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# The Welfare Effects of Farm Household Activity Choices in Post-War Mozambique

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**Abstract:** This paper analyses the effects of activity choices on farm household income and consumption in a war-affected developing country. The study uses household survey data from Mozambique and controls for the endogeneity of activity choices with instrumental variables. War-time activity choices (such as subsistence farming) are shown to enhance welfare in the post-war period. Market and social exchange induce limited welfare gains. Cotton adoption reduces household welfare, which contradicts previous studies not controlling for endogenous activity choices. The study thus demonstrates how standard predictions of economics may become invalid in post-war economies. Furthermore, the paper identifies pro-poor reconstruction policies.

**JEL Codes:** O12, I32, C31
**Keywords:** poverty, farm households, activity choices, rural development, war, reconstruction

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## Introduction

Farmers in rural African war zones are among the most destitute people in the world. One third of the world's population in 2001 lived in conflict-affected low income countries with two third of these people residing in rural areas (own calculations). Yet economic analysis has only recently started to consider the impact of war on rural poverty and underdevelopment (see for example Addison 2003). In particular, little is known about the determinants of poverty during and after violent conflict. These are periods characterised by few outside options, few public goods and extreme isolation. This article aims to fill this gap in the literature by estimating the determinants of income and consumption for war-affected farm households. In addition, the article assesses the endogenous welfare implications of farm household production choices, as these are likely to be significant in a post-war setting.

The paper therefore draws on literature analysing the determinants of household activity choices and on literature estimating the determinants of household welfare. The former literature typically assesses the effects of *on-going* shocks - such as drought, earthquakes or floods - on the activity choices of rural households (Corbett 1988). There is still little analysis, though, of *post*-disaster or of *post-war* activity choices.

More common is the study of activity choices by farmers during peace (Ellis 2000). Past research issues addressed for example the role of risk for activities choices (Dercon 1996), the linkages of the farm household with the rural non-farm sector (Abdulai and Delgado 1999), the farm household participation in markets (de Janvry et al 1991), the potential of farm diversification for raising export revenues (Delgado 1995), activity choices and poverty traps (Zimmerman and Carter 2003), informal risk sharing mechanisms (Dercon 2002), farm fragmentation (Blarel et al 1992) and the role of land abundance for income strategies (Binswanger and McIntire 1987). These issues will be addressed in the analysis below of a *post-war* economy.

A surprisingly small field considers the welfare implications of activity choices (Adams 2002, Ellis and Mdoe 2003, Grootaert 1997, Reardon et al 1992) or of cash crop adoption (Bouis and Haddad 1990, Kennedy and Cogill 1987, von Braun and Pandya-Lorch 1991). These papers discuss the welfare implications of activity choices (for example, in bivariate comparisons of farm income sources) but they do not estimate the welfare implications *directly*. Neither do these studies, unlike this paper, account for the *endogeneity* of activity choices and farm income.

The literature on the determinants of household welfare usually involves estimations with reduced form equations. The dependent variable is either a direct measure of household income or of consumption (Datt and Jolliffe 1999, Glewwe 1991), a binary dependent variable indicating a household's position above or below a poverty line (Grootaert 1997), or some other measure of welfare such as the poverty gap (Appleton 2001). Using these frameworks, the effects of education, asset endowments and locational characteristics on household welfare have been identified. That is, the literature has assessed primarily the welfare effects of who the households *are* and what the households *own* but not of what these households *do*, especially if they live in extremely poor, rural, war-affected environments.

The answer to this question is important for two reasons. First, economic analysis has little to say, to date, on how people behave under extremely adverse conditions such as war. Second, economic policy advice for governments, aid agencies and donors operating in conflict zones do not know how best to support extremely poor victims of war. Given the large numbers of war-affected farmers in developing countries, such analysis provides important insights.

The first section of this paper defines key terms and discusses the expected determinants of household welfare while the next sections describe the case of Mozambique, the household survey and the estimation strategy. The subsequent section presents a bivariate poverty profile

and discusses the results of the multivariate analysis. The last section summaries the main findings and presents some policy implications.

**The Determinants of Welfare**

A farm household activity (or coping strategy or income diversification strategy) is defined as the allocation of labour to a task designed to generate subsistence or market income. Farm household activities considered in this paper include agricultural and non-agricultural income activities, on-farm and off-farm income activities, market and non-market activities, the choice between food and cash crop adoption and the choices of the number of income activities and the area farmed per household. For lack of data, the decisions to migrate, to earn remittances or to change the household size could not be empirically analysed.

Household welfare is defined here as a household's command over market and non-market goods and services at the household level (Ravallion 1996). Welfare will be proxied by income, consumption and food consumption in the empirical analysis below. This definition of welfare 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) and the externalities of consumption. The income and consumption outcomes at the household level implicitly contain the effects of nutrition, health, education, asset endowments, climatic and market risks as well as institutional arrangements.

The imperfect nature of markets in the post-war period and the interdependency of household production, labour supply and nutrition decisions imply that the separability property of the household model does not hold (Binswanger and McIntire 1987, Singh et al 1986). Household welfare, hence, is a function of all exogenous prices and endowments. Furthermore, the high transaction costs, the low population density and the low level of technology in a war-damaged economy suggest that a variety of location-specific factors significantly co-determine household welfare.

The determinants of household income and consumption typically include household labour characteristics, land and asset endowments and village-level effects. In addition, several other variables are also included in this analysis as they may be important in the post-war context.

Refugee households, for instance, are more likely to have suffered insecurity, uncertainty and a strong depreciation of their physical, human and social assets. In particular, refugees may be disadvantaged in the allocation of land, aid and social protection (a form of "pure discrimination") thus reducing refugee welfare. Similarly, female-headed households may suffer from lower endowments and from "pure gender bias". Older heads of households are likely to have more experience and respect in the community thus enhancing their households' welfare. A larger degree of illness in the household will have a negative effect on household welfare. In addition, time constraints may reduce household income, for example if a household spends a lot of time collecting drinking water and firewood. Household education is likely to have a positive effect on household welfare.

Land characteristics might play an important role in the post-war period due to the absence of commercial fertilisers or other productivity enhancing technologies. The expected effects of land characteristics on household welfare can be summarised as follows. Lower soil quality, more field pests, a longer distance of the plot from the household residence, and low rainfall will all decrease household welfare.

Social capital and market institutions are potential determinants of post-war welfare as both help to convert output into consumption goods. Community level variables are expected to be key determinants of household income and consumption. The illness variables at the village level capture the absence of effective health and sanitation infrastructure. Their impact on income and consumption should be negative. Higher crop yields in a village denote a larger agricultural potential and should increase household welfare.

The price variance indicators reflect changes in inter-seasonal price differences across households. Post-war households are considered to be risk averse so that a higher variance of food crop, non-food crop and consumer good prices is expected to have negative effects on household welfare. The village indicator variables are included in all regressions as controls for unobservable effects.

For given prices, endowments and community characteristics, household activity choices, $X_i$, and household welfare, $Y_i$, are determined as follows:

$$X_i = a_0 + a_1L_i + a_2F_i + a_3K_i + a_4V \quad (1)$$

$$Y_i = b_0 + b_1L_i + b_2F_i + b_3K_i + b_4V + b_5X_i \quad (2)$$

for household i = 1…N and where $L_i$, $F_i$, $K_i$, and V are vectors representing household, land, asset and village-level endowments, respectively. Household composition variables (such as household size, household age and dependency ratio) are included as independent variables in the regressions. They control for differences in the composition of households (Deaton and Zaidi 1999, Glewwe 1991).

**The Case of Mozambique**

Mozambique experienced a severe civil war until 1992. The economy was badly damaged by the conflict, which occurred mainly in rural areas (Addison and de Sousa 1999, Colletta et al 1996). For example, the number of cattle in Mozambique declined from over 1.3 million in 1982 to 0.25 million in 1992 (Ministério da Agricultura 1994). Per capita food production only reached 90 percent of its pre-war level by 1996 (World Bank 2002).

At the same time, farm productivity in the post-war period was well below regional averages (Tschirley and Weber 1994). The mean monocropped maize yield in the FSP sample was only 319 kg/ha in 1995 compared to the mean Southern and Eastern African maize yield of 1,500

kg/ha and a mean developing country maize yield of 2,700 kg/ha in 1995-97 (Heisey and Edmeades 1999: 44, 62). Consequently, the incidence of absolute poverty during the war was much higher in rural areas (68%) than in urban areas (32% to 52%) (Lopes and Sacerdoti 1991). Of all poor people in Mozambique in 1988-89, 83% were resident in rural areas and only 17% in urban areas (Lopes and Sacerdoti 1991).

The north of Mozambique is often considered the "green belt" of the country. Post-war agricultural production was hampered by poor transport networks and the absence of irrigation infrastructure and of mechanized agricultural production (Cramer and Pontara 1998, Heltberg and Tarp 2002, Pitcher 1998, Tschirley and Benfica 2001, Tschirley and Weber 1994). There were few agricultural or non-agricultural wage employment opportunities and no migrant workers, unlike in southern Mozambique. Only 11 percent of all rural households in the north, for example, occasionally or regularly employed agricultural labour (UNDP 1999). Judging from the farm household income and consumption data recorded in the FSP survey and from personal interview evidence collected in 1995 and 1999, local agricultural crop markets were the most important markets. However, even output markets did not exist in all months and in all locations throughout northern Mozambique, both during the war and in the post-war period.

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

**Data Issues**

The farm household survey of this analysis includes 371 randomly selected households in 16 villages (the primary sampling units, PSU) in three districts in the provinces of Nampula and Cabo Delgado in northern Mozambique. The sample was stratified according to households' cotton growing status. The survey data, here denoted FSP, was collected by the Food Security Project at the Ministry of Agriculture, Maputo, from June 1994 to January 1996. There was no attrition from the sample over this period which corresponds to the low degree of household mobility in the study period. The FSP sample is *statistically* representative of potential cotton growing areas in relatively accessible parts of Nampula and Cabo Delgado. From a *policy* perspective, the findings of the survey are relevant for other poor post-war developing countries such as Angola, Congo, Sierra Leone, Sudan, Nicaragua, Afghanistan or East Timor.

The mean rainfall in the period 1985-94 in the FSP sample areas Montepuez and Meconta was 922 mm and 1024 mm, respectively (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 of rainfall were recorded in 1995 suggesting normal climatic conditions in the sample area.

The FSP questionnaire contains modules on household characteristics (at both the household and individual level and including some gender aspects of time allocation and the relation of the household to local political authorities), field-level characteristics (including land tenure arrangements), agricultural production activities (including food- and cash-crops, trees, fruit, vegetable and livestock), production and storage tool and technologies, monetary and in-kind transactions (including remittances and gifts), off-farm activities, and consumption. The variables used below refer to the period January till December 1995, unless otherwise noted.

Overall, the FSP survey is one of the most carefully designed, collected, and cleaned rural household survey from the early post-war period in Mozambique. The evidence from the survey data is complemented with qualitative interview evidence collected by the author in 1995 and 1999.

Three suitable welfare indicators are derived from the FSP data: net household income, total household consumption, and household food consumption (see table 1 for definitions and summary statistics of all FSP variables).

Household income data includes several sources of income. Only livestock production and livestock consumption were not well enumerated in the FSP survey. Yet, as the mean stock of large animals was extremely low due to the war, livestock production did not contribute a large share to household income or consumption. The household income variable INCOME measures the natural log of net household income per capita in US-Dollar in 1995.

It can be difficult to identify household expenditure for peasant households since food can be used to pay workers, to seed fields or to feed animals. The FSP survey appears to have captured transactions affecting hired workers and purchased inputs well, though these are not very common in northern Mozambique. Household expenditures have been weighted by Paasche price indices (Deaton and Zaidi 1999: equation 2.6). The final expenditure variables exclude durable expenditures but include imputed subsistence consumption. They refer to the year 1995, are expressed in US-Dollar and are defined as the natural log of total expenditure per capita (EXPTOTAL) and the natural log of total food expenditure per capita (EXPFOOD).

The choice of weight for household size in the welfare indicator is always arbitrary, yet some such weight must be chosen (Deaton and Zaidi 1999: 48-54). This analysis follows the example of Deaton and Zaidi and divides the welfare indicators by total number of resident household members. This is feasible as the age and gender structure is less variable than

household size across households. Furthermore, in very poor economies the scope of economies of scale in consumption is smaller as the share of food consumption in total consumption is very high.

**Estimation Issues**

Equations (1) and (2) can be estimated through the following set of semi-reduced form equations:

$$X_i = a_0 + a_1 L_i + a_2 F_i + a_3 K_i + a_4 V + u_i \quad (1')$$

$$Y_i = b_0 + b_1 L_i + b_2 F_i + b_3 K_i + b_4 V + b_5 Z_i + v_i \quad (2')$$

where $Z_i$ is a suitable vector of instruments for $X_i$ and where $u_i$ and $v_i$ are normally distributed error terms which are not correlated with the exogenous variables, thus yielding unbiased and consistent estimates.

Estimating three welfare indicators $Y_i$ 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 consumption or food consumption (Appleton 2001).

The Durbin-Wu-Hausman (DWH) test checks the endogeneity of $Z_i$ in equation 2' (Davidson and MacKinnon 1993: 236-42, Rivers and Vuong 1988). The DWH test estimates an augmented regression of the original model, where the regression also includes the residuals of each endogenous right-hand-side variable as a function of all exogenous variables. If the coefficients on the residuals are significantly different from zero, then OLS is not consistent and an instrumental variable (IV) approach should be adopted.

The IV estimation used below accounts for stratification, clustering and weights matching the survey design of the data, leading to appropriate adjustments to the standard errors of the estimates (StataCorp. 1999). All three equations are over-identified and the respective first

stage explanatory variables shown in tables 4 to 6. The first stage regressions are also summarised in table 7.

**Results and Discussion**

Households are very dependent on subsistence food crop activities for their income (table 2). Cash crops contribute only a small share to total income but three quarters of all crop marketing income derives from cash crops. Entrepreneurial, wage and social income account for even smaller shares of household income. The high shares of on-farm income (SHAREON) and non-market income (SHARESUB) of total income suggest that households in northern Mozambique were still practicing many of their war-time subsistence coping strategies three years after the end of the conflict.

*Poverty Profile*

A poverty profile is an unconditional analysis of household welfare compared across population groups with different characteristics. Table 3 summarises the mean household income per capita and 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. The "poverty" line is set arbitrarily at the median income per capita in 1995, thus dividing the sample into poor and ultra poor households. This value has been chosen as most households in this survey fall below the absolute poverty line set by the government (Government of Mozambique 1998).

Endogenous household activity choices, such as farm size measured by cultivated area and the cotton adoption and crop market participation status of a household, seem to affect poverty. Similarly, households earning more money with on-farm activities have higher per capita income. Households cultivating more land also have a higher per capita income. The type of activity choices of households thus appear to be an important determinant of income.

*Summary of Estimation Results*

The three dependent variables INCOME, EXPTOTAL and EXPFOOD and the residuals of their respective regressions are approximately normally distributed (data not shown). 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 INCOME and EXPFOOD regressions and of 0.62 for the EXPTOTAL regression (tables 4 to 6). A smaller number of significant coefficients explains the lower $R^2$ for the latter regression (table 6). All three regressions are significant at the 1% level at least. Note that the INCOME regression uses only 349 observations as EXCHANGE is included in that specification and as that variable is not defined for all households. The estimated coefficients are not sensitive to the inclusion of the remaining 22 observations (data not shown). A variance inflation factor (VIF) analysis suggests there is no problem with high inter-variable correlation coefficients or with high VIF coefficients (data not shown). The mean VIF coefficients per regression were low thus indicating that the regressions do not suffer from multicollinearity.

The DWH test statistic for AREA is significant at 1% for the income regression but the DWH tests do not reject the null hypotheses of exogeneity of AREA for the consumption regressions. AREA is thus included directly in the consumption regressions (table 7). The table also shows the fit of the first stage regression of AREA, which is very good with an $R^2$ value of 0.69. The first round instruments for AREA are jointly significant at 1%, which is a further test of the significance of the instruments (Deaton 1997: 116).

The DWH test results indicate that several activity choices have endogenous welfare effects. For household income, the degree of income diversification (INCDIVER) and the cotton adoption status (COTTON) are endogenous. For household consumption, the share of on-farm in total income (SHAREON) and the crop market participation status (CROPMARKET) are endogenous. For household food consumption, only the share of on-farm in total income

(SHAREON) is endogenous. Table 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 CROPMARKET, SHARESUB, PLOTDIVER and EXCHANGE in the income regression, COTTON in the consumption regression, and INCDIVER, CROPMARKET, COTTON and PLOTDIVER in the food consumption regression.

The hypotheses concerning the exogenous variables household characteristics, land and asset endowments and village characteristics are largely confirmed. The refugee variable turned out to be insignificant, probably because it does not measure properly the refugee status of households. Female-headed households have much lower and households with older heads have much higher welfare, as expected.

Key similarities across all three regressions are the positive effects of end-of-war assets, area cultivated, crop market participation, and the negative effects of cotton adoption on all indicators of household welfare. In addition, all regressions find that (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.

*Welfare Effects of Land Use Choices*

The variable AREA 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 almost 7% increase in household income per

capita. This result is robust with respect to the choice of dependent variable. A similarly positive and significant coefficient obtains when using an area per capita specification (data not shown).

This responsiveness of household income to area farmed depends on two key factors. First, the relative land abundance of northern Mozambique makes farm size a decision variable and thus reduces the cost of extending the area farmed. Second, the war had damaged rural infrastructure which increased transaction costs. Consequently, households produced below capacity in the immediate post-war period. Over time, households succeeded in extending their farm sizes and increased their incomes. Farmers thus improved their welfare by expanding production, not by adopting new crops or techniques as will be demonstrated below. The peace dividend in the countryside can be obtained by many farmers through raising farm sizes. In other words, war-time activities are also well suited to the post-war period. From a policy perspective, this implies that farmers in the post-war period should be supported in what they already do well, rather than persuaded to adopt new activities.

Other studies of post-war Mozambican have found much smaller land-welfare elasticities. One study, for example, estimates a consumption elasticity of area farmed of 0.05 for northern Mozambique for 1996-97 (Government of Mozambique 1998: 165). However, the study is not an agricultural household survey, and thus pays less attention to the measurement of land area and does not differentiate clearly between farmed area and total household land. Furthermore, the government study did not control for the endogeneity of area, which leads to inconsistency and smaller estimated coefficients.

Also using FSP data, Marule finds a positive and significant effect of land owned on household income (1998: 40) as does Benfica (1998). However, these studies do not control for the endogeneity of farm size and thus derive 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 farm size, the resulting inconsistency of the regression biases the coefficients downwards. Marule and Benfica both recommend to focus post-war agricultural policy on intensifying production, which is not effective according to this study.

*Welfare Effects of Activity Choices*

A higher share of on-farm (agricultural) activities (SHAREON) raises consumption and food consumption but does not affect household income. Post-war household food consumption is thus better protected by on-farm activities, rather than by off-farm income. This welfare effect of on-farm activities may change with increasingly reliable markets for labour, for consumer goods and for food (Reardon et al 1992). Yet conversely, in the immediate post-war area these coefficients may have been larger still, as markets during and immediately after the war were extremely fragile and weak. Therefore, war-affected households best protect their food consumption through on-farm work. This is plausible as the opportunities for civilian, legal off-farm work in war zones are extremely limited.

The degree of income diversification across different activities (INCDIVER) has a negative effect on income and food consumption. This is evidence of the trade-off between risk diversification and returns, which household practice widely in the post-war period. The finding is consistent with the very low yields observed in post-war Mozambican agriculture. households self-insure against risks, with strong effects for levels of income and consumption. Post-war policy should hence focus on reducing non-idiosyncratic risks and on providing alternative, less costly risk mitigation opportunities (for example through animal husbandry).

Engaging in more subsistence activities (SHARESUB) has a negative effect on household income but not on total or food consumption. Participation in at least one food or cash crop market (CROPMARKET) 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 participate in crop markets indicates that households forego some income but no loss in consumption by engaging in more subsistence activities. At the same time, households which participate in some markets strongly benefit from doing so. This emphasises the importance of farmers growing familiar crops, as they had done during the war, while benefiting from newly emerging market opportunities in the post-war period.

The finding is important as it isolates the value of market participation, which post-war policy should aim to facilitate. At the same time, it shows that there are diminishing returns to market participation. Post-war policy should thus avoid to *maximise* market participation or even dependence by farmers.

In summary, households maximise welfare by undertaking many on-farm activities. Farmers protect their food consumption by undertaking subsistence activities and they protect their income by a limited involvement in crop markets.

*Welfare Effects of Cotton Adoption*

A very surprising finding is that the adoption of cotton (COTTON) significantly reduces household welfare, unlike suggested by the bivariate poverty profile or by the literature. Households growing cotton have 27% less income, 14% less total consumption and 10% less food consumption per capita than comparable households that do not grow cotton, even though weather conditions were average in the survey area that year.

This result derives from the fact that this analysis controls for other household activities and market participation decisions, thus isolating the "pure cotton adoption effect" on welfare. The positive welfare effect of cotton adoption observed in some of the literature on Mozambique's cotton sector derives in fact from the positive effects of on-farm income

activities, of income specialisation and of crop market participation, rather than from the specific decision to adopt cotton.

The net negative effect of cotton adoption for household welfare is related to households being unable to insure well against idiosyncratic risks in the post-war period. As cotton is a very risky crop, households ex ante make complementary income choices which ex post lead to lower total household welfare. The price of insuring against the risks of cotton are thus extremely high in a very poor war-affected economy.

In addition, cotton adoption may alter the intra-household and the seasonal allocations of resources. Some household members benefit from growing cotton, while others loose proportionately more. Cotton growing reduces the available household labour for traditional crops at important times in the agricultural calendar. Cotton production hence displaces other income activities such as maize or cassava growing. These appear better suited to the highly vulnerable circumstances of most rural households. More generally, the results support the view that cash crop adoption may lead to poverty (Grootaert 1997) depending on the specific circumstances of the location (von Braun and Pandya-Lorch 1991).

*Welfare Effects of Non-Market Activity Choices*

The non-market diversification index PLOTDIVER, which measures the degree of spatial diversification of the farm household, has a positive effect on income and food consumption. Non-market diversification thus simultaneously reduces risks and improves household welfare. This result indicates how households can cope with risks without resorting to market activities. Instead, a system of flexible land access is used to manage risks.

The degree of social exchange between households (EXCHANGE) has a small positive effect on household income and no significant effect on total or food consumption. Social exchange is thus not directly related to the maintenance of consumption or food consumption

entitlements. 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 (in particular of bulky agricultural commodities) further diminishes the use of social income as a source of household welfare and insurance. Instead, the author's own interview evidence established that social exchange encompasses mainly small, short-term consumption loans. Households insure occasional, idiosyncratic shortfalls in income (for example in case of individual illness) but social exchange cannot and does not provide long-term insurance from large scale disaster or poverty.

**Conclusions**

This paper estimates the effects of activity choices for income and consumption of poor farm households in post-war Mozambique. It is demonstrated that these activity choices are determined endogenously and that they have significant and at times surprising welfare effects. On the one hand, extending the area farmed (or extending the extensive margin) increases welfare as does, to a lesser extent, market participation and social exchange. On the other hand, activity diversification and cotton adoption have strong negative welfare effects. These effects relate to the legacy of the war in Mozambique, which changes the behaviour of farm households. This in turn has important implications for pro-poor reconstruction policies.

Farm households in the post-war period operate in an environment characterised by extreme uncertainty, weak markets and few public goods. Consequently, their choice of activities has strong implications for their welfare. Farmers do better when focusing on known and low risk activities. New and higher risk activities (such as the adoption of cash crops) are not rewarded. In contrast to the standard farm household literature, households must choose from among a limited set of activity options with extremely uncertain welfare implications. It is

very difficult for post-war farm households to adjust gradually to changing circumstances, when in fact these circumstances change quite dramatically with the end of the war.

Farmers experiment with new and high risk activities, such as cotton. In the post-war economy, there is little information about the future returns of new techniques and investments. In addition, in such a high risk environment, it may be necessary to diversify even at a large welfare loss. Households, in practice, self-insure against idiosyncratic and common risks as no other risk sharing mechanisms are available.

The study is unique in that it observes the behaviour of extremely poor and isolated households emerging from conflict. There is very little empirical economic analysis of such conflict situations, yet millions of households live and work under such circumstances in Africa and elsewhere. This study reveals that households are very fluid in their market participation and social exchange decisions. Households react to changing economic and cultural constraints, switching between subsistence isolation and market interaction. The study demonstrates that market participation enhances welfare but that the benefits from market participation can be very limited under extreme circumstances.

In addition, the findings suggest that the market participation decisions of households have important external effects. In addition, these effects may vary strongly even within one location. With each additional withdrawal of a household from a market for a certain crop, traders face diminishing returns to travelling to such locality. In the extreme, certain markets may cease to exist for certain crops, locations or periods of time. The existence of markets then becomes a household-level concept (de Janvry et al 1991), especially when considering that cultural variables (such ANCEST or ORIGINM in the first round regression of CROPMARKET, table 5) also play a role in determining market participation.

This study not only advances the economic analysis of extreme forms of survival but also suggests several policy interventions for pro-poor post-war reconstruction in rural areas. In

contrast to previous studies, this analysis points to the importance of enhancing the existing survival strategies of war-affected farmers. These households are the survivors of war. In many instances, they know how to cope with the legacy of war and are extremely resilient. Therefore, government and donor interventions should focus on three areas.

First, basic safety nets to protect from strong adverse shocks affecting large regions, such as droughts in the post-war period, should be provided. War-affected households have few options for dealing with such additional disasters within households, villages or even kinship networks. Possible measures include assisting with the raising of livestock or providing basic food-for-work schemes.

Second, donors should focus on enhancing the returns to existing activities. Public goods, for example, lower transaction costs and facilitate trade while extension services increase the returns to traditional activities such as maize growing. National and international trade also raises the returns to subsistence activities, encourages investments in farming and promotes market participation.

Third, longer term measures to support rural development in war zones should concentrate on raising the return to education, providing more educational infrastructure and promoting new income opportunities such as new crops or new services. However, the findings of this paper caution against introducing these measures too early, as they have limited initial benefits in a former war zone. Focussing on the activity choices, which farm households perfected during years of war, is the best post-war reconstruction policy in developing countries. Such an approach could help lift millions of war-affected farmers in developing countries out of extreme poverty.

**Table 1: Definitions and Summary Statistics of the Variables in the FSP Dataset**

| Variable | Definition | Estimate | Std. Err. |
|---|---|---|---|
| AGEHEAD | age of household head in July 1995 | 40.93 | 1.35 |
| AGEHEADS | square of age of household head in July 1995 | 1830.0 | 111.9 |
| AGEHH | average age of household in early 1995 | 22.11 | 1.000 |
| AGEHHS | square average age of household in early 1995 | 548.88 | 48.50 |
| ANCEST | Does the household have ancestors buried here? | 0.844 | 0.041 |
| ANIMAL | Household has at least one large animal in October 1992? | 0.112 | 0.027 |
| AREA | natural log of cultivated area 1995-96 per household in hectare | 0.712 | 0.053 |
| AREAFERT | Low soil quality per household (weighted)? | 0.286 | 0.047 |
| AREATOTAL | natural log of total area held in 1995-96 per household in hectare | 1.33 | 0.057 |
| ASSET | number of durables per capita per household in 1992 | 0.405 | 0.054 |
| ASSET | natural log value of assets in real 1996 US-Dollar per household, October 1992 | 2.92 | 0.254 |
| AUTH | Is household head in any position of authority? | 0.071 | 0.013 |
| CATEGORY | identifying variable for the sampling group | 3.03 | 0.194 |
| COTTON | Does household grow cotton in 1995? | 0.505 | 0.062 |
| CROPMARKET | type of household by crop market participation in 1994-95 | 0.789 | 0.055 |
| CYCLONE | Affected by cyclone Nadia? | 0.332 | 0.082 |
| DEPEND | dependency ratio per household in July 1995 | 0.255 | 0.016 |
| DISTANCE | distance to fields in minutes in 1995 per household (weighted) | 40.67 | 3.48 |
| DISTANCES | square of distance to fields in minutes in 1995 per household (weighted) | 2312.8 | 324.3 |
| DONATION | Received food, seed or in-kind aid? | 0.079 | 0.027 |
| EDUHEADINFS | square of level of education of household head in more accessible areas in years | 4.358 | 1.28 |
| EDUMATINF | maternal level of education in more accessible areas in years | 0.489 | 0.176 |
| EDUMATINFS | square of maternal level of education in more accessible areas in years | 1.58 | 0.601 |
| EDUMAX | years of effective education per household (adjusted for literacy) | 3.58 | 0.213 |
| EDUMAXS | square of the years of effective education per household (adjusted for literacy) | 17.62 | 1.45 |
| EDUPATINF | paternal level of education in more accessible areas in years | 1.02 | 0.275 |
| EXCHANGE | index of social exchange (in natural log) | 0.003 | 0.066 |
| EXPFOOD | natural log of total weighted food expenditure per capita in US-Dollar in 1995 | 3.04 | 0.088 |
| EXPTOTAL | natural log of total weighted per capita expenditure in US-Dollar in 1995 | 3.30 | 0.079 |
| FEMHEAD | Female-headed household in July 1994? | 0.013 | 0.006 |
| FEMNR | number of females per household in 1995 | 3.47 | 0.198 |
| FEMNRS | square of the number of females per household in 1995 | 15.22 | 1.68 |
| FEMRATIO | ratio of females over total number of people per household in 1995 | 0.470 | 0.015 |
| ILLDAYS95 | total number of days ill per household in 1994-95 | 46.07 | 10.60 |
| ILLDAYS96 | total number of days ill per household in 1995-96 | 21.77 | 2.35 |
| INCDIVER | natural log of Herfindahl-Hirschman index of income diversification | 0.700 | 0.044 |
| INCOME | natural log of household income per capita in US-Dollar in 1995 | 3.37 | 0.101 |
| LABOUR | natural log of number of hrs of labour hired for farm work per village | 7.23 | 0.188 |
| LABOURPC | natural log of number of hrs of labour hired for farm work per capita per village | 1.40 | 0.184 |

| | | | |
|---|---|---|---|
| MARKET | natural log of total crop sales per village in US-Dollar in 1993-94 | 7.83 | 0.178 |
| MILL | natural log of number of mills nearby per household in 1995 | 0.562 | 0.129 |
| MONAPO | Monapo district? | 0.384 | 0.110 |
| MONTEPUEZ | Montepuez district? | 0.501 | 0.113 |
| ORIGINF | Origin of main woman in household is this village? | 0.652 | 0.050 |
| ORIGINM | Origin of main man in household is this village? | 0.678 | 0.049 |
| PEST | Do most crops suffer from pests in 1995 (unweighted)? | 0.404 | 0.071 |
| PESTMAX | Do more than 75% of stored food crops suffer from storage problems? | 0.459 | 0.040 |
| PLACE | identifying variable for the village, the primary sampling unit | 199.77 | 20.49 |
| PLOTDIVER | plot diversification index | 0.381 | 0.037 |
| PRICE13 | Paasche price index for purchased food in mid 1995 per household | 1.09 | 0.044 |
| PRICE14 | Paasche price index for purchased food in late 1995 per household | 0.929 | 0.036 |
| PRICE15 | Paasche price index for purchased food in early 1996 per household | 1.13 | 0.073 |
| PRICE23 | Paasche price index for purchased non-food in mid 1995 | 1.05 | 0.059 |
| PRICE24 | Paasche price index for purchased non-food in late 1995 | 0.978 | 0.051 |
| PRICE25 | Paasche price index for purchased non-food in early 1996 | 1.06 | 0.038 |
| PRICE33 | Paasche price index for home-produced food crops in mid 1995 | 1.04 | 0.066 |
| PRICE34 | Paasche price index for home-produced food crops in late 1995 | 1.10 | 0.152 |
| PRICE35 | Paasche price index for home-produced food crops in early 1996 | 1.30 | 0.208 |
| PRICEV1 | variance of purchased food prices | 0.090 | 0.015 |
| PRICEV2 | variance of purchased non-food prices | 0.058 | 0.013 |
| PRICEV3 | variance of home-produced food crops | 0.403 | 0.110 |
| RAIN | proportion of cultivated area with lack of rain in 1994-95 | 0.296 | 0.049 |
| REFUGEE | Has household been recognised as a refugee household? | 0.159 | 0.046 |
| RESDEP | number of dependent residents per household in mid 1995 | 1.89 | 0.111 |
| RESDEPS | square of the number of dependent residents per household in mid 1995 | 5.53 | 0.523 |
| RESNONDEP | number of non-dependent, resident members per household in mid 1995 | 5.57 | 0.330 |
| RESNONDEPS | square of the number of non-dependent, resident members per household in mid 1995 | 37.26 | 4.27 |
| SHAREON | natural log of share of income derived from on-farm activities | -0.227 | 0.026 |
| SHARESUB | natural log of share of income derived from subsistence activities | -0.577 | 0.050 |
| TOOL | number of tools per capita per household in May 1995 | 0.926 | 0.063 |
| WATERHARVEST | number of hours per month wife spent collecting water in harvest season | 24.63 | 3.27 |
| WATERHUNGRY | number of hours per month wife spent collecting water in hungry season | 15.06 | 1.00 |
| WEIGHT | weighing variable | 194.67 | 36.72 |
| WOODHARVEST | number of hours per month wife spent collecting firewood in harvest season | 7.35 | 0.843 |
| WOODHUNGRY | number of hours per month wife spent collecting firewood in hungry season | 7.31 | 0.771 |
| YIELDCOTTON | natural log of mean yield for cotton per village in 1994-95 in kilograms per hectare | 6.35 | 0.134 |

The mean and standard errors are weighted using WEIGHT and adjusted for survey design effects using the Stata 6 svyset and svymean commands. Source: FSP data and own calculations.

**Table 2: Sources of Income**

| % of Net Household Income in 1995 | | 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 |

Source: FSP data and own calculations.

**Table 3: Poverty Profile**

| | Weighted Population Share in % | Mean Income per Capita in US-Dollar (INCOME) | Headcount Ratio | Poverty Gap |
|---|---|---|---|---|
| **All Households** | 100 | 33.05 | 0.54 | 0.22 |
| **Farm Size (AREA)** | | | | |
| Small | 63 | 29.64 | 0.63 | 0.27 |
| Large | 37 | 38.95 | 0.39 | 0.13 |
| **Share of On-Farm Income (SHAREON)** | | | | |
| Low | 55 | 28.03 | 0.66 | 0.29 |
| High | 45 | 39.14 | 0.40 | 0.14 |
| **Income Diversification (INCDIVER)** | | | | |
| Low | 59 | 33.31 | 0.54 | 0.23 |
| High | 41 | 32.70 | 0.54 | 0.20 |
| **Crop Market Status (CROPMARKET)** | | | | |
| Not Participating | 21 | 21.14 | 0.81 | 0.40 |
| Participating | 79 | 36.30 | 0.47 | 0.17 |
| **Share of Subsistence Income (SHARESUB)** | | | | |
| Low | 43 | 36.10 | 0.49 | 0.18 |
| High | 57 | 30.74 | 0.58 | 0.25 |
| **Cotton Adoption (COTTON)** | | | | |
| Non-Adopter | 50 | 27.86 | 0.65 | 0.27 |
| Adopter | 50 | 38.15 | 0.43 | 0.17 |
| **Plot Diversification (PLOTDIVER)** | | | | |
| Low Diversification | 48 | 33.11 | 0.55 | 0.22 |
| High Diversification | 52 | 33.01 | 0.54 | 0.22 |
| **Social Exchange (EXCHANGE)** | | | | |
| Low Exchange | 52 | 31.50 | 0.59 | 0.24 |
| High Exchange | 48 | 34.76 | 0.50 | 0.20 |

Source: FSP data and own calculations.

## Table 4: Determinants of Income

```
Survey Instrumental Variables Regression
pweight:  WEIGHT                                  Number of obs    =       349
Strata:   CATEGORY                                Number of strata =         4
PSU:      PLACE                                   Number of PSUs   =        43
                                                  Population size  =  30505.29
                                                  F(  38,      2)  =     84.68
                                                  Prob > F         =    0.0117
                                                  R-squared        =    0.7208
------------------------------------------------------------------------------
INCOME     |      Coef.    Std. Err.       t     P>|t|      (95% Conf. Interval)
-----------+------------------------------------------------------------------
AGEHH      |  -.0332137    .0137195     -2.421   0.020     -.0609641   -.0054633
AGEHHS     |   .0004565    .0002198      2.077   0.044      .0000119    .0009011
DEPEND     |  -1.473872    .2796488     -5.270   0.000     -2.039515   -.9082287
RESNONDEP  |   -.244606    .0816773     -2.995   0.005     -.4098139   -.0793982
RESNONDEPS |   .0093799    .0058438      1.605   0.117     -.0024403    .0212002
           |
AGEHEAD    |   .0025155    .0082639      0.304   0.762     -.0141998    .0192308
AGEHEADS   |   6.99e-06     .000072      0.097   0.923     -.0001387    .0001526
EDUHEADINFS|   .0142647    .0100234      1.423   0.163     -.0060095    .0345389
EDUMATINF  |   .0044013    .0605038      0.073   0.942     -.1179791    .1267817
EDUMATINFS |   .0040367    .0133748      0.302   0.764     -.0230163    .0310897
EDUPATINF  |  -.0416433    .0603412     -0.690   0.494     -.1636948    .0804083
FEMHEAD    |  -.4012829    .1487346     -2.698   0.010     -.7021271   -.1004387
FEMRATIO   |  -.1199673    .1739991     -0.689   0.495     -.4719137    .2319792
WOODHARVEST|  -.0089415    .0025924     -3.449   0.001     -.0141852   -.0036979
           |
ANIMAL     |   .1802253    .1252647      1.439   0.158     -.0731463     .433597
ASSET      |   .0463049    .0147734      3.134   0.003      .0164228    .0761869
AUTH       |   .3324322    .1051083      3.163   0.003      .1198306    .5450337
CYCLONE    |   .1728028    .0853863      2.024   0.050      .0000927     .345513
TOOL       |    .212001    .0912487      2.323   0.025      .0274331    .3965688
           |
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
YIELDCOTTON|   .3513762    .0589914      5.956   0.000      .2320548    .4706976
           |
AREA       |   .6574404    .1207019      5.447   0.000      .4132979     .901583
INCDIVER   |  -.7993689    .3742041     -2.136   0.039     -1.556268   -.0424696
CROPMARKET |   .2467969    .0837172      2.948   0.005      .0774629     .416131
SHARESUB   |  -.3486792    .1333948     -2.614   0.013     -.6184955   -.0788628
COTTON     |  -.3205112    .1823947     -1.757   0.087     -.6894392    .0484169
PLOTDIVER  |   .4645806    .0887742      5.233   0.000      .2850178    .6441434
EXCHANGE   |   .0486189     .024046      2.022   0.050     -.0000188    .0972565
           |
PLACE111   |  -.0884474    .1268193     -0.697   0.490     -.3449636    .1680688
PLACE112   |  -.1358157    .1641588     -0.827   0.413     -.4678582    .1962269
PLACE113   |  -.1275608    .3279126     -0.389   0.699     -.7908266    .5357051
PLACE121   |   .5156376    .1821128      2.831   0.007      .1472796    .8839955
PLACE123   |   1.352448    .3531916      3.829   0.000      .6380506    2.066845
PLACE214   |    .085128    .1758689      0.484   0.631     -.2706003    .4408564
PLACE215   |    .130924    .2211673      0.592   0.557     -.3164292    .5782771
PLACE221   |   .5173103    .1638056      3.158   0.003      .1859821    .8486384
PLACE231   |   .5813827    .1639945      3.545   0.001      .2496726    .9130928
PLACE232   |   .0537003    .1157973      0.464   0.645     -.1805218    .2879225
PLACE312   |   1.371343    .3655466      3.751   0.001      .6319547     2.11073
PLACE313   |   1.164763    .2286975      5.093   0.000      .7021787    1.627347
PLACE321   |   .4103915    .1810355      2.267   0.029      .0442127    .7765704
PLACE332   |   .3985852    .1360771      2.929   0.006      .1233433    .6738271
cons       |   2.298335    .4466111      5.146   0.000      1.394979    3.201692
------------------------------------------------------------------------------
```

Instrumented: AREA COTTON INCDIVER

Instruments: ANCEST AREAFERT AREATOTAL DISTANCE DISTANCES DONATION FEMNR FEMNRS ILLDAYS95 ILLDAYS96 LABOURPC MARKET MILL MONAPO MONTEPUEZ ORIGINM PEST PESTMAX PLACE114 PLACE122 PRICE13 PRICE14 PRICE15 PRICE23 PRICE24 PRICE25 PRICE33 PRICE34 PRICE35 RAIN REFUGEE WATERHARVEST WATERHUNGRY WOODHUNGRY

Source: FSP data and own calculations.

## Table 5: Determinants of Consumption

```
Survey Instrumental Variables Regression
pweight:  WEIGHT                                  Number of obs    =       371
Strata:   CATEGORY                                Number of strata =         4
PSU:      PLACE                                   Number of PSUs   =        43
                                                  Population size  =  32539.53
                                                  F(  38,      2)  =    864.48
                                                  Prob > F         =    0.0012
                                                  R-squared        =    0.6164
------------------------------------------------------------------------------
EXPTOTAL   |      Coef.    Std. Err.       t     P>|t|      (95% Conf. Interval)
-----------+------------------------------------------------------------------
AGEHH      |   -.034995    .0152916     -2.289   0.028     -.0659251   -.0040649
AGEHHS     |   .0003003    .0002066      1.454   0.154     -.0001176    .0007182
RESDEP     |   -.200286    .0865714     -2.314   0.026     -.3753932   -.0251788
RESDEPS    |   .0074661    .0205484      0.363   0.718      -.034097    .0490292
RESNONDEP  |  -.1339431    .0940716     -1.424   0.162     -.3242208    .0563347
RESNONDEPS |   .0039355    .0072182      0.545   0.589     -.0106647    .0185358
           |
AGEHEAD    |    .014244    .0111285      1.280   0.208     -.0082654    .0367534
AGEHEADS   |  -.0000586    .0001298     -0.452   0.654     -.0003213     .000204
EDUMATINF  |  -.0449154      .06504     -0.691   0.494     -.1764711    .0866404
EDUMATINFS |   .0119461    .0108136      1.105   0.276     -.0099265    .0338186
EDUMAX     |   -.033002    .0492194     -0.671   0.506     -.1325576    .0665535
EDUMAXS    |   .0068529    .0057754      1.187   0.243     -.0048289    .0185347
FEMHEAD    |  -.5609736    .1603482     -3.498   0.001     -.8853085   -.2366387
FEMRATIO   |  -.4332336    .1746231     -2.481   0.018     -.7864421   -.0800252
ILLDAYS96  |   .0022798    .0009594      2.376   0.023      .0003391    .0042204
           |
ANIMAL     |   .0436279    .1003251      0.435   0.666     -.1592987    .2465546
ASSET      |   .3782624    .0871722      4.339   0.000        .20194    .5545848
AUTH       |   .1206285    .0843355      1.430   0.161     -.0499561    .2912132
           |
LABOUR     |   .0267581    .0340387      0.786   0.437     -.0420917     .095608
PRICEV1    |   .2157894     .199686      1.081   0.286     -.1881137    .6196925
           |
AREA       |   .1364993    .0640873      2.130   0.040      .0068704    .2661281
SHAREON    |   .8935434    .4021657      2.222   0.032      .0800865       1.707
CROPMARKET |   .6019751    .2320506      2.594   0.013      .1326084    1.071342
COTTON     |  -.1508039     .072918     -2.068   0.045     -.2982945   -.0033132
           |
PLACE111   |   .0547251    .2634764      0.208   0.837     -.4782063    .5876564
PLACE112   |  -.6091222    .1112914     -5.473   0.000     -.8342303    -.384014
PLACE113   |  -.5273597    .1701727     -3.099   0.004     -.8715664    -.183153
PLACE121   |   .0565536    .0865187      0.654   0.517     -.1184469    .2315541
PLACE122   |    -.33957    .1360725     -2.496   0.017     -.6148026   -.0643375
PLACE123   |  -.1983622    .1075031     -1.845   0.073     -.4158079    .0190834
PLACE214   |   -.125512    .1363817     -0.920   0.363     -.4013701    .1503461
PLACE215   |  -.2985392    .1504358     -1.984   0.054     -.6028244    .0057459
PLACE231   |   .1363223    .1409484      0.967   0.339     -.1487728    .4214174
PLACE232   |  -.1791666    .1657645     -1.081   0.286     -.5144568    .1561237
PLACE312   |  -.7111879    .1420036     -5.008   0.000     -.9984174   -.4239585
PLACE313   |  -.0393424    .1572609     -0.250   0.804     -.3574325    .2787478
PLACE321   |   .0117189    .2107703      0.056   0.956     -.4146043    .4380421
PLACE332   |   .2167968    .1185652      1.829   0.075     -.0230239    .4566176
cons       |   4.032277    .4172842      9.663   0.000       3.18824    4.876314
------------------------------------------------------------------------------
```

Instrumented: CROPMARKET SHAREON

Instruments: ANCEST AREAFERT AREATOTAL DISTANCE DISTANCES DONATION FEMNR FEMNRS ILLDAYS95 LABOURPC MARKET MILL MONAPO MONTEPUEZ ORIGINM PEST PESTMAX PLACE114 PLACE221 PRICE13 PRICE14 PRICE15 PRICE23 PRICE24 PRICE25 PRICE33 PRICE34 PRICE35 RAIN REFUGEE WATERHARVEST WATERHUNGRY WOODHUNGRY

Source: FSP data and own calculations.

## Table 6: Determinants of Food Consumption

```
Survey Instrumental Variables Regression
pweight:  WEIGHT                                        Number of obs    =       371
Strata:   CATEGORY                                      Number of strata =         4
PSU:      PLACE                                         Number of PSUs   =        43
                                                        Population size  =  32539.53
                                                        F(  38,      2)  =    516.54
                                                        Prob > F         =    0.0019
                                                        R-squared        =    0.7534
------------------------------------------------------------------------------
EXPFOOD     |      Coef.    Std. Err.       t     P>|t|      (95% Conf. Interval)
------------+-----------------------------------------------------------------
AGEHH       |  -.0362171    .0124465     -2.910   0.006     -.0613926   -.0110416
AGEHHS      |   .0004853    .0001729      2.806   0.008      .0001354    .0008351
RESNONDEP   |  -.1599799    .0551495     -2.901   0.006     -.2715302   -.0484295
RESNONDEPS  |   .0052606    .0042695      1.232   0.225     -.0033753    .0138965
RESDEP      |  -.1577354    .0302187     -5.220   0.000     -.2188585   -.0966123
            |
AGEHEAD     |   .0059279    .0081164      0.730   0.470      -.010489    .0223449
AGEHEADS    |   .0000344    .0000911      0.378   0.708     -.0001498    .0002186
EDUMATINF   |  -.0696631    .0466683     -1.493   0.144     -.1640586    .0247323
EDUMATINFS  |   .0102255    .0079963      1.279   0.209     -.0059486    .0263996
EDUMAX      |   .0274989    .0329467      0.835   0.409     -.0391421    .0941399
EDUMAXS     |   .0031283    .0040681      0.769   0.447     -.0051003    .0113568
FEMHEAD     |  -.7044754    .1550828     -4.543   0.000      -1.01816   -.3907908
FEMRATIO    |  -.1865782    .1675034     -1.114   0.272     -.5253857    .1522293
REFUGEE     |   .1188171    .0755645      1.572   0.124     -.0340265    .2716607
WOODHARVEST |  -.0134871    .0033433     -4.034   0.000     -.0202495   -.0067247
            |
ANIMAL      |    .039291    .0880524      0.446   0.658     -.1388118    .2173937
AREAFERT    |   -.082418    .0484067     -1.703   0.097     -.1803298    .0154938
ASSET       |    .318572    .0661106      4.819   0.000      .1848508    .4522933
AUTH        |   .3188338    .1027581      3.103   0.004      .1109858    .5266817
ORIGINF     |  -.2460459    .0579577     -4.245   0.000     -.3632763   -.1288154
ORIGINM     |  -.1138888    .0660364     -1.725   0.093     -.2474601    .0196825
RAIN        |  -.2029822    .1131915     -1.793   0.081     -.4319336    .0259692
            |
MARKET      |  -.1816463    .0487053     -3.729   0.001      -.280162   -.0831306
PRICEV1     |   .0531992    .1397043      0.381   0.705     -.2293794    .3357778
            |
AREA        |    .443588    .0738905      6.003   0.000      .2941303    .5930457
SHAREON     |   .5932566    .2917696      2.033   0.049       .003097    1.183416
INCDIVER    |  -.3682106    .1448249     -2.542   0.015     -.6611466   -.0752746
CROPMARKET  |   .1258708    .0747885      1.683   0.100     -.0254032    .2771447
COTTON      |   -.107901    .0595732     -1.811   0.078     -.2283992    .0125972
PLOTDIVER   |   .3361708    .0692831      4.852   0.000      .1960324    .4763092
            |
PLACE111    |   .4537965    .1929016      2.352   0.024      .0636162    .8439768
PLACE112    |   -.277147    .1064588     -2.603   0.013     -.4924801   -.0618138
PLACE114    |   .4184794    .1899922      2.203   0.034       .034184    .8027748
PLACE121    |   .2870687    .0979971      2.929   0.006      .0888509    .4852865
PLACE122    |  -.4210132    .1153138     -3.651   0.001     -.6542573   -.1877691
PLACE123    |   .2141659     .125937      1.701   0.097     -.0405657    .4688976
PLACE214    |   -.008862    .1040064     -0.085   0.933     -.2192349    .2015108
PLACE221    |  -.2974061    .2210773     -1.345   0.186     -.7445773     .149765
PLACE231    |   .7137438    .1143298      6.243   0.000        .48249    .9449976
PLACE232    |  -.1312145    .0856826     -1.531   0.134      -.304524    .0420949
PLACE312    |  -.7378389    .0852489     -8.655   0.000     -.9102711   -.5654068
PLACE313    |   .3821011     .120393      3.174   0.003      .1385833    .6256189
PLACE321    |   .6612416    .1509388      4.381   0.000      .3559391    .9665441
PLACE332    |   .3811662    .1152782      3.306   0.002      .1479941    .6143383
cons        |   5.704634    .5006679     11.394   0.000      4.691938    6.717331
------------------------------------------------------------------------------
```

Instrumented: SHAREON

Instruments: ANCEST AREATOTAL DISTANCE DISTANCES DONATION FEMNR FEMNRS ILLDAYS95 ILLDAYS96 MILL MONAPO MONTEPUEZ PEST PESTMAX PLACE113 PLACE215 PRICE13 PRICE14 PRICE15 PRICE23 PRICE24 PRICE25 PRICE33 PRICE34 PRICE35 WATERHARVEST WATERHUNGRY WOODHUNGRY

Source: FSP data and own calculations.

**Table 7: Summary of Endogenous Determinants of Household Welfare**

| | Instrument | | Regression | | |
|---|---|---|---|---|---|
| | $R^2$ | F | DWH | Coef | P |
| **INCOME** | | | | | |
| AREA | 0.69 | 0.00 | 0.01 | **0.66** | 0.00 |
| SHAREON | 0.56 | 0.00 | n.a. | n.a. | n.a. |
| INCDIVER | 0.54 | 0.00 | 0.02 | **-0.80** | 0.04 |
| CROPMARKET | 0.58 | 0.00 | n.a. | **0.25** | 0.01 |
| SHARESUB | 0.37 | 0.00 | n.a. | **-0.35** | 0.01 |
| COTTON | 0.53 | 0.01 | 0.15 | **-0.32** | 0.09 |
| PLOTDIVER | 0.54 | 0.02 | n.a. | **0.46** | 0.00 |
| EXCHANGE | 0.41 | 0.00 | n.a. | **0.05** | 0.05 |
| **EXPTOTAL** | | | | | |
| AREA | 0.67 | 0.00 | n.a. | **0.14** | 0.04 |
| SHAREON | 0.55 | 0.00 | 0.01 | **0.89** | 0.03 |
| INCDIVER | 0.48 | 0.00 | n.a. | n.a. | n.a. |
| CROPMARKET | 0.58 | 0.00 | 0.01 | **0.60** | 0.01 |
| SHARESUB | 0.36 | 0.00 | n.a. | n.a. | n.a. |
| COTTON | 0.53 | 0.01 | n.a. | **-0.15** | 0.05 |
| PLOTDIVER | 0.52 | 0.01 | n.a. | n.a. | n.a. |
| EXCHANGE | 0.40 | 0.00 | n.a. | n.a. | n.a. |
| **EXPFOOD** | | | | | |
| AREA | 0.67 | 0.00 | n.a. | **0.44** | 0.00 |
| SHAREON | 0.55 | 0.00 | 0.09 | **0.59** | 0.04 |
| INCDIVER | 0.49 | 0.00 | n.a. | **-0.37** | 0.02 |
| CROPMARKET | 0.58 | 0.00 | n.a. | **0.13** | 0.10 |
| SHARESUB | 0.37 | 0.00 | n.a. | n.a. | n.a. |
| COTTON | 0.53 | 0.01 | n.a. | **-0.11** | 0.08 |
| PLOTDIVER | 0.52 | 0.02 | n.a. | **0.34** | 0.00 |
| EXCHANGE | 0.40 | 0.00 | n.a. | n.a. | n.a. |

The “F” column reports the p-value of the F-test of joint insignificance of the coefficients of all variables used to instrument AREA. Small values indicate that the null hypothesis of an unsuitable choice of instruments can be rejected (Deaton 1997: 116).
The “DWH” column reports the p-value of the weighted DWH test of endogeneity. Independent categorical variables report the unweighted DWH test statistic. Small values indicate that the null hypothesis of exogeneity can be rejected.
Source: FSP data and own calculations.

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