(incr)		incr	
distance to fields	decr		(decr)		decr	
low rainfall?	decr		(decr)		decr	decr
Assets Endowment						
# tools	incr	incr	incr		incr	
# types of tools	incr		incr		incr	
storage technology?	incr		incr		incr	
end-of-war assets	incr	incr	incr	incr	(incr)	incr
end-of-war livestock	incr		incr		(incr)	
affected by cyclone?	decr	incr	decr		(decr)	
Social Capital Endowment						
local husband origin?	incr		incr		incr	decr
local wife origin?	incr		incr		incr	decr
related to authority?	incr		incr		incr	
head is local authority?	incr	incr	incr		incr	incr
ancestors buried here?	incr		incr		incr	
Markets						
labour market density	incr		incr		(incr)	
output market density	incr		incr		(incr)	decr
village days ill	decr		decr		decr	
village maize yield	incr		incr		incr	
village cotton yield	incr	incr	incr		incr	
variance of prices	decr	decr	decr		decr	
village control variables	sig		sig		sig	
Endogenous Choices						
cultivated area	incr	incr	(incr)	incr	incr	incr
% of income from on-farm activities	incr		incr	incr	incr	incr
degree of activity diversification	decr	decr	decr		decr	decr
crop market participating household?	incr	incr	incr	incr	incr	incr
% of income from subsistence activities	decr	decr	decr		decr	
cotton adopting household?	incr	decr	incr	decr	incr	decr
degree of plot diversification	decr	incr	decr		decr	incr
degree of social exchange	decr	incr	decr		decr	

† These effects are not signed for reasons discussed in the text. A question mark in the variable name indicates a categorical variable. Incr: positive significant coefficient. Decr: negative significant coefficient. Incr/decr and decr/incr: quadratic relation where the linear/quadratic variables have an increasing/decreasing effect on welfare and vice versa. Insig (or empty cell): an insignificant variable with a p-value of above 0.10 which was omitted from the final regression. Sig: significant variable with an unknown sign. Signs enclosed in brackets indicate the possible insignificance of the coefficient.

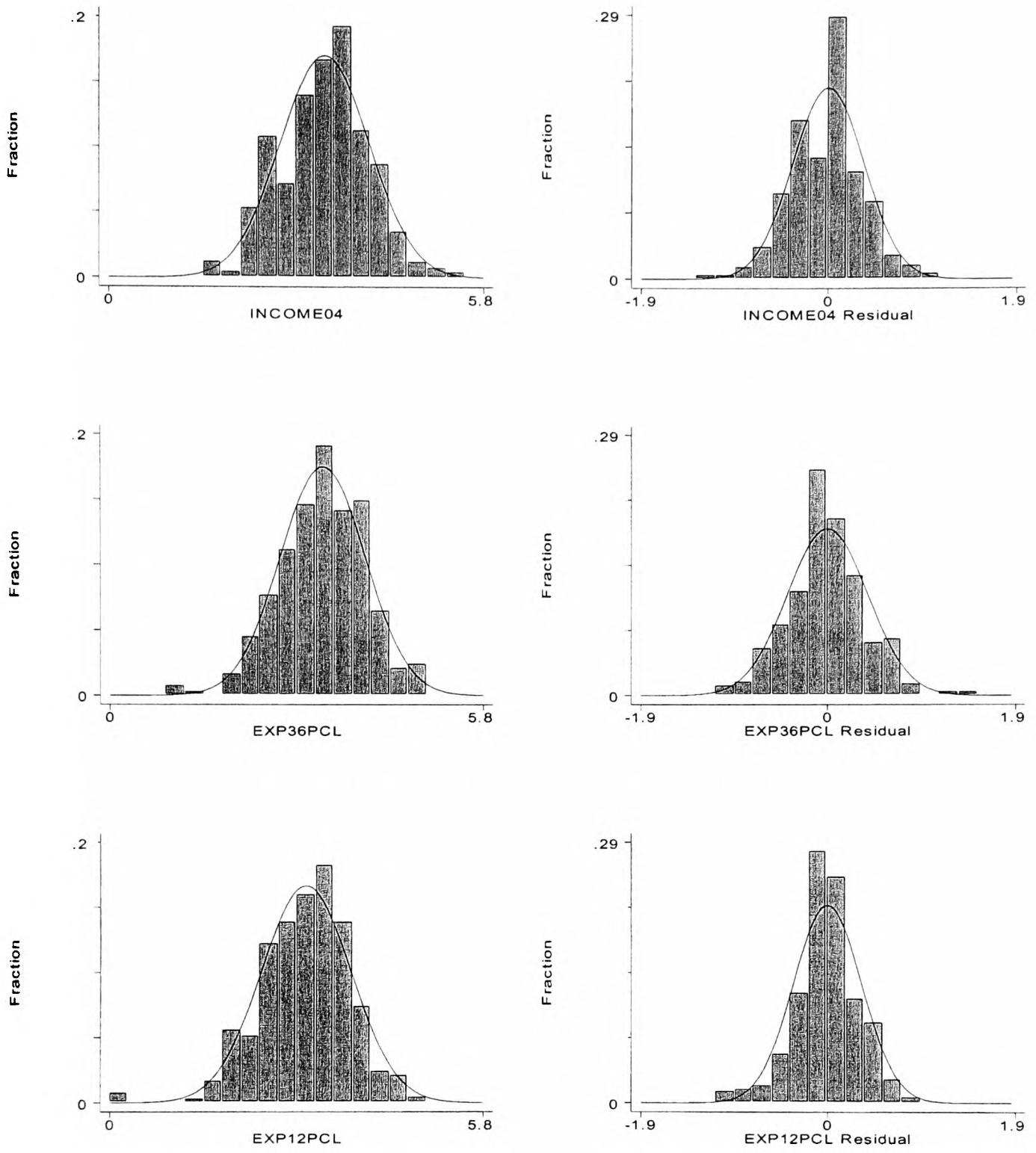
Figure 7.2: Poverty Profile

	Population Share (%)	Mean Expenditure (US$)	Headcount Ratio	Poverty Gap
All Households	100	33.05	0.54	0.22
Refugee Household?				
No	84	32.61	0.56	0.23
Yes	16	35.39	0.44	0.16
Female-Headed?				
No	99	33.27	0.54	0.22
Yes	1	17.35	0.91	0.49
Affected by Cyclone?				
No	67	30.25	0.61	0.26
Yes	33	38.70	0.41	0.13
Severe Lack of Rain?				
No	72	37.27	0.43	0.15
Yes	28	21.95	0.83	0.39
By Soil Quality				
Good	71	36.11	0.49	0.19
Bad	29	25.42	0.67	0.30
By Infrastructure				
Good	55	33.99	0.54	0.21
Bad	45	31.91	0.55	0.23
By Province				
Cabo Delgado	50	27.22	0.66	0.30
Nampula	50	38.90	0.42	0.14
By Farm Size				
Large	33	46.74	0.28	0.08
Small	67	26.32	0.67	0.29
By Cashew Adoption				
Non-Adopter	80	32.20	0.55	0.23
Adopter	20	36.45	0.51	0.19
By Cotton Adoption				
Non-Adopter	50	27.86	0.65	0.27
Adopter	50	38.15	0.43	0.17
By Crop Market Status				
Not Participating	21	21.14	0.81	0.40
Participating	79	36.30	0.47	0.17

The poverty line is the median expenditure per capita in 1995 (i.e. US$ 30.92), which broadly divides the sample into the ultra poor and the poor. Both mean expenditure and the farm size variables are calculated on a per capita basis using WEIGHT2. The total sample size is 371. This table was calculated using the command "povdeco" in Stata 6.

Source: FSP data and own calculations.

Figure 7.3: Summary Statistics of Dependent Variables



The figures show weighted histograms (using WEIGHT2) and superimposed Normal distributions of the dependent variables and their residuals.

Source: FSP data and own calculations (050301a).

Figure 7.4: Survey Instrumental Variables Regression of Income

pweight: WEIGHT2
Strata: CATEG1
PSU: ALD

Number of obs = 349
Number of strata = 4
Number of PSUs = 43
Population size = 30505.29
F(38, 2) = 84.68
Prob > F = 0.0117
R-squared = 0.7208

INCOME04	Coef.	St Err	t	P>|t|	(95% Conf.	Interval)
MEMND11	.244606	.0816773	-2.995	0.005	-.4098139	-.0793982
MEMND12	.0093799	.0058438	1.605	0.117	-.0024403	.0212002
DEPEND95	-1.473872	.2796488	-5.270	0.000	-2.039515	-.9082287
FEMALE2	-.1199673	.1739991	-0.689	0.495	-.4719137	.2319792
AGEHH01	-.0332137	.0137195	-2.421	0.020	-.0609641	-.0054633
AGEHH02	.0004565	.0002198	2.077	0.044	.0000119	.0009011
AGEHEAD3	.0025155	.0082639	0.304	0.762	-.0141998	.0192308
AGEHEAD4	6.99e-06	.000072	0.097	0.923	.0001387	.0001526
FEMHEAD1	-.4012829	.1487346	-2.698	0.010	-.7021271	-.1004387
TIME02	.0089415	.0025924	-3.449	0.001	-.0141852	-.0036979
EDINFRA5	.0416433	.0603412	-0.690	0.494	.1636948	.0804083
EDINFRA6	.0142647	.0100234	1.423	0.163	.0060095	.0345389
EDINFRA3	.0044013	.0605038	0.073	0.942	.1179791	.1267817
EDINFRA4	.0040367	.0133748	0.302	0.764	.0230163	.0310897
TOOL11	.212001	.0912487	2.323	0.025	.0274331	.3965688
ANIMAL5	.1802253	.1252647	1.439	0.158	.0731463	.433597
CYCLONE2	.1728028	.0853863	2.024	0.050	.0000927	.345513
VASSET5	.0463049	.0147734	3.134	0.003	.0164228	.0761869
AUTH12	.3324322	.1051083	3.163	0.003	.1198306	.5450337
YIELDL8	.3513762	.0589914	5.956	0.000	.2320548	.4706976
AREA56	.6574404	.1207019	5.447	0.000	.4132979	.901583
DIVERS12	.7993689	.3742041	-2.136	0.039	-1.556268	-.0424696
STATUS14	.2467969	.0837172	2.948	0.005	.0774629	.416131
SHARESUL	.3486792	.1333948	-2.614	0.013	-.6184955	-.0788628
COTTON89	.3205112	.1823947	1.757	0.087	-.6894392	.0484169
PLOT32	.4645806	.0887742	5.233	0.000	.2850178	.6441434
REMT4	.0486189	.024046	2.022	0.050	-.0000188	.0972565
PRICEV1	.010162	.1277668	0.080	0.937	-.2482708	.2685948
PRICEV2	.0497663	.1339837	-0.371	0.712	-.3207739	.2212413
PRICEV3	1.585979	.3492754	-4.541	0.000	-2.292455	-.8795026
ALD111	.0884474	.1268193	-0.697	0.490	-.3449636	.1680688
ALD112	.1358157	.1641588	-0.827	0.413	-.4678582	.1962269
ALD113	-.1275608	.3279126	-0.389	0.699	-.7908266	.5357051
ALD114	(dropped)					
ALD121	.5156376	.1821128	2.831	0.007	.1472796	.8839955
ALD122	(dropped)					
ALD123	1.352448	.3531916	3.829	0.000	.6380506	2.066845
ALD214	.085128	.1758689	0.484	0.631	-.2706003	.4408564
ALD215	.130924	.2211673	0.592	0.557	.3164292	.5782771
ALD221	.5173103	.1638056	3.158	0.003	.1859821	.8486384
ALD231	.5813827	.1639945	3.545	0.001	.2496726	.9130928
ALD232	.0537003	.1157973	0.464	0.645	-.1805218	.2879225
ALD312	1.371343	.3655466	3.751	0.001	.6319547	2.11073
ALD313	1.164763	.2286975	5.093	0.000	.7021787	1.627347
ALD321	.4103915	.1810355	2.267	0.029	.0442127	.7765704
ALD332	.3985852	.1360771	2.929	0.006	.1233433	.6738271
_cons	2.298335	.4466111	5.146	0.000	1.394979	3.201692

Instrumented: AREA56 DIVERS12 COTTON89
Instruments: FEMALE1 FEMALE3 ILLDAYS1 ILLDAYS2 REFUGEE1 TIME01 TIME03 TIME04 AREA53 AREAFER6 DISTANC3 DISTANC9 PEST01 RAIN4 MILL21 PEST13 DONA1 ANCEST1 ORIGINM1 LABOUR5 MARKET7 PRICE13 PRICE14 PRICE15 PRICE23 PRICE24 PRICE25 PRICE33 PRICE34 PRICE35 DIS1 DIS3 + STATUS14 SHARESUL PLOT32 REMT4 MEMND11 MEMND12 DEPEND95 AGEHH01 AGEHH02 AGEHEAD3 AGEHEAD4 FEMHEAD1 FEMALE2 TIME02 EDINFRA3 EDINFRA4 EDINFRA5 EDINFRA6 TOOL11 ANIMAL5 CYCLONE2 VASSET5 AUTH12 YIELDL8 PRICEV1 PRICEV2 PRICEV3 ALD111 ALD112 ALD113 ALD114 ALD121 ALD122 ALD123 ALD214 ALD215 ALD221 ALD231 ALD232 ALD312 ALD313 ALD321 ALD332

Adjusted Wald tests of jointly zero coefficients: MEMND11 and MEMND12: F(2, 38) = 72.10, Prob > F = 0.0000. AGEHH01 and AGEHH02: F(2, 38) = 2.93, Prob > F = 0.0656. AGEHEAD3 and AGEHEAD4: F(2, 38) = 0.48, Prob > F = 0.6233. AGEHH01 to AGEHEAD4: F(4, 36) = 1.60, Prob > F = 0.1944. EDINFRA3 and EDINFRA4: F(2, 38) = 0.81, Prob > F = 0.4535. EDINFRA5 and EDINFRA6: F(2, 38) = 2.76, Prob > F = 0.0759. EDINFRA3 to EDINFRA6: F(4, 36) = 3.42, Prob > F = 0.0181.

Source: FSP data and own calculations (010302b).

Figure 7.5: Survey Instrumental Variables Regression of Expenditure

```
pweight:  WEIGHT2                                 Number of obs    =       371
Strata:   CATEG1                                  Number of strata =         4
PSU:      ALD                                     Number of PSUs   =        43
                                                  Population size  =  32539.53
                                                  F(  38,      2)  =    864.48
                                                  Prob > F         =    0.0012
                                                  R-squared        =    0.6164
------------------------------------------------------------------------------
EXP36PCL |      Coef.   St Err        t     P>|t|     (95% Conf. Interval)
---------+--------------------------------------------------------------------
 MEMND11 |   .1339431  .0940716    -1.424   0.162      .3242208    .0563347
 MEMND12 |   .0039355  .0072182     0.545   0.589      .0106647    .0185358
  MEMD11 |   -.200286  .0865714    -2.314   0.026      .3753932   -.0251788
  MEMD12 |   .0074661  .0205484     0.363   0.718      -.034097    .0490292
 FEMALE2 |  -.4332336  .1746231    -2.481   0.018      .7864421   -.0800252
 AGEHH01 |   -.034995  .0152916    -2.289   0.028      .0659251   -.0040649
 AGEHH02 |   .0003003  .0002066     1.454   0.154      .0001176    .0007182

AGEHEAD3 |    .014244  .0111285     1.280   0.208     -.0082654    .0367534
AGEHEAD4 |   .0000586  .0001298    -0.452   0.654     -.0003213     .000204
FEMHEAD1 |   .5609736  .1603482    -3.498   0.001     -.8853085   -.2366387
ILLDAYS2 |   .0022798  .0009594     2.376   0.023      .0003391    .0042204
 EDUMAX3 |   -.033002  .0492194    -0.671   0.506     -.1325576    .0665535
 EDUMAX4 |   .0068529  .0057754     1.187   0.243     -.0048289    .0185347
EDINFRA3 |   .0449154    .06504    -0.691   0.494     -.1764711    .0866404
EDINFRA4 |   .0119461  .0108136     1.105   0.276     -.0099265    .0338186

 ANIMAL5 |   .0436279  .1003251     0.435   0.666     -.1592987    .2465546
 ASSET13 |   .3782624  .0871722     4.339   0.000        .20194    .5545848

  AUTH12 |   .1206285  .0843355     1.430   0.161     -.0499561    .2912132

 LABOUR3 |   .0267581  .0340387     0.786   0.437      .0420917     .095608

  AREA56 |   .1364993  .0640873     2.130   0.040      .0068704    .2661281
SHAREONL |   .8935434  .4021657     2.222   0.032      .0800865       1.707
STATUS14 |   .6019751  .2320506     2.594   0.013      .1326084    1.071342
COTTON89 |   .1508039   .072918    -2.068   0.045     -.2982945   -.0033132

 PRICEV1 |   .2157894   .199686     1.081   0.286      .1881137    .6196925
  ALD111 |   .0547251  .2634764     0.208   0.837     -.4782063    .5876564
  ALD112 |  -.6091222  .1112914    -5.473   0.000      .8342303     .384014
  ALD113 |   .5273597  .1701727    -3.099   0.004     -.8715664     .183153
  ALD114 |  (dropped)
  ALD121 |   .0565536  .0865187     0.654   0.517      .1184469    .2315541
  ALD122 |     .33957  .1360725    -2.496   0.017     -.6148026   -.0643375
  ALD123 |  -.1983622  .1075031    -1.845   0.073     -.4158079    .0190834
  ALD214 |   -.125512  .1363817    -0.920   0.363      .4013701    .1503461
  ALD215 |   .2985392  .1504358    -1.984   0.054      .6028244    .0057459
  ALD221 |  (dropped)
  ALD231 |   .1363223  .1409484     0.967   0.339     -.1487728    .4214174
  ALD232 |  -.1791666  .1657645    -1.081   0.286     -.5144568    .1561237
  ALD312 |  -.7111879  .1420036    -5.008   0.000      .9984174   -.4239585
  ALD313 |  -.0393424  .1572609    -0.250   0.804     -.3574325    .2787478
  ALD321 |   .0117189  .2107703     0.056   0.956     -.4146043    .4380421
  ALD332 |   .2167968  .1185652     1.829   0.075      .0230239    .4566176

   _cons |   4.032277  .4172842     9.663   0.000       3.18824    4.876314
------------------------------------------------------------------------------
Instrumented:  SHAREONL STATUS14
Instruments:   FEMALE1 FEMALE3 ILLDAYS1 ILLDAYS2 REFUGEE1 TIME01 TIME03 TIME04
AREA53 AREAFER6 DISTANC3 DISTANC9 PEST01 RAIN4 MILL21 PEST13 DONA1 ANCEST1 OR
IGINM1 LABOUR5 MARKET7 PRICE13 PRICE14 PRICE15 PRICE23 PRICE24 PRICE25 PRICE3
3 PRICE34 PRICE35 DIS1 DIS3 + AREA56 COTTON89 MEMND11 MEMND12 MEMD11 MEMD12 A
GEHH01 AGEHH02 AGEHEAD3 AGEHEAD4 FEMHEAD1 FEMALE2 ILLDAYS2 EDUMAX3 EDUMAX4 ED
INFRA3 EDINFRA4 ANIMAL5 ASSET13 AUTH12 LABOUR3 PRICEV1 ALD111 ALD112 ALD113 A
LD114 ALD121 ALD122 ALD123 ALD214 ALD215 ALD221 ALD231 ALD232 ALD312 ALD313 A
LD321 ALD332
------------------------------------------------------------------------------
```

Adjusted Wald tests of jointly zero coefficients: MEMND11 and MEMND12: F(2, 38) = 17.69, Prob > F = 0.0000. MEMD11 and MEMD12: F(2, 38) = 22.72, Prob > F = 0.0000. MEMND11 to MEMD12: F(4, 36) = 27.51, Prob > F = 0.0000. AGEHH01 and AGEHH02: F(2, 38) = 3.06, Prob > F = 0.0588. AGEHEAD3 and AGEHEAD4: F(2, 38) = 2.66, Prob > F = 0.0827. AGEHH01 to AGEHEAD4: F(4, 36) = 1.77, Prob > F = 0.1566. EDUMAX3 and EDUMAX4: F(2, 38) = 2.75, Prob > F = 0.0767. EDINFRA3 and EDINFRA4: F(2, 38) = 1.09, Prob > F = 0.3469. EDUMAX3 to EDINFRA4: F(4, 36) = 2.64, Prob > F = 0.0496.

Source: FSP data and own calculations (010302c).

Figure 7.6: Survey Instrumental Variables Regression of Food Expenditure

pweight: WEIGHT2
Strata: CATEG1
PSU: ALD

Number of obs = 371
Number of strata = 4
Number of PSUs = 43
Population size = 32539.53
F(38, 2) = 516.54
Prob > F = 0.0019
R-squared = 0.7534

EXP12PCL	Coef.	St Err	t	P>|t|	(95% Conf.	Interval)
MEMND11	-.1599799	.0551495	-2.901	0.006	-.2715302	-.0484295
MEMND12	.0052606	.0042695	1.232	0.225	-.0033753	.0138965
MEMD11	-.1577354	.0302187	-5.220	0.000	-.2188585	-.0966123
FEMALE2	.1865782	.1675034	-1.114	0.272	-.5253857	.1522293
AGEHH01	-.0362171	.0124465	-2.910	0.006	-.0613926	-.0110416
AGEHH02	.0004853	.0001729	2.806	0.008	.0001354	.0008351
AGEHEAD3	.0059279	.0081164	0.730	0.470	-.010489	.0223449
AGEHEAD4	.0000344	.0000911	0.378	0.708	.0001498	.0002186
REFUGEE1	.1188171	.0755645	1.572	0.124	-.0340265	.2716607
FEMHEAD1	-.7044754	.1550828	-4.543	0.000	-1.01816	-.3907908
TIME02	.0134871	.0033433	-4.034	0.000	.0202495	.0067247
EDUMAX3	.0274989	.0329467	0.835	0.409	.0391421	.0941399
EDUMAX4	.0031283	.0040681	0.769	0.447	-.0051003	.0113568
EDINFRA3	.0696631	.0466683	-1.493	0.144	.1640586	.0247323
EDINFRA4	.0102255	.0079963	1.279	0.209	.0059486	.0263996
AREAFER6	-.082418	.0484067	-1.703	0.097	.1803298	.0154938
RAIN4	-.2029822	.1131915	-1.793	0.081	-.4319336	.0259692
ANIMAL5	.039291	.0880524	0.446	0.658	-.1388118	.2173937
ASSET13	.318572	.0661106	4.819	0.000	.1848508	.4522933
AUTH12	.3188338	.1027581	3.103	0.004	.1109858	.5266817
ORIGINF1	-.2460459	.0579577	-4.245	0.000	-.3632763	-.1288154
ORIGINM1	-.1138888	.0660364	-1.725	0.093	-.2474601	.0196825
MARKET7	-.1816463	.0487053	-3.729	0.001	.280162	-.0831306
AREA56	.443588	.0738905	6.003	0.000	.2941303	.5930457
SHAREONL	.5932566	.2917696	2.033	0.049	.003097	1.183416
DIVERS12	-.3682106	.1448249	-2.542	0.015	.6611466	.0752746
STATUS14	.1258708	.0747885	1.683	0.100	-.0254032	.2771447
COTTON89	-.107901	.0595732	-1.811	0.078	-.2283992	.0125972
PLOT32	.3361708	.0692831	4.852	0.000	.1960324	.4763092
PRICEV1	.0531992	.1397043	0.381	0.705	-.2293794	.3357778
ALD111	.4537965	.1929016	2.352	0.024	.0636162	.8439768
ALD112	-.277147	.1064588	-2.603	0.013	-.4924801	.0618138
ALD113	(dropped)					
ALD114	.4184794	.1899922	2.203	0.034	.034184	.8027748
ALD121	.2870687	.0979971	2.929	0.006	.0888509	.4852865
ALD122	.4210132	.1153138	-3.651	0.001	.6542573	-.1877691
ALD123	.2141659	.125937	1.701	0.097	-.0405657	.4688976
ALD214	-.008862	.1040064	-0.085	0.933	-.2192349	.2015108
ALD215	(dropped)					
ALD221	-.2974061	.2210773	-1.345	0.186	-.7445773	.149765
ALD231	.7137438	.1143298	6.243	0.000	.48249	.9449976
ALD232	-.1312145	.0856826	-1.531	0.134	-.304524	.0420949
ALD312	-.7378389	.0852489	-8.655	0.000	.9102711	-.5654068
ALD313	.3821011	.120393	3.174	0.003	.1385833	.6256189
ALD321	.6612416	.1509388	4.381	0.000	.3559391	.9665441
ALD332	.3811662	.1152782	3.306	0.002	.1479941	.6143383
_cons	5.704634	.5006679	11.394	0.000	4.691938	6.717331

Instrumented: SHAREONL
Instruments: FEMALE1 FEMALE3 ILLDAYS1 ILLDAYS2 REFUGEE1 TIME01 TIME03 TIME04 AREA53 AREAFER6 DISTANC3 DISTANC9 PEST01 RAIN4 MILL21 PEST13 DONA1 ANCEST1 ORIGINM1 LABOUR5 MARKET7 PRICE13 PRICE14 PRICE15 PRICE23 PRICE24 PRICE25 PRICE33 PRICE34 PRICE35 DIS1 DIS3 + AREA56 DIVERS12 STATUS14 COTTON89 PLOT32 MEMND11 MEMND12 MEMD11 AGEHH01 AGEHH02 AGEHEAD3 AGEHEAD4 REFUGEE1 FEMHEAD1 FEMALE2 TIME02 EDUMAX3 EDUMAX4 EDINFRA3 EDINFRA4 AREAFER6 RAIN4 ANIMAL5 ASSET13 AUTH12 ORIGINF1 ORIGINM1 MARKET7 PRICEV1 ALD111 ALD112 ALD113 ALD114 ALD121 ALD122 ALD123 ALD214 ALD215 ALD221 ALD231 ALD232 ALD312 ALD313 ALD321 ALD332

Adjusted Wald tests of jointly zero coefficients: MEMND11 and MEMND12: F(2, 38) = 38.33, Prob > F = 0.0000. AGEHH01 and AGEHH02: F(2, 38) = 4.14, Prob > F = 0.0237. AGEHEAD3 and AGEHEAD4: F(2, 38) = 3.25, Prob > F = 0.0497. AGEHH01 to AGEHEAD4: F(4, 36) = 2.56, Prob > F = 0.0551. EDUMAX3 and EDUMAX4: F(2, 38) = 13.52, Prob > F = 0.0000. EDINFRA3 and EDINFRA4: F(2, 38) = 1.10, Prob > F = 0.3418. EDUMAX3 to EDINFRA4: F(4, 36) = 7.65, Prob > F = 0.0001.

Source: FSP data and own calculations (010302c).

Figure 7.7: Summary of Endogenous Determinants of Household Welfare

		Instrument		Individual Regressions					Regression 1			Regression 2			Regression 3		
Regression	Variable	R^2	F	DWH	Regr	R^2	Coef	P	DWH	Coef	P	DWH	Coef	P	DWH	Coef	P
INCOME04	AREA56	0.69	0.00	0.00	IV	0.73	**0.41**	0.00	0.00	**0.54**	0.04	0.00	**0.66**	0.00	0.01	**0.66**	0.00
	SHAREONL	0.56	0.00	0.02	IV	0.55	**1.51**	0.00	0.30	**0.74**	0.11	n.a.	0.10	0.63	n.a.	n.a.	n.a.
	DIVERS12	0.54	0.00	0.00	IV	0.57	**-1.30**	0.00	0.01	**-0.56**	0.05	0.01	-0.59	0.16	0.02	**-0.80**	0.04
	STATUS14	0.58	0.00	0.01	IV	0.70	**0.66**	0.00	0.32	0.06	0.77	n.a.	**0.22**	0.03	n.a.	**0.25**	0.01
	SHARESUL	0.37	0.00	0.66	OLS	0.70	-0.12	0.19	0.40	**-0.46**	0.11	n.a.	**-0.31**	0.03	n.a.	**-0.35**	0.01
	COTTON89	0.53	0.01	0.01	IV	0.70	-0.06	0.72	0.06	**-0.41**	0.08	0.16	**-0.41**	0.03	0.15	**-0.32**	0.09
	PLOT32	0.54	0.02	0.61	OLS	0.72	**-0.16**	0.00	0.26	0.12	0.70	n.a.	**0.44**	0.00	n.a.	**0.46**	0.00
	REMT4	0.41	0.00	0.01	IV	0.67	**0.18**	0.00	0.97	-0.02	0.79	n.a.	**0.05**	0.06	n.a.	**0.05**	0.05
EXP36PCL	AREA56	0.67	0.00	0.09	IV	0.64	**0.30**	0.00	0.31	0.37	0.19	n.a.	**0.29**	0.02	n.a.	**0.14**	0.04
	SHAREONL	0.55	0.00	0.00	IV	0.53	**1.58**	0.00	0.06	0.62	0.25	0.00	**0.70**	0.12	0.01	**0.89**	0.03
	DIVERS12	0.48	0.00	0.01	IV	0.53	**-1.23**	0.01	0.82	-0.31	0.51	n.a.	-0.12	0.55	n.a.	n.a.	n.a.
	STATUS14	0.58	0.00	0.00	IV	0.54	**0.96**	0.00	0.01	**0.43**	0.09	0.01	**0.44**	0.10	0.01	**0.60**	0.01
	SHARESUL	0.36	0.00	0.27	OLS	0.64	**0.28**	0.02	0.46	-0.11	0.73	n.a.	0.14	0.26	n.a.	n.a.	n.a.
	COTTON89	0.53	0.01	0.00	IV	0.61	0.08	0.64	0.42	-0.14	0.49	n.a.	**-0.13**	0.11	n.a.	**-0.15**	0.05
	PLOT32	0.52	0.01	0.07	IV	0.61	**-0.20**	0.05	0.47	0.26	0.47	n.a.	**0.16**	0.12	n.a.	n.a.	n.a.
	REMT4	0.40	0.00	0.00	IV	0.55	**0.14**	0.03	0.05	**0.82**	0.01	0.33	0.00	0.94	n.a.	n.a.	n.a.
EXP12PCL	AREA56	0.67	0.00	0.23	OLS	0.66	**0.17**	0.00	0.79	**0.61**	0.08	n.a.	**0.55**	0.00	n.a.	**0.44**	0.00
	SHAREONL	0.55	0.00	0.00	IV	0.61	**1.53**	0.00	0.02	0.55	0.30	0.01	**0.54**	0.10	0.09	**0.59**	0.04
	DIVERS12	0.49	0.00	0.00	IV	0.59	**-1.49**	0.00	0.32	-1.12	0.16	n.a.	**-0.80**	0.02	n.a.	**-0.37**	0.02
	STATUS14	0.58	0.00	0.00	IV	0.63	**0.74**	0.00	0.12	-0.07	0.81	n.a.	0.13	0.24	n.a.	**0.13**	0.10
	SHARESUL	0.37	0.00	0.05	IV	0.67	0.13	0.55	0.00	-0.61	0.31	0.00	-0.45	0.27	n.a.	n.a.	n.a.
	COTTON89	0.53	0.01	0.00	IV	0.64	-0.02	0.91	0.54	0.07	0.76	n.a.	-0.08	0.30	n.a.	**-0.11**	0.08
	PLOT32	0.52	0.02	0.25	OLS	0.64	-0.03	0.48	0.78	0.48	0.31	n.a.	**0.50**	0.00	n.a.	**0.34**	0.00
	REMT4	0.40	0.00	0.04	IV	0.61	0.09	0.21	0.34	**-0.17**	0.10	n.a.	-0.01	0.57	n.a.	n.a.	n.a.

AREA56: The natural log of cultivated area per household in hectare in 1995/96. INCOME04: The natural log of household income per capita in US$ in 1995. EXP36PCL: The natural log of household expenditure per capita in US$ in 1995. EXP12PCL: The natural log of household food expenditure per capita in US$ in 1995. SHAREONL: The natural log of the share of total household income derived from on-farm agricultural activities in 1995. DIVERS12: The natural log of the Herfindahl-Hirschman index of income diversification in 1995. STATUS14: Discrete variable which codes one if a household participates in any crop market in 1995. SHARESUL: The natural log of the share of total household income derived from subsistence agricultural activities in 1995. COTTON89: Discrete variable which codes one if household grows cotton in 1995. PLOT32: The natural log of the effective number of plots per hectare per household in 1995. REMT4: The natural log of remittances and gifts given and received per capita per household in 1-9/1995 in US$. Bold coefficients indicate that the variable is significant at 15% or below. The "DWH" column reports the p-value of the weighted DWH test of endogeneity as described in the text. Independent categorical variables report the unweighted DWH test statistic. Small values indicate that the null hypothesis of exogeneity can be rejected. The "F Instr" column reports the p-value of the F-test of joint insignificance of the coefficients of all variables used to instrument AREA56. Small values indicate that the null hypothesis of an unsuitable choice of instruments can be rejected (Deaton 1997: 116). The full set of results are available from the author on request. Source: FSP data and own calculations (001127b, 001128a-b, 001204a, 010227, 010302).

Chapter 8: Conclusions

This thesis analyses how poor farm households in developing countries cope with the legacy of internal war. A theoretical framework was developed, drawing on the peasant household literature. This was applied to the case of post-war northern Mozambique, using a detailed household survey for the empirical analysis. Four empirical themes were studied in detail, namely land access, land use, coping strategies and household poverty.

Sections 8.1 to 8.4 of this chapter discuss the main results and broader implications from the preceding chapters. Sections 8.5 to 8.7 address the three themes raised at the start of the thesis, namely an evaluation of peasant household models for the analysis of war-affected behaviour, the nature of the war legacy and its behavioural and welfare effects on peasant households, and the experience of war in the case of northern Mozambique.

It was argued that while the econometric results cannot be generalised to more than the sample areas, the post-war situation in the sample area is typical for northern Mozambique and the results are relevant for other poor, rural, post-war economies such as in Central America or Sub-Saharan Africa (chapter 3.6). The discussion below will thus derive policy advice which are useful for other post-conflict economies as well.

8.1 Land Access

Chapter 4 extended the existing literature on the role of land in rural development by considering the effects of war on land and by subsequently considering a variety of potentially endogenous effects, some of which were previously considered to be exogenous in the literature, partly due to the peace-time nature of other studies.

The initial discussion outlined why and to what extent land can be expected to be a key resource for post-war rural households. The role of the low war vulnerability of land was addressed and three working hypotheses were formulated. First, it was expected that the post-war period would see no landless households. This was shown to be true with land being a significant asset for all households. Second, land in post-war Mozambique was expected to be abundant. It will be reviewed below why this was indeed the case. Third, other variables were expected and shown to be significant in the determinant of the land-labour ratio.

The results show that war has enhanced the degree of land abundance in northern Mozambique by increasing labour (or life cycle), asset and technology constraints, by enforcing economic isolation, by interacting with social institutions, and by affecting the risk and incentive structures of different agricultural and off-farm activities. In part the

effects of war in the rural economy accentuate the predictions following from the BM model but the war legacy also created additional constraints.

These effects of war imply that households can satisfy a large share of their demand for land in most cases. In some important cases, however, households are constrained in their land choice, for example through custom for female-headed households. Consequently, land abundance is a household-level concept, not a macro-level concept, in post-war northern Mozambique. This is a new view of land abundance not previously discussed in the literature. Such concept is akin to the concept of commodity and household-specific market failure and has strong implications for the design and interpretation of economic reconstruction policies.

8.2 Land Tenure Insecurity and Land Investment

Chapter 5 analysed the determinants of land tenure insecurity and land investment while explicitly accounting for potential endogeneities which appear more likely in the post-war environment. This analysis extends the BM model of production of chapter 2 by breaking the production process into three related processes of land access, land tenure status and land investment. Using the resulting PH model, but accounting for potential endogeneity between all three variables, yielded a new formal framework for the analysis of land use in post-war Mozambique.

The key result for land tenure insecurity is that it cannot be assumed to be fixed a priori but that it has few endogenous determinants, though previous area farmed matters. Land investment on the other hand is endogenously affected by tenure insecurity and is affected by previous area farmed.

The evidence supports the analytical and econometric approach adopted above of modelling all possible endogeneities explicitly and testing if these endogeneities exist in practice. It is likely that some studies of African land use suffer from a spurious correlation bias as they potentially underestimate the degree of endogeneity between variables. Potential endogeneities for land should be suspected a priori and tested explicitly, unlike what is practiced in most of the African land literature.

Furthermore, the analysis emphasised the need to consider dynamic processes of land use as area farmed in the previous year appeared a significant determinant of both tenure status and land investment. Finally, the use of plot-level data, as practised by some studies already, is helpful for a more detailed analysis of some land use practices. Taken together, these three changes to the study of land use patterns in peace-time and post-war Sub-Saharan Africa would yield further interesting insights in future studies.

8.3 Household Coping Strategies

Chapter 6 analysed the post-war coping strategies by rural farm households in northern Mozambique. These strategies involve different types of activities, to which households allocate varying labour shares. The BM model of peasant household production was extended to include the subjective valuation of labour and two activities, which involved different risks and returns. This extended model was also derived mathematically and graphically.

Post-war coping strategies were found to include many different market and non-market activities. The war forced households into a high degree of activity specialisation in on-farm, subsistence activities (especially when compared to other African data). In the post-war period, households are diversifying their activities as a response to the varying war legacy and to emerging peace-time opportunities. The sample exhibits a high degree of variance in activity choices and especially in market participation rates which fluctuate between households and between seasons. This supports the view that market failure can be a household- and commodity-specific concept.

The indirect war effects were the main determinants of post-war diversification. The estimated determinants are consistent with the model initially proposed. The strong role of life cycle effects indicates the relevance of Chayanov-style models for the study of war-affected African peasant households, in particular via the negative effect of war on the marginal value of effort.

The determinants of social exchange are similar to those of output market participation and, like market exchange, social exchange is limited after the war. This restricts the participation and benefits of social exchange for the poorest households. The small degree of social exchange practiced is caused by the high degree of covariance of risks within families and even across distance, thus limiting the potential benefits of reciprocity. The extreme poverty also restricts the scope for exchange, which pre-supposes some surplus or income which can be exchanged, even in expectation of future exchange. Finally, the high degree of displacement and volatility in a war economy restrict the opportunities to enforce reciprocity through social means thus further weakening this opportunity for profitable exchange.

8.4 Household Welfare

Chapter 7 built on findings from previous chapters to analyse the determinants of rural household welfare in post-war, northern Mozambique. The main hypotheses put forward were that the war legacy continues to affect household welfare significantly through a

variety of mainly indirect effects, that these war effects create poverty traps from which households cannot escape endogenously, and that these adverse war effects differ by type of welfare indicator. These hypotheses have strong policy implications which are discussed in section 8.7.

Households can indeed become trapped in a war-induced, low-welfare equilibrium in the post-war period. For instance, households were expected to reduce their labour supply in the war period and this effect might have persisted post-war. Instead, peasant households apply increasing amounts of labour to their farm activities in the post-war period thus generating potentially large returns from farming extra land. However, this post-war labour supply response is limited by the low asset endowments and by poor household technology which jointly restrict total farm output.

The war also destroyed on a very large scale the infrastructure to provide rural primary education. More significantly and less obviously, the war also destroyed the demand for education as activities with higher human capital requirements were made unprofitable or unfeasible by the war. While the reconstruction and funding of schools in itself is a large challenge with a state strongly burdened by war debt, stimulating rural demand for more skill-intensive activities is more challenging still. The more war-affected local markets are and the more economically isolated a household is, the lower will be the demand for education and the higher will be the benefits of pursuing subsistence activities, including those carried out by school-age children. This then explains why the returns to education were found to be low in the FSP sample (for instance when compared to the IAF findings). Therefore, low returns to education represent a second dimension of the war-induced poverty trap.

The war also encouraged households to value current utility more highly than future utility (i.e. war increased the discount rate) which is a particularly strong effect for households close to the survival constraint. The war also reduced household assets directly and indirectly so that post-war households have low asset endowments, a low incentive to re-capitalise their endowments, and few opportunities to do so. This process thus represents a third aspect of the post-war poverty trap.

Chapter 7 also assessed the welfare implications of the land use and coping strategies analysed in previous chapters. Expanding the area farmed is clearly a welfare enhancing strategy, which is a result contrasting with similar studies from Mozambique. Income diversification on the other hand has a large welfare cost, however measured. Cotton adoption also appears to be less profitable than estimated by other studies using the same dataset but not correcting for endogenous activity choices. These surprising results have

far-reaching policy implications. In particular, they reject the agricultural intensification and export-oriented cropping strategies advocated by USAID and other donors to Mozambique (USAID 1995, 1996). Spatial diversification on the other hand is associated with higher income and food consumption, as households used several plots to raise production by optimising their production choices for given field-level characteristics.

The analysis also analysed social exchange as an alternative to market-based income generation and income insurance. Due to the war-induced, wide-spread and correlated destruction of livelihoods and the resulting high level of transaction costs, the potential benefit of social exchange in the post-war period was found to be limited to insuring against unexpected and uncorrelated income shortfalls, for example due to individual illness. Social exchange is at best a short-term coping strategy but it is not a long-term poverty alleviating strategy. Factors helping to make social exchange profitable in the post-war period will also make market-based activities more profitable.

These findings advance the understanding of the determinants of post-war rural poverty in Mozambique, which had not previously included a parallel analysis of competing welfare indicators and of the effects of endogenous activity choices on household welfare. These methodological improvements therefore yield new empirical insights which cast strong doubts on some rural development policies currently practiced in northern Mozambique.

8.5 Peasant Household Models

The focus of these conclusions will now shift from an analysis of empirical issues to the three core themes of the thesis, namely the study of peasant household models, war and Mozambique.

The thesis assessed how useful standard models of farm household behaviour are in the post-war context. It was found that the BM model of peasant household behaviour in land abundant areas is a useful guide to forming expectations about household behaviour after war. However, war changes the reasons for the predictions derived using that model. Therefore, the economic transition processes at the farm household level differ between a peace-time and a war-affected economy.

It may even be misleading to speak of a transition process between temporary equilibria in the case of a war or post-war economy as the expectation formation and information forming processes are massively dislocated by conflict. This causes households to make non-marginal choices which have significant welfare effects. In the extreme, each individual household does not have a very large choice set under conditions of war with both the technically feasible and the desirable options being severely curtailed through direct and

indirect effects. In aggregate, this is compatible with outcomes varying strongly across households or over time as there are many possible short-term equilibria depending on individual circumstances.

Combining the effects of a war and those of land abundance (where war enhances the degree of de facto land abundance) then leads to the war-time and post-war economy being characterised by circumstances quite different from those of many other developing countries. These circumstances, however, remain largely traceable using standard economic analysis.

8.6 The Nature of the War Legacy

One theme of this thesis has been an assessment of the nature of the war legacy on labour, land, assets, markets and social institutions in northern Mozambique. At the household level, the war reduced the household labour supply and damaged household human capital. The former appears more reversible in the post-war period than first expected but the latter is slow to reverse due to the costs of providing education and the low demand for education.

The war legacy also forced households to reduce their planning horizon. This had particularly strong effects for households close to the survival threshold and further reduced asset holdings and investment in productive assets and long-term activities. Some of these effects are difficult to reverse without aid to provide a large boost to assets, hence helping to re-establish some forms of production (e.g. in the cashew sector) and helping to insure very poor households against some forms of risk.

At the institutional level, social institutions of the Macua society appeared surprisingly resilient to the war and helped households cope with its long-term, adverse effects. More anthropological and sociological research into this phenomenon would yield large dividends in terms of the understanding of these institutions. Market institutions suffered severely and households retreated into subsistence production to provide at least a minimal level of food consumption.

The destruction of market institutions indicates how some of the most significant war effects, from the point of view of household welfare and economic development, occurred indirectly and are not easily and endogenously reversible. The reversibility of the indirect war effects then emerges as a key characteristic determining the speed of post-war production recovery, poverty alleviation and food security.

One reversible war effect is that on own-farm labour supply which increases with a decreased need to be alert to attacks. In addition, the area cultivated is seemingly reversible

in line with this increased post-war labour supply. Chapters 4 and 5, however, uncovered important constraints on land access and land use therefore preventing households from fully utilising what had been an increased degree of war-induced land abundance. For instance, the high degree of asset destruction and depletion due to the war reduces the ability of households to expand farm production.

Moreover, the war vulnerability of certain activities suitable to rebuild assets implies that households find it nearly impossible to rebuild their endowments endogenously. This example of a post-war poverty trap is accentuated by the need for households to use assets as a precautionary savings instruments in the face of absent credit markets. Destitute households close to the absolute survival constraint therefore cannot rebuild their asset in the face of significant exogenous fluctuations of income.

These results concerning the effects of the war legacy indicate that post-war reconstruction at the rural household level is a very slow process, in northern Mozambique and in other similar circumstances. Recognising that post-war reconstruction requires more than the ending of the war is an important finding. The micro-economic analysis added to this finding by indicating several transmission effects of war on long-term growth in rural areas, hence providing some suggestions for the alleviation of war-induced poverty in Mozambique.

8.7 Post-War Reconstruction Policy in Mozambique

There are several general pre-requisites for successful post-war reconstruction policies appropriate for northern Mozambique. These include the importance of externalities of market withdrawal, the role of public goods in overcoming these, and the need for decentralising reconstruction policy.[93]

Chapter 7 analysed several mechanisms which accentuate post-war rural poverty at the household level. These are compounded in the worst war-affected and in the economically most isolated areas of northern Mozambique by the externality effect of the household market participation decision. If a household decides to withdraw from a market, this enhances the degree subsistence in the local economy, in turn reducing the incentives of other households to engage in market activity. Government intervention in establishing and building markets in the most war-affected areas will thus be particularly important to create the initial incentive to join a market.

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[93] See chapter 3 for references to Mozambican economic policy debates since the war.

Taking into consideration that the FSP survey was not conducted in the first two years after the ceasefire and that it is slightly biased towards less isolated rural areas, it is expected that in earlier seasons and in more isolated areas the benefits from market participation would be weaker and the welfare losses associated with cotton adoption stronger. Overcoming these post-war poverty traps hence involves stimulating household production through government and donor aid, especially in the early post-war years and in the most-war affected areas.

The importance of village-level effects implies that the government and donors can assist household coping strategies by providing public goods to enhance market participation and diversification opportunities. Post-war public policy must therefore recognise the importance of local and individual differences in the experience of war and aim to decentralise its interventions given that different villages or districts may face different constraints to expanding production and trade. Other policy options following from these results include re-capitalising war-affected households, enhancing human capital, and reducing rural transaction costs to affect the whole range of diversification determinants.

In summary, post-war reconstruction policies should assist market reconstruction and support the expansion of household production as this is not possible for many households without outside support. Policies should help to rebuild public goods as well as household-specific capital and take into consideration the diverse effects of war across locations.

The remainder of this section will discuss the apparent choices between emergency and development aid, between human capital and physical capital development, and between on-farm and off-farm coping strategies and their impact on household welfare in the post-war period. These three choices have been important themes in post-war Mozambican policy debates. To analyse these issues, it is helpful to recall that some variables affected all three indicators of welfare. For example, female-headed households or asset-constrained households are significantly poorer as measured by all indicators, even if the strength of the effects varied between indicators.

However, some determinants differed across these indicators. In particular, household income was affected by assets, markets, prices and activity choices while household food consumption was affected by land characteristics and social institutions. Both the difference in groups of significant determinants and the scale of the individual effects are shaped by the experience of the war at the household and market levels.

The implications for the policy debates are that there is a core set of common welfare determinants while at the same time there is some degree of divergence between the

determinants of the different aspects of household welfare. Some policies may thus help to alleviate poverty and increase food security while other policies may achieve only one of these objectives for only some types of households. In consequence, the distinction between emergency and development policies in the post-war period is artificial. Instead, policies should be evaluated as to their effect on household income, consumption and food consumption, and any other indicator of interest.

What were considered emergency policies in the immediate post-war period in northern Mozambique (e.g. distributing seeds and tools) may thus have positive long-term effects on household income if such policy helps to alleviate a household asset constraint and thus increases the household labour supply response. Similarly, what are considered development policies in the later post-war period (e.g. the construction of schools) may have little impact on most rural households as long as complementary, genuine development policies aimed at restoring the demand for education are ignored. In the worst case, offering only a selected or unbalanced set of post-war development programmes for rural areas may lead to the divergence between income and food security intensifying and could make seemingly prospering households (e.g. cotton growers) become very food insecure.

The evidence also suggests that the debate over the relative importance of human capital versus physical capital policies is misguided as the broad destruction of war at the household and market levels requires an integrated approach to rebuilding human, physical and institutional assets. It may be administratively easier to organise selective large scale programmes. Yet the key war legacies will only be overcome with integrated rural development programmes.

Finally, the debate between the relative importance of off-farm versus on-farm activities and, within the on-farm debate, the choice between food crop versus cash crop programmes both disregard the prevailing constraints and incentives in post-war rural areas. Based on the evidence of the FSP dataset from northern Mozambique, the contribution of off-farm activities for post-war household welfare is very limited and probably was even more limited during the war. Households under conditions of war maintained their food security to an incredible degree by retreating into food subsistence production. In the post-war period, they faced increasing incentives to return to market based agricultural and especially tradable food crop activities. However, the welfare effects of adopting cotton or off-farm activities have been more limited if not negative.

Policy makers can thus encourage war-affected households to consolidate their post-war welfare gains by strengthening rural food crop markets and opening international markets,

especially in Malawi, for northern Mozambican food crops. Alternatively, they can try to improve the incentives for adopting cash cops and expanding off-farm activities. Given the persisting war legacy, the consequent need to restore basic market and social institutions, and the weak capacity of the state in rural northern Mozambique, the former policy option appears to offer higher returns for some time to come.

The organisation of a wide-spread rural education network should not take priority from an agricultural production point of view. Enhancing the household coping strategies perfected in a situation of near market autarky during the war appears to be a relatively low cost and yet effective agricultural development, poverty alleviation and above all food security strategy for the early post-war period in northern Mozambique.

8.8 Suggestions for Future Research

The research presented in this thesis was initiated at a time when the effects of war were not yet viewed by most economists as a distinct research theme or indeed as largely rational phenomena. Meanwhile, an economic "conflict" literature has evolved and is starting to shed light on the economic rationale for war and on the economic consequences of war.

At the theoretical level, models emphasising the importance of survival constraints, severe shocks, massive transaction costs, and rapidly changing economic circumstances should advance the study of behaviour before, during and after conflict. The distinction between different types of conflicts and the comparison with different types of disasters promise to yield further insights as would interdisciplinary approaches including anthropological or sociological analyses of war-affected behaviour. Within economics, the international and macroeconomic analyses of the effects of war could be connected more closely with microeconomic studies of war. Within the microeconomic analysis of conflict, the effects of war on income inequality remain to be modelled and tested more carefully. It would appear that war strengthens inequality though this may depend on the type of war. Another issue not yet fully developed in the conflict literature is the gender dimension of war and reconstruction, although this may be strongly location dependent.

At the empirical level, the economic study of war is naturally constrained by poor data. The returns to better data should thus be large. In particular, panel data or natural experiments in countries with a good pre-war level of microeconomic data supply should improve the empirical analysis of conflict. Other academic disciplines may have a comparative advantage in the study of war-time processes to the extent that they rely less on quantitative data. Economists studying these issues might benefit from conducting fieldwork in

countries experiencing the first phase of post-war reconstruction, especially now that some theoretical insights are available into how war is likely to affect such economy.

At the policy level, the key challenge for policy advisors remains to convince governments and donors of the opportunities and the benefits of intervening in war and post-war economies. As this thesis has shown, households respond rationally to the various constraints imposed by war, minimising risks and maximising welfare. Policy makers have an important role in assisting war-affected households in these difficult circumstances, thus significantly accelerating post-war poverty alleviation beyond what has been practised or thought possible in the past.

Appendices

These appendices present theoretical and empirical results which are complementary to some of the main chapters above. Note that figures are listed at the end of each section.

Appendix A.1 summarises a mathematical version of the Binswanger and McIntire (BM) model presented graphically in figure 2.2 in chapter 2. This explicit model is developed here as the original BM paper (Binswanger and McIntire 1987) does not develop mathematical or geometric versions and as the explicit model is a useful way of explaining the choice of independent variables for the econometric specifications.

The next section of the appendix analyses land use patterns across time in Mozambique, using all feasible data sources. This inter-temporal analysis complements the cross-sectional analyses of chapters 4 and 5 and provides new insights through the novel comparison of data sources.

Appendix A.3 outlines the formal model of household activity choices used in chapter 6 and summarised in figure 6.2. The model combines an analysis of risk and returns based on portfolio theory with elements of peasant household analysis derived from Chayanov. The model can explain how poor peasant households are forced into adopting very risky portfolio choices as a result of war and how post-war coping strategies adjust only slowly after the end of the conflict, thus resulting in very slow rural reconstruction.

The final appendices A.4 and A.5 complement the welfare analysis of chapter 7. The first part analyses the variability and smoothing of income and expenditure and supports the choice of the three welfare indicators adopted in chapter 7. The second part addresses the inequality of the welfare indicators and asks if it may be caused by inequalities in asset endowments after the war. On the one hand, conflict can be expected to destroy endowments indiscriminately thus reducing asset inequality. On the other hand, the actual experiences of war differ markedly across households and the effects of war may not be distributed as randomly as is commonly thought. In addition, asset inequality differs by the type of asset class and the type of conflict under analysis.

A.1 Specification of the BM Model

This appendix formalises the BM model of a peasant household under conditions of land abundance as described verbally in section 2.2 (Binswanger and McIntire 1987). It can be summarised as follows:[94]

$$\max \quad U = U(X, L),\ U_X > 0,\ U_{XX} < 0,\ U_L < 0,\ U_{LL} > 0 \tag{A.1}$$

$$\text{w.r.t.} \quad L$$

$$\text{s.t.} \quad X = X(Q),\ X_Q > 0,\ X_{QQ} < 0 \tag{A.2a}$$

$$Q = Q(L),\ Q_L > 0,\ Q_{LL} = 0 \tag{A.2b}$$

$$L \leq L_{max} \tag{A.2c}$$

$$X \geq X_{min} \tag{A.2d}$$

where:

U = utility function (e.g. measured in calories/person)

X = retained agricultural staple crop or storage function

Q = household's production function for a staple crop

L = household labour input (e.g. measured in hrs/person)

L_{max} = maximum household labour supply

X_{min} = minimum household consumption target (survival threshold).

The consumption of retained output has a positive but decreasing effect on utility while increasing the labour supply has an increasingly negative effect on utility, where the utility function (equation A.1) has a standard form. The latter is equivalent to stating that there are decreasing returns to utility from leisure, where the total time available (L_{max}) can be allocated to either leisure or labour. The household must aim for a minimum level of consumption (X_{min}) as survival is otherwise threatened (equation A.2d). The production function equation A.2b has constant returns to scale as land is abundant. The total household labour supply, which has an upper bound as shown by equation A.2c, determines the total area cultivated and hence output. This is stored to be consumed throughout the year. The storage function has decreasing returns to scale as produce deteriorates when stored over time (equation A.2a).

Assets are integrated into the model indirectly by assuming constant capital/labour ratios which are required for a given production function to be valid. This model assumes that farm management skills, technology and assets are initially given across households. A change in these parameters would affect the shape of the production and storage functions.

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[94] The equation numbers refer to chapter 2 to maintain consistency with the discussion presented there.

The risk aversion of the household shows itself in the model through the shape of the indifference curves. The riskiness of production is not directly shown in the model but production in the model could easily be thought of as being random around the mean Q with each household not knowing in advance which outcome will obtain after planting. In addition, the crop storage function, which is required due to the presence of seasonality, could include an element of risk as storage need not result in predictable losses.

Changes in household characteristics (which affect both the household labour supply and its consumption needs) will shift the constraints A.2c and A.2d and the shape of the indifference curves, resulting in a different subjective wage rate (where the slope of the indifference curves represents the subjective wage level of the household, measured in leisure foregone per unit of stored output). Such changes are most pronounced throughout the life-cycle of a household.

A.2 Patterns of Land Use over Time

This appendix analyses the long-term pattern of land distribution in the peasant household sector in Mozambique using a broad range of sources. Such inter-temporal perspective complements the cross-sectional, econometric analysis presented above. Comparing data from such a range of sources has of course strong limitations but it appears that some general conclusions can still be made. These include the apparent ease with which households adjust farm sizes between two agricultural years, the relative abundance of land in northern Mozambique, and the observation that households may have extended the area farmed during war to make increased use of the agricultural extensive margin. In the post-war period, however, land inequality may have increased, perhaps as some households failed to escape war-time poverty traps. At the very least, it can be concluded that land abundance appears to coexist with inequalities in the distribution of land. This apparent paradox is resolved in chapters 4 and 5.

There are a number of data sources available for studying changes to land holdings by farm households in northern Mozambique since the late colonial period. These include: 1960s MIA (Hill 1995), 1991 FSP (MOA/MSU/UA Research Team 1992b), 1993-95 Care (Care Mozambique 1995), 1996 TIA (Ministério da Agricultura 1996), 1996 IAF (IAF 1998), and finally the 1994-96 FSP survey analysed in detail in this thesis. Most of these surveys cover at least some districts in northern Mozambique but their varying and often unspecified methods do not permit accurate comparisons of findings across surveys. The comparative discussion of these paragraphs is therefore very tentative, though it may well represent the most accurate and comprehensive review of historical land distribution data for northern Mozambique possible and ever presented in one study.[95]

Figure A.1 summarises some household survey evidence from the late war years and from 1993, the first post-war year.[96] Unfortunately, the source does not indicate whether the values refer to cultivated land or cultivated and fallow land and how households were selected for the 1993 survey. The values shown are likely to be representative of the respective districts within each study but not of the country as a whole. The two columns compare the same districts within each row but each study interviewed different households in each district. The mean farm size appears very small in comparison to

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[95] For discussions of land distributions in northern Mozambique based on single household surveys, see: Care Mozambique (1996), Hill (1995), IAF (1998), Marule (1998), Melamed (1998, 1999), MOA/MSU Research Team (1994), MOA/MSU/UA Research Team (1992c), and Tschirley and Weber (1994).

[96] The figures in the appendices are presented at the end of each section.

findings presented below. This may be a result of the methodology of these two studies which are different from those conducted by the FSP.

Given these limitations, the figure suggests that mean land holdings per household have increased by 36% to 47% between 1988 and 1993, except in the district of Nampula where there was no change in farm size. Note that it is not clear if the observed increases are the result of larger areas farmed per capita or due to decreases in household size. The town of Nampula, the largest in northern Mozambique and held by the government throughout the war, was the destination of many refugees during the war thus substantially increasing the population density in Nampula district and limiting the scope for farm size increases.

Figure A.1 then suggests two things. First, that households during the worst phase of the war actually increased the scale of their farm operation, by increasing the amount of area farmed per capita, by increasing household sizes, or by doing both. Given the limited nature of markets and transport during the war, this suggests that households increasingly grew subsistence crops destined for home consumption. The war may thus have induced a significant increase in the extensive margin of agriculture with a likely parallel decrease in the intensive margin (i.e. a drop of productivity per hectare farmed).

Second, the data suggests that there is some degree of land abundance in the more remote and less secure areas. Land abundance appears to be a very location-dependent concept in northern Mozambique, related to population movements induced by the war and the prevailing security situation. If there had been large return migrations after the end of the war to all areas of origin, the pressure on the land near Nampula town, for instance, would have lifted significantly.

Figure A.2 summarises the results of two two-year surveys from the post-war period in northern Mozambique. The Care survey has some methodological flaws and is less reliable than the FSP survey. For example, it was not possible to construct appropriate weights for the Care survey so that the calculated results may be systematically biased. The Care survey also did not record household characteristics for 1993-94 so that the estimates for per capita and per ACE values had to use the 1994-95 household sizes instead. In addition, the Care survey covers more interior districts in Nampula than the FSP survey and was not affected by the cyclone Nadia in early 1995 so that some of the observed differences between the surveys may derive from different underlying populations studied.

The most reliable indicator in both surveys is the number of plots per households, which is most easily enumerated in a survey. For the overlapping agricultural year of 1994-95, both surveys indicate that an average household farms about 3.8 plots, where each plot has a size of about 0.8 hectares. The change in the number of plots over the years is highly significant

in both surveys but it is not linear. From 1993-94 to 1994-95 the mean number of plots per household increased by 18%, only to fall by 21% in the subsequent year. These findings indicate that households to a large degree adjust the scale of their farm operation from year to year. Households do not appear to be strongly constrained in their ability to adjust to changing economic circumstances, such as the occurrence of the cyclone which may have caused a reduction in the number of plots in 1995-96.

The area farmed per capita and per ACE in both surveys diverges strongly, most likely due to different definitions of household and residency. However, these values, even if not directly comparable across surveys, indicate a strong degree of flexibility in farm size from year to year, with both area per capita and per ACE changing by between 13% and 17% from one agricultural year to the other.

Figure A.3 summarises a divergent set of household survey results from northern Mozambique, covering the period 1991 to 1996. The table shows land holdings per ACE to permit also the even grouping of households into quintiles. The Care results and to a lesser degree the IAF results are methodologically less comparable to each other and to the FSP and TIA results. The Care results are likely to overestimate land holdings per ACE. The areas covered by the surveys also vary, which will explain some of the differences between the distributions of land. In particular, the FSP 1994-96 survey focuses on potential cotton growing areas which also have more off-farm income opportunities. Finally, the IAF survey is the only non-agricultural household survey included in this table and its estimate of land holdings are therefore not very accurate.

This evidence suggests two points. First, the land endowment per ACE appears remarkably stable, though perhaps declining slightly, when comparing the FSP and TIA surveys. This may indicate a slight post-war shift away from land as the key foundation of rural coping strategies. Second, there appears to be a slight increase in the inequality of the distribution of cultivated land. This can be observed both with the two two-year surveys and across the more comparable FSP 1991, Care, TIA and IAF surveys. Recall that the choice of districts makes the distribution described by the FSP 1994-96 survey less comparable to the other results. Another indicator of inequality is presented in the far right column in figure A.3 where the ratio of the mean in the top quintile over the mean of the bottom quintile is shown. Again, an increase in inequality within the multi-year surveys and across some of the other surveys can be detected, though the initial 1991 value is actually higher than the corresponding 1996 IAF value.

An alternative interpretation, which can not be proven correct or otherwise with the available data, is that the war created inequalities in land holdings (see also the discussion

on this below) but that local circumstances affected whether the distribution improved or worsened in the post-war period. The more easily accessible areas covered by the 1994-96 FSP survey may be indicative of how land inequality diminished over time (perhaps due to a generally large supply of agricultural land and complementary off-farm income opportunities) while in the districts covered by the TIA 1996 survey land inequality worsened (perhaps due to increasing land scarcity or the existence of poverty traps for the poorest households which leads to their loss of control over land). The main conclusions from the analysis of these figures are that land inequality exists despite the apparent land abundance, that land inequality is variable across space and time, and that there are some areas where land inequality appears to worsen over time.

Similar evidence on the distribution of land is presented in figure A.4 which also summarises the ratio of the mean land holdings, where land holdings are defined in four different ways. The Care data again stands out for not being weighted while the FSP data does not cover the same districts in all years. The table shows clearly that there is a strong variation of inequality across space in a given year, across time for a given area, and across definitions of inequality for a given time and place. The data in this figure does not suggest a change in inequality over time but it does show how inequality is not constant. The allocation of land is therefore strongly dependent on location- and household-specific variables, which is one of the reasons for the detailed regression analysis presented below.

Figures A.5 and A.6 make the boldest and perhaps least justifiable inter-temporal comparison of land distributions so far. Building on colonial data reported by Hill (1995: 5), figure A.5 indicates the proportion of households belonging to each group defined by the area farmed (measured in hectare) per household. For example, in the 1960s 3% of all households had less than 0.1 ha of land while 30% of all households (the largest single group) had 1 to 2 ha of land. It is then possible to calculate similar values for more recent surveys such as the 1993 DEA, the 1993-95 Care and the 1994-96 FSP surveys.

The MIA data is the result of a large scale and very thorough data collection in the colonial period and it is drawn from an unknown number of households across the whole country. The DEA data is derived from 1616 households, also drawn from across the country. Both the Care and the FSP surveys only refer to the north of Mozambique. Note that the MIA survey grouped all households with five or more hectares of land in one group. This turns out to be quite restrictive for the surveys from the 1990s in which up to six times more households report land holdings of such size. This causes the graph in this figure (and in figure A.6) to exhibit a slight, artificial tilt on the far right hand side.

Given the different methodologies and the subsequent problems in comparing results from different surveys, two speculative observations can be made (figure A.5). First, the shape of the distributions across all surveys is quite similar (with perhaps the methodologically most doubtful Care data being the least similar). This may of course be the result of chance, with so many ambiguities attached to comparing different surveys. However, it remains quite a striking similarity suggesting that the very long-term has seen comparatively little change in the relative distribution of land. Second, the curves representing survey results from the 1990s appear to have shifted slightly to the right, supporting the earlier finding that mean land holdings have increased since, during or perhaps even before the war (unless the entire shift to the right is due to systematic differences in the measurement of the land).

Figure A.6 plots the cumulative share of land held by each group of households for the same surveys as analysed in figure A.5. Note that the same caution concerning the validity of a comparison across the surveys as in figure A.5 applies in this figure. Such cautious comparison then appears to suggest two points. First, the slope of the curves shown in the graph are quite similar, except perhaps for the later FSP data that is slightly steeper around the mean due to a relatively low degree of land inequality observed in that sample. The similarity between the MIA and the DEA data spanning a period of about 30 years is particularly striking. Second, the mean landholdings appears to have increased since the 1960s, as has been noted above.

The overall evidence on long-term changes in the distribution of land holdings in northern Mozambique is thus ambiguous, especially given the varying quality and methodologies of the available surveys. With the evidence of slight increases in land inequality in the multi-year surveys, a cautious hypothesis of changing post-war land distribution might suggest that such distribution, while quite dynamic generally, had tended to become less equal, especially in some areas or for some households.

Such differentiation across farm households concerning their most important asset may be the result of diverging activity choices, which may include a move away from land-based activities (chapter 6). Alternatively, the diverging access to markets (including those for credit) and social institutions may imply that households accumulate assets at diverging rates hence increasing inequality. Finally, a de facto privatisation of land rights may cement an unequal land distribution more than purely social and communal land access (as in the traditional model) would ensure (chapter 5). The available evidence does not permit a final evaluation of these explanations at this point but the purpose of these descriptive statistics is to indicate the possible existence of this process of differentiation, which is relevant for the interpretation of results in the main thesis chapters.

Returning from the discussion of land inequality to that of land abundance in northern Mozambique, Tschirley and Weber have used the evidence from the FSP survey of 1991 shown in figure A.4 to argue that there is no land abundance in northern Mozambique (1994). They argue that with land abundance, households with more household members should be able to increase their household land endowment correspondingly, so that a fixed land per capita endowment can be maintained. The increases in the different per capita ratios in figure A.4 suggest, according to Tschirley and Weber, that household land endowments do not adjust to changing household characteristics because of land scarcity.

However, the analysis of chapter 2 suggests that in the circumstances prevalent in the early 1990s in Mozambique, households do not aim for a fixed land per capita endowment. With land abundance and war-induced breakdown of markets, the valuation of leisure will vary across households as will the optimal farm size per capita (figure 4.1). Not considering these household characteristics (such as the dependency ratio) will therefore lead to misleading comparisons of household land endowments. This is akin to comparing bi-variate poverty incidents (e.g. for male- versus female-headed households) where the observed differences in poverty may not be due to the gender of the household head but to other variables (such as education of the household head).

Instead, in the land abundant and war-affected economy of northern Mozambique one can expect the distribution of land to be unequal exactly because different households have different land requirements, capabilities and preferences. That is, households with different consumption requirements, production technologies and preferences will have a variety of different land endowments, even though all rural households are very strongly dependent on land for their survival.

Apart from this theoretical and war-related reason not to expect an equal distribution of land in the war and post-war periods, the evidence presented here suggests that despite the obvious inequality of land holdings there is a quickly changing system of land use in northern Mozambique. Nevertheless, it may be that individual households face additional constraints to acquiring and maintaining the tenure of land. For example, it could be that refugee households find access to land more difficult than non-refugee households, even if their immediate environment is not characterised by land scarcity. It may thus be land access which is constrained in northern Mozambique and not the overall supply of agricultural land. This is another reason why chapter 5 also analyses the subjective security of land tenure, as it is both the quantity and the characteristics of land which affect household activity choices and ultimately welfare.

In discussing land distribution and land abundance in northern Mozambique, it has been implicitly assumed that there are no landless labourers in rural northern Mozambique. From a methodological point of view, household surveys can be poor instruments for analysing landlessness as land-poor households may end up migrating to urban areas leaving only the better land-endowed households behind (Maxwell and Wiebe 1998: 28, Troutt 1994). This is particularly true in the post-war period in Mozambique where (for various reasons) not all refugees returned to their mainly rural areas of origin.

However, given the presumed land abundance in northern Mozambique and the small relative sizes of urban areas in the north of the country where even a large majority of urban settlers farm some land (IAF 1998), the main impact of the war may not have been primarily to create landless households but to increase land pressures in semi-urban, historically less war vulnerable areas. While it is not possible with the current data to assess the selection bias against landless households, none of the interview partners during the fieldwork ever pointed to landlessness as being a problem.

The FSP 1994-96 survey (as well as other surveys as shown above) include a very large range of land holdings. For example, 90% of all households in the FSP 1994-96 survey cultivated between 0.17 and 1.32 ha/ACE in 1994-95, which suggests a level of production just able to provide enough nutrients for survival (especially when complemented by some off-farm or transfer income). Even the bottom decile of the land distribution per ACE in 1994-95 cultivated on average 0.17 ha but controlled an additional, fallow area of 0.14 ha. This evidence suggests that while landless households may have migrated permanently to the urban areas, the remaining rural households do not suffer an ongoing problem of complete landlessness.

In addition, the FSP survey methodology appears to have been aware of the issue of landlessness and does not appear to have systematically under sampled more land constrained or landless households (MAP/MSU Research Team 1996, Strasberg 1997). This supports the conclusion that there is no long-term problem of landlessness in northern Mozambique.

This appendix has reviewed some descriptive evidence on land endowments and land distribution from a variety of rural household surveys from Mozambique. The period of analysis spanned over 30 years, though there are some significant doubts about the validity of comparing results from surveys covering different districts and time periods which will invariably have adopted different research designs and variable definitions.

The cautiously interpreted evidence suggests that the apparent paradox of an unequal distribution of land in a generally land abundant area can be explained by considering

household- and location-specific problems of land access. It is not the overall land availability but rather factors governing land demand and its actual allocation which explain varying land endowments across households. To the extent that households have different valuations of leisure, they may not face a shortage or disequilibrium of land. Occasionally land which is demanded may be available but denied to a household, pointing to household- and community-level factors and processes in the allocation of land which can contribute to observed differences in land endowments. These issues are analysed in more detail in chapter 4.

Figure A.1: Landholdings in Mozambique in the Late War Period

	Hectare/Household		Change	N
Sample	**1988**	**1993**	**(in %)**	
20 Districts in all Provinces	1.26	1.71	36	1616
Monapo District, Nampula Province	1.32	1.94	47	86
Nampula District, Nampula Province	1.52	1.53	0.01	68

The 1988 data is derived from a 1988 FAO study and represents estimates based on the 1960s MIA survey. The 1993 data was collected by the Department of Statistics, Ministry of Agriculture, Maputo.

Source: Hill (1995: 4).

Figure A.2: Landholdings in Northern Mozambique in the Post-War Period

	Care	Care	Change	FSP	FSP	Change
	1993-94	**1994-95**	**(in %)**	**1994-95**	**1995-96**	**(in %)**
Plots/Household	3.23	3.82	18.3***	3.89	3.10	-20.8***
Std Dev, St Err	1.17	1.39		0.16	0.14	
Hectare/Household	2.79	3.18	6.0***	2.87	2.59	-9.63
Std Dev, St Err	1.80	1.94		0.21	0.24	
Hectare/Person	0.70	0.82	17.1***	0.43	0.38	-13.2
Std Dev, St Err	0.57	0.71		0.05	0.03	
Hectare/ACE	0.89	1.03	15.7***	0.54	0.46	-13.8
Std Dev, St Err	0.70	0.83		0.06	0.04	
Hectare/Plot	0.88	0.85	-3.4	0.75	0.86	14.0**
Std Dev, St Err	0.58	0.59		0.04	0.06	
N	238	238		371	371	

The calculations for the FSP survey have been weighted and show standard errors. The Care survey does not include data on household sizes in 1993-94; some calculations use values for 1994-95 instead. The Care data is not weighted. Adult-consumption-equivalent (ACE) is defined in chapter 3. *** These values are significantly different at 99%, as calculated by a paired t-test. ** These values are significantly different at 95%, as calculated by a paired t-test.

Sources: Care data, FSP data and own calculations (iv19/iv20 in ivb&exg.sav, 980116.lst and 980721.lst; iv15/iv16 in ivb&exg.sav, 980106.lst and 980721.lst; iv26/iv27 in ivb&exg.sav, 980125.lst and 980721.lst; iv45/iv46 in ivb&exg.sav, 980721.lst and 980721.lst; iv24/iv25 in ivb&exg.sav, 980125.lst and 980721.lst).

Figure A.3: Summary of Land Holdings and Distributions

Survey (Year)	N	ha/ACE (%)	Q1 ha (%)	Q2 ha (%)	Q3 ha (%)	Q4 ha (%)	Q5 ha (%)	Q5/Q1
FSP (1991)	343	0.55 (101)	0.16 (7)	0.29 (11)	0.44 (17)	0.67 (23)	1.28 (43)	8.00
Care (1993-94)	238	0.89 (100)	0.33 (7)	0.53 (12)	0.74 (17)	1.03 (24)	1.80 (40)	5.45
Care (1994-95)	238	1.03 (100)	0.37 (7)	0.62 (12)	0.85 (17)	1.17 (22)	2.14 (42)	5.78
FSP (1994-95)	371	0.54 (100)	0.22 (11)	0.38 (17)	0.54 (19)	0.73 (25)	1.34 (28)	6.09
FSP (1995-96)	371	0.46 (99)	0.16 (8)	0.31 (14)	0.42 (23)	0.64 (23)	1.22 (31)	7.63
TIA (1996)	685	0.51 (101)	0.12 (5)	0.25 (10)	0.39 (16)	0.58 (24)	1.21 (46)	10.08
IAF (1996)	701	0.75 (100)	0.23 (6)	0.39 (11)	0.56 (15)	0.86 (23)	1.71 (45)	7.43

The data for the quintiles Q1 to Q5 have been ranked by ha/ACE and show mean ha/ACE per household per quintile and the share of total land held by each quintile. All measures refer to cultivated land and resident household members only. Some percentages do not add up to 100 due to rounding. FSP 1991: Data are weighted. Care 1993-95: Data are not weighted; they are paired. FSP 1994-96: Data are weighted; they include paired observations from two consecutive agricultural years from Nampula and neighbouring Cabo Delgado provinces. TIA 1996: Data are weighted. IAF 1996: Data are weighted; data refer to rural Nampula province only.

Sources: Own calculations (FSP 1991: areaace in f-hh.dta, 000203.log; Care 1993-95: iv45/iv46 in ivb&exg.sav, 980721.lst; FSP 1994-96: areace2 in area.dta, 000210.log; TIA 1996: areaace in land-namp.dta, 000207.log; IAF 1996: areaace in n04av08.dta, 000208.log).

Figure A.4: A Comparison of the Distribution of Land

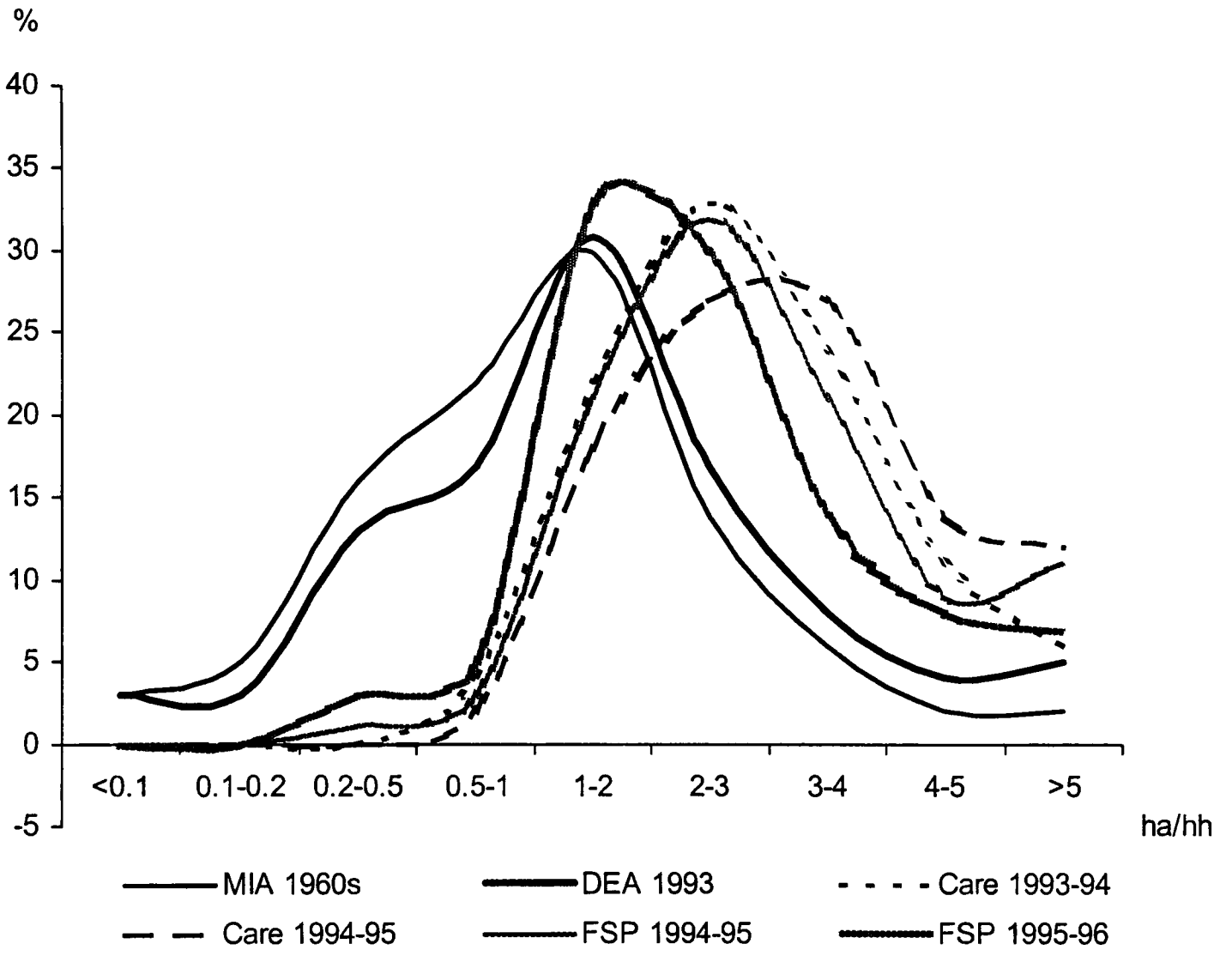
	Mean of Top Quartile over Mean of Bottom Quartile						
Survey	FSP			Care		FSP	
Location	Monapo	Ribaué	Angoche	All Sample Districts		All Sample Districts	
Year	1991	1991	1991	1993-94	1994-95	1994-95	1995-96
ha/household	5.67	5.10	4.92	4.17	2.50	4.32	4.59
ha/person	n.a.	n.a.	n.a.	4.68	3.09	4.95	6.28
ha/labourer	6.23	6.97	7.40	n.a.	n.a.	n.a.	n.a.
ha/ACE	6.40	6.53	6.76	4.61	3.04	4.97	6.23

The values shown are ratios, not sizes in hectares.

Sources: 1991 values are calculated from Tschirley and Weber (1994: 162). 1993-95 values are based on Care data and on own calculations (iv15/iv16, iv26/iv27 and iv45/iv46 in ivb&exg.sav and 980721.lst). 1994-96 values are based on FSP data and own calculations.

Figure A.5: Distribution of Landholdings

Households per Group in %	Size of Cultivated Landholdings (ha/household)										N
Survey	**<0.1**	**0.1-0.2**	**0.2-0.5**	**0.5-1**	**1-2**	**2-3**	**3-4**	**4-5**	**>5**	**Total**	
MIA 1960s	3	5	16	22	30	14	6	2	2	100	n.a.
DEA 1993	3	3	13	17	31	17	8	4	5	100	1616
Care 1993-94	0	0	0	4	22	33	24	11	6	100	238
Care 1994-95	0	0	0	2	18	27	27	14	12	100	238
FSP 1994-95	0	0	1	3	21	32	21	9	11	100	371
FSP 1995-96	0	0	3	5	33	30	14	8	7	100	371

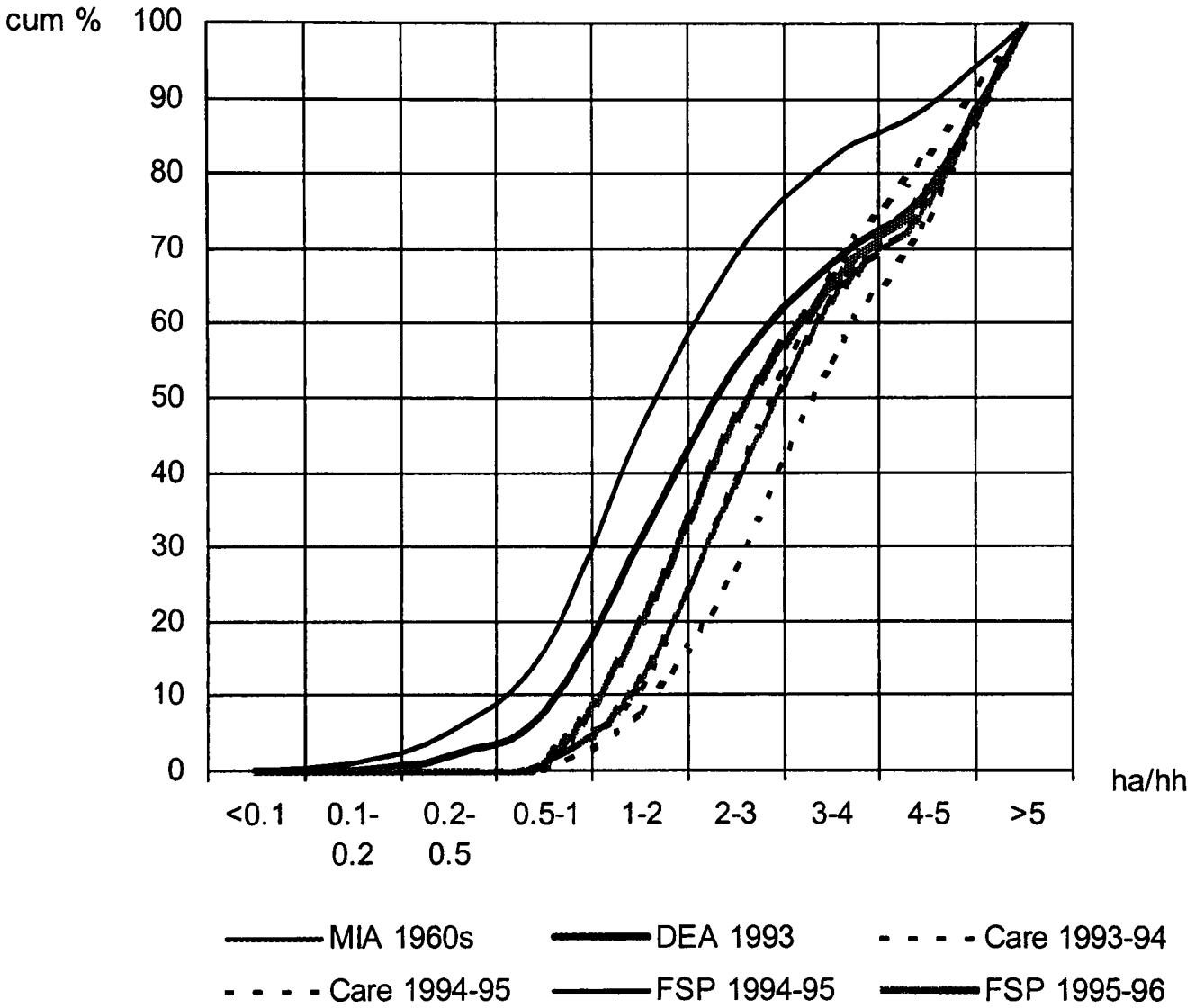


Individual figures may not add to total values due to rounding. The 1993-95 Care data includes the restricted sample where iv15/iv16<15 ha/household. The FSP 1995 data is weighted. Curves have been smoothed.

Sources: The data from the 1960s refers to the MIA survey while the data from 1993 refers to the DEA survey. These results are reported in Hill (1995: 5). The data from 1993-94 and 1994-95 is based on own calculations from the 1995 Care survey (iv15/iv16 in ivb&exg.sav in 980729.lst). The FSP 1994-96 data is based on own calculations (land-r20, land-fig-02.doc).

Figure A.6: Distribution of Landholdings

Cumulative Share of Total Area in %	Size of Cultivated Landholdings (ha/household)									N
Survey	**<0.1**	**0.1-0.2**	**0.2-0.5**	**0.5-1**	**1-2**	**2-3**	**3-4**	**4-5**	**>5**	
MIA 1960s	0	1	5	16	46	69	82	89	100	n.a.
DEA 1993	0	0	2	8	31	54	68	78	100	1616
Care 1993-94	0	0	0	1	11	39	66	83	100	238
Care 1994-95	0	0	0	0	8	27	55	74	100	238
FSP 1994-95	0	0	0	1	12	38	63	76	100	371
FSP 1995-96	0	0	0	1	20	47	65	78	100	371



Individual figures may not add to total values due to rounding. The 1993-95 Care data includes the restricted sample where iv15/iv16<15 ha/household. The FSP 1995 data is weighted. Curves have been smoothed.

Sources: The data from the 1960s refers to the MIA survey while the data from 1993 refers to the DEA survey. These results are reported in Hill (1995: 5). The data from 1993-94 and 1994-95 is based on own calculations from the 1995 Care survey (iv15/iv16 in ivb&exg.sav in 980729.lst). The FSP 1994-96 data is based on own calculations (land-r20, land-fig-02.doc).

A.3 A Model of Activity Portfolio Choices

This section of the appendix will present a simple model of activity portfolio choice under risk to formalise the arguments presented in chapter 6. The model does not contain a specific "war variable" which explains the effects of the war in Mozambique on household activity choices. Instead, section 6.3 discusses how war can affect the many variables in the model and how this will affect activity choices during and after conflict.

Consider a peasant household with two production activities where these activities may differ in their productivity, riskiness and the farm-gate prices that can be obtained with these products. Land is abundant and the total labour supply equals household labour supply as there is no labour market (see chapter 4 for the household choice between labour and leisure). Assets are given in each period. Utility depends positively on profits and negatively on the riskiness of the portfolio of activities. The household maximises its utility by allocating household labour between the two activities.

Portfolio Risk

The main risk in household production derives from the variance of portfolio revenue net of costs:

$$V = \sum_i q_i^2 s_i^2 + 2\sum_i \sum_j q_i q_j s_{ij} \quad \text{(A.3)}$$

such that:

$$s_{ij} = \varrho_{ij} s_i s_j$$

where q_i is the share of labour dedicated to activity i, s_i is the standard deviation of the return of the i^{th} activity, s_{ij} is the covariance of returns between two activities i and j, and ϱ_{ij} is the correlation coefficient of the returns to i and j (Bodie and Merton 1998: 282-9, Dixit 1990: 129-33).

In the context of agricultural rain-fed production, returns to activities (that is the marginal revenue of labour) are themselves uncertain, especially with a low input use. Under optimal conditions, a peasant farmer in a developing country might know the distribution of the returns from each activity based on past experience. The model sketched here could be rewritten using expectation operators but to simplify notation, this has not been done. Chapter 6 will discuss in more detail the effects of war on the expectation-formation process in rural areas.

For two activities, equation A.3 can be re-written as:

$$V = q_1^2 s_1^2 + q_2^2 s_2^2 + 2q_1 q_2 s_{12}$$
$$= s_1^2 - 2q s_1^2 + q^2 s_1^2 + q^2 s_2^2 + 2q s_{12} - 2q^2 s_{12}$$

$$= s_1^2 \quad 2q(s_1^2 + s_{12}) + q^2(s_1^2 + s_2^2 - 2s_{12}) \qquad (A.4)$$

where:

$$\partial V/\partial q = -2s_1^2 + 2qs_1^2 + 2qs_2^2 + 2s_{12} \quad 4qs_{12}$$
$$\partial V/\partial q = -2s_1^2 < 0 \text{ (for } \varrho = 0 \text{ and } q = 0)$$
$$\partial V/\partial q = 2s_2^2 > 0 \text{ (for } \varrho = 0 \text{ and } q = 1)$$
$$\partial^2 V/\partial q^2 = 2s_1^2 + 2s_2^2 - 4s_{12}$$
$$\partial^2 V/\partial q^2 > 0 \text{ (for } \varrho = 0)$$
$$q_{Vmin} = s_1^2 / (s_1^2 + s_2^2) \text{ (for } \varrho = 0)$$

and where q_{Vmin} denotes the share of labour allocated to the second activity such that total portfolio risk is minimised. The labour share-risk relationship of equation A.4 is described in figure 6.2 in the bottom-right quadrant.

Peasant Household Production

The peasant household is assumed to operate in an economy similar to that sketched in chapter 3 which does not have credit markets. For a given agricultural year household labour as well as physical and social capital endowments are fixed so that the household asset endowment can be normalised at one. The household labour-capital ratio can then be written as L where L is total household labour supply (e.g. during the peak agricultural season) for a given level of household leisure.

Total farm production then is:

$$X = X_1 + X_2 \qquad (A.5)$$

such that:

$$X_i = X_i(L_i) = a_i q_i \qquad (A.6)$$

and:

$$L \leq L_1 + L_2 \qquad (A.7)$$

where i = 1, 2 are two risky activities (e.g. food and cash crops, or on-farm and off-farm activities), a_i is the activity-specific constant returns to scale (CRS) production technology, and L cannot exceed the sum of L_i. Given the assumption of a fixed asset stock and CRS, equation A.6 contains asset endowments per worker at the activity level equivalent to those at the household level so that the sum of the activity-related capital stocks is one as before. The focus in this model is hence the changing labour allocation, not the allocation of the household stock of capital.

Total farm revenue net of variable, non-labour inputs is given by:

$$R = R_1 + R_2$$
$$= p_1X_1 + p_2X_2 \qquad (A.8)$$

where p_i are farm-gate output prices. Each activity can thus obtain different outputs due to different production technology and different revenue due to different producer prices. Farm-gate prices are net of transaction costs t_i so that:

$$p_i = p_i^* - t_i \quad \text{(A.9)}$$

where p_i^* are given wholesale market prices for good i and transaction costs for each commodity are determined by given household characteristics and market imperfections (de Janvry et al 1991: 1401, Delgado and Siamwalla 1999: 128-9). This implies that commodity prices and commodity market failure are household-specific.

At the beginning of the agricultural year, a household must allocate its total labour supply L between both activities for a given set of expected revenues and for given preferences and endowments:

$$\begin{aligned} E(R) &= E(p_1)E(X_1) + E(p_2)E(X_2) \\ &= E(p_1)a_1(1-q) + E(p_2)a_2q \\ &= E(p_1)a_1 - qE(p_1)a_1 + qE(p_2)a_2 \end{aligned} \quad \text{(A.10)}$$

such that:

$$\begin{aligned} q &= q_2 \\ &= L_2 / L \end{aligned} \quad \text{(A.11)}$$

where E(.) denotes the expectations operator. Total household revenue is thus dependent on the allocation of labour between both activities, relative producer prices and the available technologies. The latter is given in the short-term but may change in the long-term, for example if the household looses some tools or realises its seeds have a lower quality than expected. Expected revenue of equation A.10 is described in figure 6.2 in the bottom-left quadrant.

Subjective Wage and the Profit Function

Peasant households do not pay a monetary wage to the household labour employed but instead incur a subjective wage. The subjective wage is defined as the amount of output a household would require as compensation for a given unit of leisure foregone (Ellis 1993: 111). This is captured here through the subjective wage rate w such that total subjective equilibrium labour costs per household are:

$$\begin{aligned} W &= wL_1 + wL_2 \\ &= wL \end{aligned} \quad \text{(A.12).}$$

These wage costs are affected by the specific household characteristics, which define for example its dependency ratio and thus its labour-leisure trade-off. For the purpose of this

model, W is given as the household life cycle and thus the dependency ratio are not likely to change significantly within one agricultural year.

Total household profits, i.e. revenue net of subjective labour costs, are:

$$\Pi = R - W \qquad \text{(A.13)}$$

so that expected profits are:

$$E(\Pi) = E(R) \quad W \qquad \text{(A.14).}$$

The rate of return of the activity portfolio is then given by:

$$\pi = \Pi / R$$
$$= 1 \quad (W / R) \qquad \text{(A.15)}$$

where:

$$\partial\pi/\partial R \quad > 0$$

and:

$$\partial^2\pi/\partial R^2 < 0.$$

The expected rate of return is thus given by:

$$E(\pi) = 1 - (W / E(R)) \qquad \text{(A.16)}$$

This is described in figure 6.2 in the top-left quadrant. Note that for a given R and as W approaches zero, π approaches one. Similarly, for given W and as R approaches infinity, π approaches one.

Peasant Household Utility

As first indicated in the set up of the BM model in chapter 2.2 and in A.1 above, households value consumption (e.g. of a staple food crop). As before, households have an increasingly high marginal valuation of consumption as they approach the biological survival constraint (e.g. of a certain calorie limit per ACE per day). In addition, households dislike portfolio risk (that is they are risk averse) as this could potentially reduce the available consumption to below the amount necessary for survival. At very low levels of expected profits or at very high levels of risk households thus have a low level of utility.

Mathematically, this implies that the generic peasant household utility function contains two elements: one representing expected portfolio profits and one representing the expected portfolio risk. In a more general model, this second element may not be necessary as risk aversion can be specified without it. However, in this model both elements are introduced explicitly to allow the specific modelling of high levels of risk in times of war and under the presence of a survival constraint (or an increasing disutility from falling income).

The household utility function then is:

$$U = U(\Pi, V) \qquad \text{(A.17)}$$

where:

$$\partial U/\partial \Pi > 0$$
$$\partial^2 U/\partial \Pi^2 < 0$$
$$\partial U/\partial V < 0$$
$$\partial^2 U/\partial V^2 > 0.$$

The utility of equation A.17 is plotted in risk-expected rate of return space in figure 6.2 in the top-right quadrant. Note that more risk averse households would have steeper iso-utility curves (i.e. a small increase in V would have to be compensated by a larger gain in $E(\pi)$ for utility to remain constant). In addition, the iso-utility curves bunch increasingly closer together near the bottom right part of quadrant II where households approach their absolute survival constraint (which has not been plotted in figure 6.2).

Equilibrium

Households maximise utility with respect to the labour allocation subject to the labour constraint:

$$\max U = U(\Pi, V)$$
$$\text{w.r.t.} \quad q$$
$$\text{s.t.} \quad 0 \leq q \leq 1 \qquad \text{(A.18).}$$

Assuming $\varrho = 0$ and additive utility, this is solved as follows:

$$U = R - W \quad V$$
$$= p_1a_1 - qp_1a_1 + qp_2a_2 - W - s_1^2 + 2qs_1^2 - q^2s_1^2 - q^2s_2^2 \qquad \text{(A.19)}$$

where:

$$\partial U/\partial q = - p_1a_1 + p_2a_2 + 2s_1^2 - 2qs_1^2 - 2qs_2^2$$
$$= 0$$
$$\partial^2 U/\partial q^2 = - 2s_1^2 \quad 2qs_2^2$$
$$< 0$$

so that this utility function, with a negative sign of the risk aversion parameter U"/U', implies risk aversion (Dixit 1990: 123).

Rearranging the first order condition yields:

$$q = - (p_1a_1 - p_2a_2 - 2s_1^2) / 2(s_2^2 - s_1^2) \qquad \text{(A.20)}$$
$$\geq 0$$
$$\leq 1$$

where the numerator of equation A.20 is negative and the denominator is positive such that:

$$\partial q/\partial p_1 < 0, \partial q/\partial p_2 > 0, \partial q/\partial a_1 < 0, \partial q/\partial a_2 > 0,$$
$$\partial q/\partial s_1 > 0, \partial q/\partial s_2 < 0, \partial q/\partial t_1 > 0, \partial q/\partial t_2 < 0.$$

Note that transaction costs do not appear directly in equation A.20 but their effects on q can be traced via equation A.9. Transaction costs will lower the farm-gate product price received and thus inhibit the adoption of that activity.

The share q does not depend on endowments and, with additive utility, q does not depend on the subjective wage, either. However, assuming additive utility, although convenient, is non-trivial as a multiplicative functional form would result in a different specification for q:

$$\begin{aligned} U &= \Pi / V \quad (A.21) \\ \partial U/\partial q &= (\partial \Pi/\partial q\, V - \Pi\, \partial V/\partial q) / V^2 \\ &= 0 \end{aligned}$$

where the first order condition also includes a term for profits and thus for the subjective wage. This implies that for peasant household production in the absence of labour markets and with no riskless activity to engage in, household preferences affect the optimal allocation of resources between risky activities through both the profit and the utility functions. This result does not hold for households facing perfect markets and a riskless investment opportunity (Bodie and Merton 1998: 288). In addition, more risk averse households in fact prefer a more diversified portfolio, particularly if technology is CRS (Fafchamps 1999: 68).

Geometric Representation

Figure 6.2 summarises the model where quadrant I plots the profit function A.16, quadrant III plots the production function A.10, quadrant IV plots the risk function A.4 and quadrant II plots the utility function A.17 in risk-return space. Quadrant II also summarises the trade-off between risk and return in the activity portfolio, as postulated by financial portfolio theory (Bodie and Merton 1998: 282-4).

Households prefer higher expected returns and lower portfolio risk so that $U_3 > U_2 > U_1$. At point a, $q = 1$ and the household specialises in activity 2. At point d, $q = 0$ and the household specializes in activity 1. At point c, the portfolio has the lowest possible risk V_{min} and $q = q_{Vmin}$. Curve abc (i.e. the top-left section of abcd) represents the efficient portfolio frontier (Bodie and Merton 1998: 288).

Equilibrium is obtained at point b where abcd is tangential to the highest possible utility curve U_2. The equilibrium level of q is q^* which is larger than q_{Vmin} in figure 6.2. The

household will thus decide at the beginning of the agricultural season to allocate q* of its labour to activity 2 and 1 - q* to activity 1. The expected shares of revenue from activities 2 and 1 are therefore q* and 1 - q*, respectively. Note that more risk averse households would choose q* closer to q_{Vmin}.

In summary, this appendix has sketched a mathematical and geometric version of a two-activity model of peasant household production which complements the analysis of the effects of war on key variables in chapter 6. These key variables include total portfolio risk, the technology of the production process and the returns from production, the subjective wage, the household labour endowment, and the household utility function. This model differs from standard models of farm production under uncertainty by emphasising aspects of peasant production such as the lack of labour and output markets, the existence of a survival constraint, and the role of the subjective valuation of labour.

A.4 Income and Expenditure Variability

In estimating welfare and the determinants of welfare, using a long-run indicator of household welfare is preferable to short-run indicators which also reflect inter-year variability induced by random events such as the weather. However, measuring long-run welfare is very difficult and household income and expenditure per capita only manage to capture this imperfectly. This appendix will therefore follow the example of Anand and Harris and will analyse the variability of various welfare indicators (1990: 311-7). A similar analysis for an African case is not known so that the following will draw on the Sri Lankan case calculated by Anand and Harris.

Figure A.7 shows the weighted mean income per capita (column 2), expenditure per capita (column 4) and food expenditure per capita (column 5) per income per capita decile for the FSP dataset. Note that the total expenditure excludes durables. In the absence of savings, life cycle effects and seasonality, and abstracting from the role of durables in expenditure, the values for income and expenditure should be similar in each decile, with the former at least as large as the latter.

In fact, figure A.7 shows that mean expenditure per capita exceeds mean income per capita in five of the six lowest deciles, suggesting that poorer households dissave to a large extent. In none of the deciles does household food expenditure exceed household income, which is expected. In the third poorest income decile, households dissaving amounts to 22% of household income. In all other deciles, the gap is much smaller, suggesting that households do in fact smooth both income and consumption in northern Mozambique. T-tests of equality of mean for income and expenditure in column 3 suggest that the difference between the means are not significant in five deciles, leaving two out of ten deciles with significant income shortfalls. As expected, these deficit deciles are among the poorest of the households.

Given the scarcity of capital markets, the high transaction costs of conducting informal social security and the low level of assets in the whole sample (figure A.11), it is surprising that expenditure (especially after excluding the use of durables) exceeds household income in several deciles. This may be explained by, first, the difficulty in estimating subsistence household income, which is larger for poorer households as shown in column 6 in the figure. It is thus conceivable that subsistence income has been underestimated thus increasing the estimated shortfall for some income deciles. Second, animal breeding, sales and slaughters are the worst enumerated sections of this survey therefore underestimating those components of household income likely to be used for adjusting shortfalls in crop income. Third, the cyclone in early 1995 may have reduced household income below the

long-run expected mean therefore explaining the large number of deciles in deficit in 1995. The seasonality and chance involved particularly in low-input agricultural activity thus imply that income cannot be smoothed as much as household consumption even if this is the household's aim.

Figures A.8 and A.9 calculate the same measures as figure A.7 but group and rank the data by expenditure per capita and food expenditure per capita, respectively. No decile has an income deficit in either figure, suggesting that the genuine variability of income underlies the actual income shortfalls observed in figure A.7. On the other hand, and as shown in figure A.12, the high food share across households in the sample implies that food expenditure may not accurately predict changes in household welfare. In figure A.9, for example, the fourth, sixth, and eighth deciles have a mean income per capita smaller than the third, fifth and seventh deciles, respectively (i.e. mean income does not increase monotonically with mean food expenditure across all deciles). If household income is more variable due to economic choices and outcomes (and not due to enumeration error) then analysing household income, rather than household food expenditure, can capture differences between household welfare better. This also applies to household expenditure to some extent, as household food expenditure is such a large component of household expenditure.

Compared with the estimates from rural Sri Lanka obtained by Anand and Harris (1990), household income in rural northern Mozambique is less variable and fewer deciles are in significant deficit despite the cyclone in Mozambique in that year. This is probably due to the extent of income smoothing practiced in Mozambique, where capital markets are less developed than in Sri Lanka. The surplus income deciles in Mozambique also have much larger surpluses than those in Sri Lanka, suggesting that some richer households in rural Mozambique engage in a process of positive and significant saving. However, it is not possible to say without panel data if these households are experiencing a temporary income surplus or if they are continuously building up their asset position over several years.

The degree of consumption smoothing can also be illustrated with figure A.10. It plots the rank of 100 groups sorted by household income versus the rank of 100 groups sorted by household expenditure excluding durables in 1995. The figure shows that income and expenditure are clearly and positively correlated. The weighted correlation coefficient of the natural logs of per capita income and expenditure is 0.85. However, more than 10% of all households change more than 30 rank groups, which suggests that some households are very income-poor but less expenditure-poor and vice versa.

This may be due to measurement error, as discussed above and as suggested by the subsistence share column in figure A.7. Alternatively, it may be due to actual consumption smoothing. In this case, an income-poor household can compensate for an income shortfall by dissaving and thus increasing its expenditure in the short-term. If ranked separately by income and by expenditure, such household would occupy different ranks in these calculations. Column 7 in figure A.7 summarises the mean change in income versus expenditure ranks per income decile.[97]

Broadly speaking, better off (poorer) households are more likely to (dis-) save compared to median income households. This indicates that income poorer households dissave to compensate for the current shortfall in income while currently less poor households save some of their windfall income. The households not located on the 45°-degree line in figure A.10 may thus be reacting to realised deviations from their permanent income, rather than their actual income having been incorrectly recorded.

The conclusion from this evidence is that household income per capita leads to a clearer differentiation of households into poorer and less poor households and that a small part of that differentiation may be due to data imperfections. More significantly, some of the differentiation can be compensated by households as some degree of consumption smoothing is possible even in post-war rural Mozambique. Using the FSP data available, it is difficult to distinguish between the degree of measurement error and the degree of consumption smoothing. Evaluating this aspect would be easier if similar calculations existed for other African countries but no such study is known at present.

Both measurement error and consumption smoothing are likely to affect the indicators presented here to an unknown extent. It appears as if the conjecture that household income captures "welfare opportunities" and household expenditure captures "realised welfare" has some merit in practice and that with imperfect data all indicators can contribute to the analysis of poverty.

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[97] Note that its values will correlate strongly with the income-expenditure gap between columns 2 and 4. However, these columns are both ranked by income while column 7 measures a change in ranks based on income and expenditure.

Figure A.7: Variation of Welfare (Ranked by Income)

Column	1	2	3	4	5	6	7
Income Decile	n	Income	T-Test	Expenditure	Food Expenditure	Subsistence Share	Change in Rank
1 (Poorest)	26	8.86 (0.34)	=	9.62 (0.66)	7.89 (0.65)	62%	-2.7
2	24	13.54 (0.30)	<	15.75 (0.68)	12.79 (0.99)	66%	-5.0
3	33	18.35 (0.15)	<	22.34 (1.38)	16.00 (1.50)	63%	-9.6
4	30	22.75 (0.21)	=	22.69 (1.64)	17.25 (1.79)	65%	-1.5
5 (Middle)	34	28.18 (0.39)	=	32.39 (4.22)	23.27 (3.85)	62%	-5.7
6	32	33.24 (0.31)	=	33.64 (3.37)	28.59 (2.85)	61%	-1.6
7	35	39.16 (0.52)	=	36.26 (2.29)	28.61 (2.12)	56%	2.9
8	43	47.43 (0.75)	>	40.55 (2.37)	33.64 (2.15)	61%	6.5
9	44	59.94 (0.91)	>	46.99 (3.46)	36.75 (2.27)	47%	10.0
10 (Least Poor)	69	102.22 (5.46)	>	72.36 (7.40)	57.21 (7.54)	47%	7.5
Mean	370	37.13 (3.87)	>	33.05 (2.75)	26.05 (2.37)	59%	0.0

Values are the weighted mean of income per capita, non-durable expenditure per capita and food expenditure per capita per income decile and over the whole sample in 1995 in US$. Standard errors are shown in brackets. The inequality signs in column 3 indicate that a t-test rejects the null hypothesis of equality at a 5% level of significance. Column 6 summarises the share of total household income derived from subsistence production. Column 7 indicates the mean number of ranks the households in each decile change from income to expenditure, where households are grouped in 100 groups according to either variable (i.e. change in rank = income rank - expenditure rank). A positive value suggests saving while a negative value suggests dissaving. Pweight: WEIGHT2; strata: CATEG3; PSU: ALD.

Sources: FSP data, own calculations (001109a), and Anand and Harris (1990).

Figure A.8: Variation of Welfare (Ranked by Expenditure)

Column	1	2	3	4	5
Expenditure Decile	**n**	**Income**	**T-Test**	**Expenditure**	**Food Expenditure**
1 (Poorest)	38	11.56	>	9.56	7.44
		(1.00)		(0.32)	(0.20)
2	37	17.45	=	15.27	12.26
		(1.51)		(0.36)	(0.70)
3	37	24.43	=	19.10	14.99
		(2.60)		(0.15)	(0.65)
4	37	32.42	>	23.69	19.30
		(2.11)		(0.29)	(0.66)
5 (Middle)	37	29.74	=	28.64	23.33
		(1.94)		(0.26)	(0.75)
6	37	37.53	=	33.27	26.62
		(4.25)		(0.39)	(0.84)
7	37	44.75	=	39.53	32.32
		(2.96)		(0.50)	(1.15)
8	37	52.87	=	46.74	35.47
		(5.91)		(0.44)	(1.51)
9	37	58.62	=	58.99	44.20
		(4.54)		(0.65)	(2.62)
10 (Least Poor)	37	99.24	=	92.58	73.61
		(10.61)		(6.14)	(6.98)
Mean	371	37.13	>	33.05	26.05
		(3.87)		(2.75)	(2.37)

Values are the weighted mean of income per capita, non-durable expenditure per capita and food expenditure per capita per expenditure decile and over the whole sample in 1995 in US$. Standard errors are shown in brackets. The inequality signs in column 3 indicate that a t-test rejects the null hypothesis of equality at a 5% level of significance. Pweight: WEIGHT2; strata: CATEG3; PSU: ALD.

Sources: FSP data, own calculations (001109d), and Anand and Harris (1990).

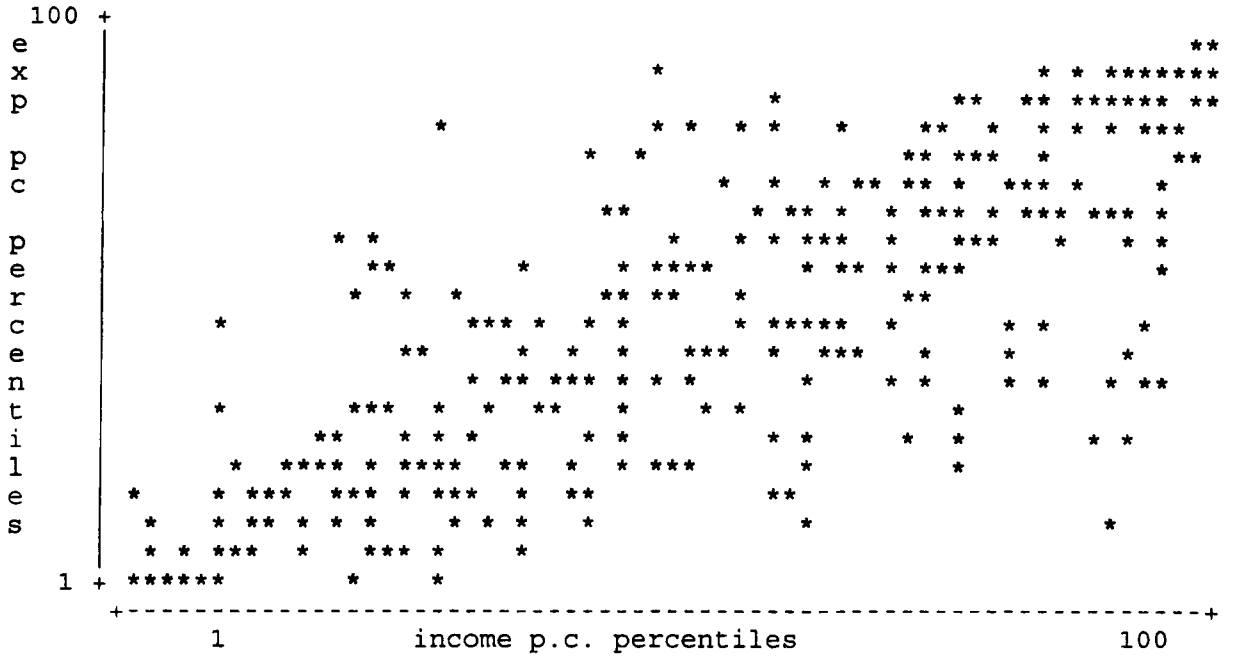
Figure A.9: Variation of Welfare (Ranked by Food Expenditure)

Column	1	2	3	4	5
Food Expenditure Decile	n	Income	T-Test	Expenditure	Food Expenditure
1 (Poorest)	38	11.90	>	9.33	6.69
		(1.06)		(0.55)	(0.30)
2	37	17.16	=	17.62	12.24
		(1.60)		(2.37)	(0.21)
3	37	27.26	>	20.84	14.82
		(2.59)		(1.12)	(0.17)
4	37	25.84	=	21.94	18.52
		(3.97)		(0.94)	(0.39)
5 (Middle)	37	39.24	=	30.01	22.65
		(8.18)		(1.43)	(0.13)
6	37	32.36	=	32.00	26.03
		(2.95)		(0.99)	(0.29)
7	37	53.69	>	40.78	30.89
		(3.05)		(1.76)	(0.16)
8	37	47.06	=	46.34	37.08
		(2.11)		(2.52)	(0.52)
9	37	57.24	=	56.76	45.67
		(3.56)		(1.50)	(0.47)
10 (Least Poor)	37	95.69	=	88.08	76.39
		(12.02)		(6.69)	(5.41)
Mean	371	37.13	>	33.05	26.05
		(3.87)		(2.75)	(2.37)

Values are the weighted mean of income per capita, non-durable expenditure per capita and food expenditure per capita per food expenditure decile and over the whole sample in 1995 in US$. Standard errors are shown in brackets. The inequality signs in column 3 indicate that a t-test rejects the null hypothesis of equality at a 5% level of significance. Pweight: WEIGHT2; strata: CATEG3; PSU: ALD.

Source: FSP data, own calculations (001109c), and Anand and Harris (1990).

Figure A.10: Rank Changes in Income and Expenditure



The x-axis and the y-axis show the income per capita and the expenditure per capita percentile groups from 1 to 100, respectively.

Source: FSP data and own calculations (001109b).

A.5 Income, Expenditure and Asset Inequality

This appendix addresses the degree of asset, income and expenditure inequality observed in the FSP dataset. Figure A.11 summarises different indicators of asset ownership by human capital, physical capital and social capital, all ranked by household expenditure per capita.[98] The human capital variables in figure A.11 show very low absolute values, no systematic differentiation by poverty group, and low Gini values. This is due to the devastating effect of the war on the education infrastructure in Mozambique, a deliberate war aim by the rebel movement. This suggests that educational achievement is unlikely to explain welfare outcomes or differentials in a post-war environment.

Livestock, tools and trees do not appear to be strongly correlated with the distribution of expenditure, though the poorest households have less livestock and tools than any other group. It appears that livestock inequality as measured by the Gini coefficient has lessened since the end of the war and that tools are also quite equally distributed. This might be due to the focus of emergency aid programmes in the province on the distribution of tools and seeds, or perhaps because agricultural tools are among the most important assets for farm households thus encouraging most households to have at least some. In addition, for tools their quality may be more important than their quantity for productivity though the quality of tools could not be measured during the survey.

The average value of total household assets does not appear to have changed significantly since the war (assets at the end of the war are measured in constant prices). However, the distribution of assets, which is clearly related to the expenditure group, has become even less equal, with a Gini coefficient of 0.61 for the value of current assets. The lack of asset ownership may thus be an important determinant of ultra poverty, though its impact may not vary much among the higher welfare groups. The role of low asset ownership may be particularly important if assets are required to start high-income activities required to escape war-induced poverty traps. This is analysed in more detail in chapter 6.

The social capital indicators are also listed by expenditure group. In particular a household's relation to the local authority seems an important determinant of household expenditure. Paradoxically, more poorer households are related to a local chief than better off households, although more better off households are themselves in a position of authority than the poorer households. While the latter observation accords with intuition,

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[98] For a discussion of land inequality, which may not be exogenous, see appendix A.2.

the former is hard to explain. It may be that such households are part of larger family networks where resources are concentrated around the head of a kin network and thus, on average, households more distanced from such centre of authority but still related with it have fewer resources under their control. In the absence of a closer anthropological understanding of Macua culture, this variable will be important but difficult to interpret.

Given that some asset inequality appears to be related to welfare inequality, the latter is analysed in more detail in figure A.12. It shows the mean level of household income per capita, expenditure per capita and food expenditure per capita across the whole sample and by total household per capita expenditure quintiles. In 1995, household income per capita was US$ 37.13 and household expenditure per capita was US$ 33.05. With the rural poverty line calculated by IAF in 1997 adjusted for 1995 prices (1998), this suggests a headcount poverty ratio of about 98% for the FSP sample.

While one might expect war-affected households to be very poor, it appears that poverty within the sample is not uniform. Instead, there is a large degree of inequality even among these poor households, with income inequality being marginally higher than consumption inequality. The Gini coefficients for income per capita, expenditure per capita and food expenditure per capita are 0.37, 0.34, and 0.35, respectively.

Nevertheless despite such inequality, the food share (i.e. the proportion of expenditure spent on food) is almost constant (and very high) across expenditure quintiles, thus implying that there is a high elasticity of food expenditure with respect to income (figure A.12). Increases in household resources can thus be expected to raise household food consumption, which may in turn consist of increases in food quantity, quality, and prices (especially during the hungry season, when unit food prices rise significantly). It is difficult to distinguish these three effects with the available data. But given the restricted nature of food markets with few processed foods being available (chapter 3) it can be assumed that a significant share of the increase in food expenditure will also increase food quantity.

Households in northern Mozambique have been reported to spend marginal food expenditure on improving the flavour of their (generally quite bland) diet by buying dried fish (Tschirley and Weber 1994). Figure A.12 shows how better off households spend absolutely more money and relatively a higher share of the food budget on this commodity, which is expensive per calorie. However, even the least poor households only spend 5.5% of their income on dried fish, suggesting that more basic food items are very important for all households. Note that while dried fish may be highly valued for its flavour, it also contains valuable protein and can be easily transported and stored thus explaining why even the poorest households spend 3.2% of their income on dried fish.

Figure A.11: Distribution of Assets

	Gini	Mean	Expenditure Quintiles 1	2	3	4	5
Human Capital							
Education of Head (years)	0.26	1.91	1.92	1.61	1.86	2.03	2.13
Education of Head*Infrastructure (years)	0.27	1.02	1.11	0.93	0.67	1.39	0.98
Maternal Education*Infrastructure (years)	0.24	0.49	0.44	0.61	0.37	0.72	0.28
Highest Education (years)	0.25	3.59	3.24	3.98	3.65	3.91	3.08
Total Education (years)	0.37	7.26	7.48	7.55	7.43	7.55	6.22
Physical Capital							
Large Livestock at End of War (#)	0.48	0.67	0.09	1.54	0.63	0.72	0.32
Current Large Livestock (#)	0.36	1.42	0.35	2.58	1.54	1.31	1.29
Number of Tools	0.23	6.17	4.79	5.82	6.69	7.31	6.23
Number of Types of Tools	0.18	2.90	2.63	2.87	3.13	2.81	3.03
Number of Trees per Capita	0.47	1.22	1.23	0.46	1.78	1.29	1.32
Assets at End of War (US$)	0.49	166.80	51.06	162.45	128.80	269.76	222.78
Current Assets (US$)	0.61	165.31	43.64	121.79	310.78	187.19	162.56
Social Capital							
Ancestors Buried Here (%)	n.a.	84	86	89	78	86	80
Household is Related to Authority (%)	n.a.	48	61	55	36	44	39
Head is an Authority (%)	n.a.	7	3	2	6	11	12
Local Origin of Husband (%)	n.a.	68	66	69	66	74	62
Local Origin of Wife (%)	n.a.	65	58	63	66	64	74

Sample has been grouped by total household expenditure per capita. Columns 1 to 5 indicate the poorest to least poor quintiles. Social capital is measured with categorical variables. The data indicates the proportion responding yes. Data have been weighted using WEIGHT2.

Source: FSP data and own calculations.

Figure A.12: The Distribution of Welfare and Expenditure Shares

	Mean	Expenditure Quintiles 1	2	3	4	5
Income						
US$	37.13	13.74	23.17	31.54	45.24	72.94
% of Total		6	12	16	23	43
Expenditure						
US$	33.05	11.01	19.55	28.67	39.69	67.30
% of Total		7	12	17	24	40
Food Expenditure						
US$	26.05	8.64	15.77	23.05	32.05	51.43
% of Share of Total		7	11	18	23	41
Expenditure on						
Food (%)	79	78	80	80	81	75
Non-Food (%)	12	12	11	11	10	14
Semi-Durables (%)	9	10	9	9	9	11
All Items (%)	100	100	100	100	100	100
Dried Fish Expenditure						
US$	1.21	0.26	0.68	1.16	1.48	3.33
% of Food Expenditure	4.4	3.2	4.3	4.8	4.9	5.5
Health Expenditure per Capita						
US$	0.22	0.09	0.13	0.20	0.27	0.43
% of Non-Food Expenditure	6.7	7.4	6.9	6.3	7.2	5.6
% of Total Expenditure	0.7	0.8	0.7	0.7	0.7	0.7
Sample Size	371	64	62	73	78	93

Income and expenditure values are weighted annual per capita values. Columns 1 to 5 indicate the poorest to least poor quintiles. The five population groups and the expenditure shares are based on total household expenditure per capita in 1995. The weight used is WEIGHT2.

Source: FSP data and own calculations.

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