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Coffee Price Risk in Perspective – Household Vulnerability among Rural Coffee Growing Smallholders in rural Tanzania

March 10, 2006

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Abstract:

Despite the precipitous decline in coffee prices in early 2000, cash crop growing smallholders in Kilimanjaro and Ruvuma, Tanzania, identified health shocks, droughts as well as commodity price declines as their major risk factors. About one third of the rural population in Kilimanjaro suffered either from drought or health shocks in 2003, resulting in 18 percent welfare loss. Through reliance on savings and aid they reduced this loss to 8 percent on average. In Ruvuma rainfall is more reliable and drought did not affect welfare. Surprisingly, health shocks appeared not to affect welfare either, most likely related to lower observed medical expenditures in case of illness given limited access to health facilities. Coffee growers appeared not worse off in 2003 than non-coffee growers, apart from the smallest ones in Kilimanjaro, whose consumption level was on average 20 percent lower, and the largest ones in Ruvuma, whose consumption levels appear larger. Interventions to improve health conditions and reduce the effect of droughts emerge as important to reduce vulnerability in rural Tanzania.

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[1] Paper presented at the CSAE Conference 2006: Reducing Poverty and Inequality: How can Africa be included? held on 19-21 March 2006, **at** St Catherine's College, Oxford England. The authors are Senior Economist at the World Bank, Ph.D. candidate Cornell University and Director of the Commodities and Trade Division at the Food and Agriculture Organization of the United Nations respectively. The authors would like to thank Donald Mmari, Lucas Katera, Donald Sango and Professor Joseph Semboja at Research on Poverty Alleviation (REPOA) in Dar es Salaam, Tanzania, who have managed the surveys on which this research is based, Panos Varangis and Benno Ndulu for their continuous support of the project. The study has been funded by the EU Trust Fund on Commodity Management and the Dutch-Japanese Poverty Reduction Strategy Trust Fund. The findings, interpretations, and conclusions expressed are entirely those of the authors, and they do not necessarily represent the views of the World Bank, its Executive Directors, or the countries they represent, or the views of FAO and its member countries.

1 Introduction

The precipitous decline in coffee prices since the late 1990s has attracted a lot of attention. Yet, not only are the actual welfare effects for coffee growers in Sub Saharan Africa of this price decline poorly understood, the focus on coffee prices has also distracted attention away from the wide array of risks coffee growing households face. A more holistic approach to commodity growing households' vulnerability status is called for. Moreover, while there is increasing evidence that rural households in developing countries only partially manage to smooth their consumption in the face of shocks (Dercon, 2004), the size of the immediate and long term welfare losses associated with shocks are still poorly documented. Such information is important to gauge the benefits from vulnerability reducing interventions.

This paper takes a more holistic perspective on household vulnerability and examines the immediate effects of shocks on household welfare in the context of rural Kilimanjaro and Ruvuma, both coffee and cashew growing regions in Tanzania, while accounting for households' coping capacity and differential effects across livelihoods. From a directly administered shock module in a survey administered in 2003 to 900 households in each region, we learn that households identify droughts, health shocks and commodity price declines as their major risk factors both in terms of the frequency of their occurrence as well as the severity of their effects, underscoring the need for a more holistic perspective on household vulnerability even among commodity producing households.

The paper addresses three broad questions in particular. First, it explores the welfare effect of the health and drought shocks and to the extent possible, it will also reflect on the welfare effects of the more systemic commodity price shocks. Second, the paper examines the effectiveness of different ex post coping and ex ante risk reducing strategies in mitigating the negative welfare effects associated with these risks. It will focus in particular on self and informal insurance schemes and irrigation respectively. Finally, the determinants of people's coping capacity are investigated.

The paper proceeds by outlining the empirical methodology in section 2. A series of data considerations are addressed in section 3. Empirical results regarding the effects of the different shocks on household welfare are presented in section 4 and the effectiveness of the different coping strategy is explored in section 5. Section 6 examines the correlates of households' coping capacity, followed by concluding remarks in section 7.

2 Empirical Methodology

From economic theory we know that, assuming households maximize inter-temporal utility with instantaneous utility concave (i.e. risk averse), households prefer smooth to volatile consumption. Given access to well functioning credit or insurance markets, these preferences will generate stable consumption paths, even when shocks occur. If credit and insurance markets are imperfect, household consumption may be susceptible to shocks (Deaton, 1992; Besley, 1995). These theoretical insights provide a practical framework to empirically explore whether and to what extent shocks and households' coping capacity affect their consumption levels.

More formally, suppose households at time t maximize inter-temporal expected utility U_t. Let u (c_t) be instantaneous utility derived from consumption c_t (≥0) and u'(.)>0, u''(.)<0 such that:

$$U_t = E_t \sum_{\tau=t}^{T} (1+\delta)^{t-\tau} u(c_\tau) \tag{1}$$

with δ the rate of time preference and T the end of the life-cycle. Households face risky income y_t and income can be used to obtain consumption at prices p_t. Define r as the rate of returns to savings between periods and A_{t+1} as the value of assets at the beginning of period $t+1$. Assets evolve from one period to the next according to:

$$A_{t+1} = (1+r)(A_t + y_t - p_t c_t)$$

Solving (1) and (2) using the envelope condition and assuming that households have full access to credit and/or (formal or informal) insurance yields:

$$\frac{u'(c_t)}{p_t} = \frac{(1+r)}{(1+\delta)} E_t \left[\frac{u'(c_{t+1})}{p_{t+1}} \right]$$

Discounted marginal utilities suitably corrected for relative price changes will be equated. In the absence of uncertainty, with r equal to δ and prices constant over time, the optimal consumption path implies equal consumption over time. In the tradition of Hall (1978) and Morduch (1990) we assume constant relative risk aversion with instantaneous marginal utility defined at t as $c_t^{-\rho} e^{\theta_t}$ with ρ the coefficient of relative risk aversion and θ_t a general taste shifter to parametrize (3) and obtain an empirical specification. Taking logs, and introducing subscript i and j to denote households i in location j, (3) can be written as:

$$\ln\frac{c_{ijt+1}}{c_{ijt}} = \frac{1}{\rho}\left(\ln(1+r) - \ln(1+\delta) + \ln\frac{p_t}{p_{t+1}} + (\theta_{ijt+1} - \theta_{ijt})\right) + e_{ijt+1} \tag{4}$$

with e_{ijt+1} the expectation error which has mean zero and is orthogonal to all variables known at time t given rational expectations. According to equation (4) the path of consumption over time is only affected by taste shifters and price changes, as long as there are no binding liquidity constraints over time and provided the underlying factors determining wealth (or permanent income) are not changing. In other words, under the hypothesis of perfect consumption smoothing, the optimal consumption path is not affected by idiosyncratic and/or covariate (income) shocks S_{ijt+1} and introduction of these shocks overidentifies equation (4). This provides an empirical framework to explore the effects of shocks on welfare. We further allow differential ability across households to cope with shocks ex post, leading to the following linear empirical specification:

$$\ln\frac{c_{ijt+1}}{c_{jit}} = \alpha_0 + \alpha_1 Z_{ijt} + \alpha_2 S_{ijt+1} \otimes M_{ijt} + e_{ijt+1} \tag{5}$$

with Z_{ijt} comprising price changes and taste shifters (such as changes in household composition) and M_{ijt} a vector of variables such as initial wealth, social capital, access to credit, availability of safety net programs, capturing the household's capacity to mitigate the effect of income shocks ex post. Differential ability to cope with shocks ex post is likely to condition the effect of income shocks on consumption.

Alternatively, assume X_{ijt} the comprehensive set of observable (and exogenous) household and location characteristics affecting preferences, permanent income and coping capacity (after shocks S_{ijt} have materialized)[2], such that $c_{ijt} = c(X_{ijt}, v_{ij}, \omega_j)$ with v_{ij} and ω_j reflecting unobserved (time invariant) household and location heterogeneity respectively. Equation (5) can then also be written and estimated as:

$$\ln c_{ijt+1} = \beta_0 + \beta_1 X_{ijt} + \beta_2 S_{ijt+1} \otimes X_{ijt} + v_{ij} + \omega_j + \varepsilon_{ijt+1} \tag{6}$$

When panel data are available, equation (5) could be estimated (either as a difference or a fixed effects model) and unobserved household (and location) heterogeneity would be explicitly controlled for. Yet in practice, panel data are often not available, and when available, they tend to focus on a limited set of livelihoods/ populations and usually span relatively short time periods. This poses a particular challenge when studying the effect of slow onset, systemic shocks such as broad economic crises or a decline in commodity prices. The period covered by the panel may be too short to fully encompass the period of the shock (e.g. precipitous commodity price decline) and the shock may affect all households in the sample leaving the researcher in effect without a control group. Estimates of the welfare effect of an economy wide shock based on welfare before and after the shock will be biased, if there are secular trends.

[2] These include but are not limited to Z_{ijt} and M_{ijt}.

Furthermore, the availability of repeated observations on a household's consumption and income, does not eliminate the need for explicit information on shocks to estimate the welfare effects of shocks. While changes in consumption are sometimes regressed on changes in income (Harrower and Hoddinott, 2005), attenuation bias due to oft observed measurement error in the latter would lead us to underestimate the effect of an income shock. At the same time, imputation errors in valuing consumption from own food production in constructing the consumption and income variables may lead to a spurious positive correlation between total household consumption and income, biasing the income coefficient upwards (Deaton, 1997). Direct information on shocks usually provides the necessary instruments to address this problem. It also enables inference on the effect of shocks on income and consumption.

In the absence of panel data, but given cross sectional data on household consumption (C_{ijt+1}), explicit information on shocks experienced during t+1 (S_{ijt+1}) and comprehensive recall data on households' assets and their coping capacity (X_{ijt}) the differential effect of different shocks across households could be explored through estimation of equation (6), in effect using a retrospective panel approach and assuming $E(X_{ijt}v_{ij}) = E(S_{ijt+1}v_{ij})=0$. In practice, a comprehensive description of the household characteristics (X_{ijt}) helps reduce the likelihood of potential bias due to unobserved household heterogeneity. Furthermore, potential endogeneity issues related to the shock variables can be avoided through the use of external shock information as opposed to self reported measures of shocks from the household questionnaire. The use of village fixed effects controls for bias due to correlation of X and S with unobserved village effects. Yet as this may cause an underestimate of the full effect of covariate shocks, it is useful to also explore models with an explicit comprehensive description of the location/village characteristics when available.

Given that slow onset commodity price shocks such as the systemic coffee and cashew price shocks only directly affect producers of these crops the effect of these shocks could in principle be explored when the sample includes a sufficiently large control group of non-coffee or cashew crop growers with similar characteristics. The shock variable (S_{ijt}) in this case becomes being a coffee (cashew) crop grower at t or not. Yet, caution is warranted in interpreting the empirical results. First, it is implicitly assumed that cash and non-cash crop growers are ceteris paribus equivalent (i.e. $E(S_{ijt+1} \cdot v_{ij})=0$) such that the effect of being a cash crop grower only captures the effect of the systemic price shock. Second, if the overall economic activity in the region declines as a result of the price decline, the approach is likely to underestimate the direct negative effect as non-coffee growers are likely to have suffered as well, albeit indirectly. Bearing these caveats in mind and using a comprehensive specification to minimize potential bias due to unobserved differences in nature between cash crop and non-cash crop growers, the proposed approach also sheds light on the effect of the cash crop price decline on household welfare in Kilimanjaro and Ruvuma.

3 Data considerations

To analyze the welfare effects of these different shocks, we use a primarily collected household vulnerability survey conducted in October-December 2003 in Kilimanjaro and February-March 2004 in Ruvuma. A detailed description of the survey and key characteristics of the households is given in Christiaensen and Sarris (2006). We take (the logarithm of) total household expenditures per adult equivalent excluding expenditures on health, education and functions (baptism, funerals) from the first survey round as our measure of welfare.[3] To capture differences in household preferences, their permanent income potential and their coping capacity we include age of the household head (a life cycle proxy), the dependency ratio, gender of headship and the years of formal education achieved by the household head (allowing for differential effects across primary, secondary and post secondary education). As cultivation of certain cash crops may be traditionally dominated by certain ethnic groups (see below), we also control for the ethnic origins of the household head. This also helps control for people's social capital and thus their capacity to cope with shocks ex post. For example, the Chagga, which make up 74 percent of the total rural population in Kilimanjaro, are known to be highly mobile and well connected in Tanzania.

To proxy households' productive capacity and thus also their permanent income potential, we include the size of their landholdings owned, the numbers of their large (cattle, oxen, horses) and small (goat, sheep, pigs) livestock owned, and the value of their agricultural equipment and vehicles (all normalized by the number of adult equivalents) as well as their squared terms to capture non-linearities in their effects on consumption. A self reported measure of ease in obtaining seasonal credit for inputs is included to proxy access to production (as opposed consumption) credit.

The effect of the fall in coffee prices is explored through inclusion of the number of coffee trees owned by the household in 2000 when the coffee price decline set in. Where the data allow, we correspondingly also lag our asset variables to 2000 to be consistent. We furthermore divide the coffee growers in our sample in five quintiles based on their amount of coffee trees in 2000 to allow for differential effects among smaller and larger coffee farmers. The omitted category is the non-coffee growers, which makes up about one third of the total sample in Kilimanjaro. A similar approach is followed in Ruvuma, though we also include quintile categories for cashew growers

[3] A detailed description of the construction of the expenditure variable is in Christiaensen and Sarris (2006). Comparison of health expenditures among households with and without an illness shock shows that households who experienced a health shock have on average two to three times more health expenses. Similarly, we find that expenditures on functions are also larger among households who experienced a death over the past two years. Since we can't distinguish between health expenditures for preventive reasons, which may be an expression of larger household welfare, and health expenditures for curative reasons or between expenditures on functions for funerals and baptisms, we opt to exclude all expenditures on health and functions to avoid a downward bias in the estimated coefficient of the welfare effects of health shocks.

based on their number of cashew trees and a category for tobacco growers.[4] As our data in Ruvuma allowed us only go to two years back these were based on tree ownership in early 2002.[5]

Table 1 and 2A and B review differences among coffee growers in the different quintiles and non-coffee growers in Kilimanjaro and Ruvuma along a series of (observed) characteristics. Consistent with the agro-ecological requirements of coffee production coffee growing households in Kilimanjaro live at higher altitudes. They are also more likely to be Chagga than Pare in Kilimanjaro and almost exclusively Matengo in Ruvuma, confirming the importance of controlling for ethnicity when exploring the effect of coffee price shocks through a retrospective panel approach. Cashew production is largely confined to the Yao. There is a large difference in the amount of coffee trees owned across the different quintiles with the amount of trees estimated at about 40 in the lowest quintile and more than doubling from quintile to quintile to about 1325 trees in the highest quintile in Kilimanjaro. In Ruvuma, coffee growing households have on average three times as many trees than in Kilimanjaro with those in the highest quintile owning on average 5 times as many trees as those in the lowest quintile.

Coffee growers in the lowest quintile in Kilimanjaro tend to own less land, livestock and consumer durables compared with non-coffee growers while coffee growers in the largest quintile tend to have more land, have more valuable housing and receive more remittances compared with non-coffee growers. Further exploration does not show much difference across coffee and non-coffee growers in the likelihood of using one's savings or receiving aid from others when experiencing a shock (see Table 1). Coffee growers in higher quintiles in Ruvuma tend to own more livestock and have more valuable compounds. The larger cashew growers tend to have much more land, though they do not appear richer on other ground compared with other households in Ruvuma. They are however more likely to use savings when faced with shocks.

Households' coping capacity is approximated both directly through the inclusion of reported coping through saving or receipt of aid in case of a health and drought shock and indirectly through the value of household consumer durables (per adult equivalent) in the year preceding the survey. We also control for the proportion of time in non-farming activities and the amount of remittances (per adult equivalent) received as further indirect determinants of households' coping capacity. The amount of acres irrigated (per adult equivalent) indicates exposure to drought shocks. Similarly, the proportion of time spent on non-farming activities also indirectly captures exposure to drought shocks.

To mitigate potential endogeneity problems arising from the self reporting of drought shocks we use an index of a household's qualitative assessment of the rainfall amount across its plots as opposed to the self-reported occurrence of a drought shock

[4] Given that only 4 percent of the households in our Ruvuma sample were tobacco growers, we did not disaggregate the group of tobacco growers further.

[5] The first survey rounds for Kilimanjaro and Ruvuma were conducted in the fall of 2003 and the spring of 2004 respectively.

from the directly administered shock module in the questionnaire.[6] According to the former measure, 21 percent of all households in Kilimanjaro experienced rainfall much below normal on their plots in 2003 and 42 percent rainfall below normal. Drought shocks are much less frequent in Ruvuma with four percent of all households experiencing rainfall much below normal in 2003 and 34 percent rainfall somewhat below normal. To better capture actual exposure to the rainfall shock, the rainfall shock indicator is multiplied by the household's cultivated land area per adult equivalent.

Our health shock variable includes both the occurrence of a death and/or an illness shock in the two years preceding the survey. While death shocks are arguably not infected by self-reporting bias, illness shocks may be. The literature on the accuracy of self-reported health shocks (Foster, 1994; Groot, 2000; Gertler and Gruber, 2002; Baker, Stabile, and Deri, 2004) suggests that the likelihood of reporting a health shock is associated with a household's reference group (the poor tending to report fewer health problems), the intensity of the problem (the more severe the illness, the more likely it is it will be reported, and the need for justification (for example to rationalize absenteeism from work). While the two latter motivations are less of a concern in the current context, the former might bias our results. Inclusion of the comprehensive vector of households' assets and consumer durables described above capturing household wealth will however substantially mitigate the potential bias from self-reporting illness shocks. We also provide robustness tests using non-self village means of self-reported illness incidence as an instrument. Being a coffee or cashew crop grower is treated as exogenous to the household's current living standards.

While we use village dummies in our base models to control for unobserved heterogeneity across locations, we also present a model unbundling the village effects. This will allow us to further explore whether our shock variables underestimate the welfare effects of shocks when they cannot fully capture the covariant nature albeit at the expense of potentially introducing endogeneity related to unobserved village effects. We measure in particular how connected a village is, proxy the quality of its infrastructure through the availability of electricity at the village level, and use the altitude at which the village is located to help define its agro-ecological characteristics and thus also its agricultural potential. To capture the connectivity of the village we use information on the presence of a tarmac road in the village, the availability of a public phone and a cell phone signal, the regular organization of a market, and the availability of a bus service to the village.

[6] In particular, households were asked for each plot whether the rainfall was much below normal, below normal, normal, above normal, much above normal. A plot size weighted average of these rainfall assessments was calculated and rounded off to the nearest digit to obtain a qualitative assessment for each household.

4 Determinants of welfare and welfare effects of shocks

Given the divergent nature of the economies in Kilimanjaro and Ruvuma, we run separate regressions for both regions. The results are in tables 3 and 4. The baseline model in column (1) includes the shock variables and controls for location effects through village dummies. Models incorporating interaction terms of coping strategies (aid, use of own savings, and remittances) with the different shocks are in column (2). The differential effects of the different health shocks (death and illness of an adult member) are explored in column (3). A model explicitly identifying the location effects through inclusion of village proxies of connectivity, access to electricity and agro-ecological conditions is presented in column (4). The different specifications fit the data very well and explain almost half the variation in the observed (log) expenditures (R-squared between 0.45 and 0.50).

The coefficients on the household characteristics and assets are highly significant and largely consistent with predictions from theory. Households with higher dependency ratios tend to be poorer and households with better educated heads enjoy higher consumption. However, the latter effect only holds when the heads have secondary education in Kilimanjaro and only when heads have primary education in Ruvuma, possibly reflecting the fact that Kilimanjaro finds itself further on the path of structural transformation than Ruvuma. Surprisingly, household heads with post secondary education appear disadvantaged in Kilimanjaro though not in Ruvuma, which may reflect the current lack of remunerative employment opportunities for the well educated in Kilimanjaro. Once a household's possession of assets and education are controlled for, female headed households tend to be better off, though the results are only weakly significant.

Households with more asset variables (landholdings, livestock ownership, total value of productive assets) tend to be richer. These effects were found to be highly statistically significant and the marginal returns were often observed to be declining as asset possessions increase. Households with easy access to credit for modern inputs were on average estimated to be about ten percent richer in Kilimanjaro underscoring the importance of access to capital and the use of modern inputs. Yet, the opposite appears to hold in Ruvuma, where those with easy access to seasonal credit appear worse off. This result warrants deserves further investigation.

Consumption is also positively associated with possession of consumer durables albeit at a declining marginal rate. Access to irrigation substantially enriches households with consumption in Kilimanjaro estimated to increase on average by 19 percent per acre per adult equivalent irrigated. While irrigation also affects consumption positively in Ruvuma, it is not found to be statistically significant. This is likely related to the limited use of irrigation in Ruvuma, consistent with its more reliable rainfall pattern, and thus the limited variability in the sample. Only 2.1 percent of all households in Ruvuma irrigate (some of) their land, while 21 percent do so in Kilimanjaro. Income from remittances positively contributes to consumption both in Kilimanjaro and Ruvuma, though the effect is (again) somewhat less precisely estimated in the latter sample. Also, households with a larger proportion of productive time spent in non-agricultural activities tend to be richer.

Farmers in Kilimanjaro who have faced a drought shock over the past year (ie, those who reported receiving much below normal rainfall on their plots) experienced a reduction of consumption of 10 percent per acre cultivated per adult equivalent. While the corresponding reduction in gross total agricultural revenue was estimated to be much more severe at about 50 percent per acre (Sarris, Savastano, and Christiaensen, 2005), households in Kilimanjaro clearly cannot fully protect their consumption from drought shocks.

The availability of (cash) savings may help offset the effect of the drought shocks, though its effect is imprecisely estimated (column 2). While access to irrigation is associated with larger overall consumption levels, it does not mitigate the effect of severe rainfall shocks. As most irrigation in Kilimanjaro is gravitation irrigation and when rainfall failure is relatively widespread as in 2003, this does not come as a surprise. More generally, rivers are reported to dry up which reduces their effectiveness in acting as an insurance device. The result should thus be seen in the particular context of Kilimanjaro and not as a statement on the ex ante risk mitigation capacity of irrigation more generally. Our results further suggest that the reception of aid may exacerbate the effect of a drought shock. While it is quite plausible that aid received is not sufficient to offset the negative effect of covariate shocks, the estimated negative relationship seems counterintuitive. It may reflect the fact that those getting aid from neighbors and relatives even in times of a covariate shock are actually the very poorest. About one fifth of all households in Kilimanjaro experienced a drought shock in 2003 with double this number reporting suffering from drought in 2004.

In contrast, households who experienced on average somewhat below normal rainfall on their plots did not see their consumption decline. The 35 percent estimated average reduction in households' gross total agricultural revenues associated with somewhat below normal rainfall on their plots (Sarris, Savastano, and Christiaensen, 2005) does not translate into a reduction in households' consumption levels. Households in Kilimanjaro appear able to cope with milder rainfall shocks.

Household consumption in Ruvuma appears not to be negatively affected by drought shocks. The effect of the drought shock may however be imprecisely estimated due to the small number of households who experienced a drought shock in 2003 (less than 4 percent of the sample). Somewhat surprisingly those who experienced somewhat below rainfall were even found to be slightly better off, though this result was only statistically significant at the 10 percent level. Somewhat surprisingly those who experienced somewhat below rainfall were even found to be slightly better off, though this result was only statistically significant at the 10 percent level.

The results in column (1) of Tables 3 and 4 would suggest that household welfare is unaffected by death and/or illness shocks experienced over the past two years. Yet, when we also control for the household's coping behavior through the self reported use of savings and/or receipt of aid when faced with an illness or death of an adult member (column (2)), health shocks are found to have a strong negative effect on consumption. In particular, households in Kilimanjaro who were unable to cope with the shocks suffered a 16 percent loss in consumption. It furthermore appears that households who used savings (often cash) to cope with health shocks managed to almost completely offset the negative effects associated with the shock. Receipt of aid from others appeared less effective. Finally, and somewhat surprisingly, health shocks appear not to affect household welfare in Ruvuma, even after controlling for households' use of coping strategies.

Further decomposition of the health shock into illness and death shocks to explore whether illness and death have differential effects (results in column 3), suggest that households suffer especially from illness shocks, and less so from the death of an adult member. This is in line with the findings from Kagera, in northwest Tanzania by Beegle (2005) who reports that wage employment of adult men declines substantially in response to a future female or male adult death, but that past deaths are not associated with changes in either wage employment or non-farm self-employment. Similarly, she finds that coffee farming is reduced in households with a death within 6 months, but not for deaths after 6 months.

Welfare loss from health shocks comes about through 1) increased medical expenditures and 2) foregone opportunities through a loss in labor supply (and thus earnings) and/or a decrease in the return to labor (Gertler and Gruber, 2002). While we do not have directly comparable information on the opportunity cost related to changes in labor supply and returns to labor in both regions, the survey did record expenses related to illness and death shocks on two separate occasions in the questionnaire. First, it asked the household about how many extra expenses (medical and others) it incurred in case of an illness or death shock of one of its members. Second, health expenditures (and expenditures on functions) during the last 30 days were recorded separately as part of the expenditure module. In both cases, expenditures in case of illness and death shocks are substantially larger in Kilimanjaro than in Ruvuma indicating much larger immediate welfare losses in Kilimanjaro than in Ruvuma, in line with the results of the regression analysis (Table 5). Moreover, regular (preventive) health expenditures (i.e. health expenditures when there is no illness shock) in Ruvuma (see second part Table 5) are only about half those in Kilimanjaro (when expressed in per adult equivalence)[7]. This is consistent with the much lower reported use of health providers in case of illness/injury.[8] While this might be because illnesses/injuries are generally less severe in Ruvuma, the larger average distance to a dispensary or health centre in rural Ruvuma (4.5 km) compared with rural Kilimanjaro (2 km) would suggest that lower accessibility of health

[7] Health expenditures during past 30 days per adult equivalent are not reported in Table 5, but available from authors upon request.

[8] While about the same proportion of households reported an illness/injury over the past 4 weeks in Kilimanjaro and Ruvuma (23 and 24 percent respectively) during the 2000/01 Household Budget Survey, 74 percent of all households (includes both rural and urban) in Kilimanjaro consulted a health provider, compared with 47 percent of all households in Ruvuma (National Bureau of Statistics, 2002, Table C16).

care underpins this difference in health spending.[9] In other words, the absence of a significant result on the health shock in Ruvuma should not be taken to mean that there is no welfare loss associated with illness and/or dealth shocks in Ruvuma.

The estimated welfare loss from the regression analysis is also consistent with those emerging from the directly reported expenditures related. First, our regression results indicated that the welfare loss is much more pronounced when there is an illness shock. This is largely consistent with the results from the bi-variate analysis in Table 6 which shows that consumption among households who experienced a death shock is sometimes even larger than among those without a death shock. Second, we estimated an average welfare loss of 16 percent associated with a health and in particular an illness shock in Kilimanjaro or an average reduction of 38,800 TSH per adult equivalent given the estimated average consumption per adult equivalent of 242,500 TSH in Kilimanjaro 2003. The directly reported health expenditures during the first survey round in Kilimanjaro in case of an illness are around 37,000 TSH.[10] This does not only provide confidence in the reported estimates, but also suggests that the welfare loss is largely due to medical expenses and less due to labor supply effects and income loss. The latter is also consistent with the low marginal productivity of labor (and labor surplus) reported by Sarris, Savastano and Christiaensen (2005) in Kilimanjaro. Labor seems even more abundant in Ruvuma, and when combined with the limited medical expenditures, the absence of a welfare loss in Ruvuma does no longer come as a surprise.

Finally, the overall absence of welfare loss in case of the death of an adult member, despite expenditures equivalent to those in case of an illness shock suggests that 1) households don't appear to suffer major labor supply or income losses as mentioned above and especially that 2) households manage to insure themselves from such shocks both through their savings and reliance on traditional/informal insurance schemes such as group based funeral insurance as illustrated in Dercon, et al. (2004).[11]

Kilimanjaro coffee growers in the lowest quintile category of tree ownership are on average ceteris paribus about 20 percent poorer than rural households not growing coffee, while those in the richest quintile tend to enjoy higher consumption levels. Households in the intermediate quintiles do not appear to differ from non-coffee growers in their consumption levels, though the signs of the coefficients are all negative. As in the case of health shocks, when we include interactions with the amount of remittances received (one of the coping strategies)[12], the negative effects are exacerbated, though still not statistically significant for the intermediate quintiles, and coffee growers in the richest

[9] National Bureau of Statistics, 2002, Table C17.

[10] To obtain the reported health expenditure in case of an illness shock, we divided the average health expenditures (137,000 TSH from Table 5) by the average adult equivalent per household, i.e. average households size (=5.3)*average adult equivalent per person (=0.7).

[11] The reported amount of contributions to (other) funerals also suggests substantial solidarity in bearing the funeral costs. Rutherford (2001) has documented the existence of insurance mechanisms for funerals across the developing world and highlights funeral insurance as one of the most popular products offered by more formalized micro-finance institutions.

[12] Unlike for the health and rainfall shocks, no data has been collected on the particular strategy coffee growers used to cope with the systemic coffee price shock (e.g. use of savings and/or aid).

quintile are no longer statistically significantly richer. Given our comprehensive controls for differences in wealth among households at the time of the onset of the coffee price shocks, these result would suggest that while most coffee growers have managed to cope with the coffee price decline, or at least did not see their consumption levels fall below those of the non-coffee growers, for example through the use of remittances and cash savings, the smallest among them experienced a substantial decline in their consumption. Given several years of high prices preceding the collapse in coffee prices starting in 2000, it is indeed plausible that coffee growers largely managed to smooth their consumption, albeit at the expense of their (cash) savings. In sum, while it cannot be excluded that coffee growers' welfare declined, most of them appear not worse off nowadays compared with non-coffee growers, apart from the smaller coffee growers who clearly suffered substantially.

Similarly, coffee growers in Ruvuma appear not worse off than non-cash crop growers and the larger ones actually enjoy substantially higher consumption levels despite the decline in coffee prices since 2000.[13] Again, given that we control extensively for asset holdings, though not for cash savings, this may reflect the availability of large amounts of cash savings held by the larger coffee growers following windfall earnings from coffee production during the late 1990s. This hypothesis is further supported by the fact that the likelihood of using (cash) savings in case of a drought or health shock is largely unassociated with a household's asset holdings as discussed in section 6.

While cashew growers also appear better off than non-cash crop growers, this picture reverses when we replace the village dummies (column 2) by village characteristics (column 4). This follows from the fact that cashew growers live concentrated in one district in Ruvuma and that virtually all households in our sample villages have at least some cashew trees. The overall lower consumption levels among cashew crop growers are thus captured through the village dummies. As there are no reasons to believe that the cashew crop growing villages systematically differ from the non cash crop growing villages beyond the village characteristics included in the analysis, the results in column four suggest that the smaller cashew growers are substantially worse off than the non cash crop growers. This is consistent with the observed collapse in cashew prices since the late 1990s and the fact that the smaller cashew growers are likely to hold less cash savings to help smooth their consumption compared with the larger cashew farmers.

Finally, the models with the village dummies unbundled are presented in columns 4 of Tables 3 and 4. Especially noteworthy is the fact that households in villages with a tarmac road are on average about 16 percent richer in Kilimanjaro and about 33 percent richer in Ruvuma. While these effects may partly reflect placement effects, the effects are sufficiently large to underscore the critical importance for overall household welfare of being connected through all weather roads. As indicated above, village dummies may also capture some of the covariant effect of shocks. This is borne out by the slight

[13] Given the limited number of observations receiving remittances in each of the coffee and cashew quintile categories, we did not interact these with the receipt of remittances.

reinforcement of the shock effects observed in the Kilimanjaro estimations when replacing the village dummies with the village characteristics. Yet, for all practical purposes the observed changes are negligible.

5 Poverty effects of shocks and the effectiveness of coping strategies

To gauge the overall effects of the shocks and coping on average welfare and poverty in our sample, we perform a series of simulations. As the evidence does not reveal a negative effect of health or drought shocks on household welfare in Ruvuma, we focus on the estimated results for Kilimanjaro. In particular we estimate by how much average consumption and poverty incidence in our sample would have improved in the absence of shocks (and thus also coping) compared with the currently observed situation and by how much it would have deteriorated if there hadn't been any coping in the face of the observed shocks. To do so, we use the village fixed effect model including interaction terms with households' coping strategies (column 2, table 3). Given that our model is loglinear, we can examine the effects of the different shocks and coping strategies on log consumption directly by adding or subtracting the relevant terms $\hat{\beta}_{21} S_{ijt+1}$ and $\hat{\beta}_{22} S_{ijt+1} X_{ijt}$. We focus on the use of savings and receipt of aid from others when faced with a shock as coping strategies. When coping more than offsets the effect of the shock itself, the positive compensating effect of coping is set equal to the negative effect of the shock. The results of these simulations are presented in Table 7.

The gross total loss among Kilimanjaro households in 2003 due to health and drought shocks is estimated at about 11,100 TSH per adult equivalent or about 6 percent of annual consumption on average. Put differently, households who experienced either one or both shocks lost on average 33,369 TSH per adult equivalent gross or about 18 percent of their annual consumption. This amounts to a total gross loss of about 8.43 billion TSH or 8.43 million US$ in 2003 among rural households in Kilimanjaro alone.[14] Clearly the gross costs of shocks to the economy can be substantial.

As about 12 percent of all rural households in Kilimanjaro experienced an illness or death of an adult member in the two years preceding the survey and almost twice as many households experienced a drought shock in 2003 (Table 8), drought shocks contributed more to the loss (7,000 TSH per adult equivalent) than health shocks (4,100 TSH per adult equivalent), even though the welfare loss associated with a health shock was estimated to be slightly larger than the estimated gross loss from a drought shock.[15] Put differently, the total gross loss in personal consumption among rural households in Kilimanjaro attributed to drought is estimated at 5.32 billion TSH, while the loss

[14] From Table 8, it can be seen that 63,134 households experienced either a health or a drought shock in 2003, corresponding to 252,536 adult equivalents at an estimated average of 4 adult equivalents per household. Given an average loss of 36,707 TSH, this results in a total estimated gross loss of 8,427,000,000 TSH or about 8.43 million US$ at an exchange rate of about 1,000 TSH per US$ in 2003.

[15] The gross negative effect of the health and drought shock are estimated at 16 and 11 percent respectively (see column 2, Table 3).

associated with illness and death of adult household members is estimated at 3.11 billion TSH.

Yet, some households managed to (partly) smooth their consumption in the face of these shocks. Consequently, the actual reduction in consumption experienced by the population was smaller than it would have been in the absence of coping. The difference between the observed average consumption in our sample and the average consumption in the absence of any (or the use of other) coping strategies[16] provides an estimate of the effectiveness of households' coping strategies. On average about 53 percent of the loss due to health and rainfall shocks was compensated for either through use of one's own savings or reliance on aid from family and neighbors or traditional funeral insurance schemes. This could also be taken as an upper bound estimate of the potential crowding out effect of private insurance, were public insurance to be introduced either through public health or rainfall based insurance. Furthermore, households were better able to cope with health shocks than with rainfall shocks. This follows from the fact that in the former case, which is more idiosyncratic in nature, households could rely on both their own savings as well as aid from others, while in the latter case their coping strategies were confined to use of their own savings only.

Finally, assuming the decline in welfare among the small coffee growers could be completely ascribed to the coffee price decline, we estimated that the coffee price decline resulted in a net average loss of about 3,900 TSH per adult equivalent. Given that larger farmers may have used their (unobserved cash) savings to cope with the coffee price decline, this is likely to be an underestimate.

To further explore the distributional consequences of the different shocks, we also report the effect of these shocks on poverty incidence. While health and drought shocks would increase poverty by 1.7 percentage points from 15.0 to 16.7 in the absence of coping, private coping strategies (either through self or informal mutual or funeral insurance) substantially mitigate the poverty increasing effects. In the absence of health and drought shocks, rural poverty incidence in Kilimanjaro would have been 0.6 percentage point lower in 2003 (14.4 versus 15.0 percent currently). Furthermore, the average increase in poverty can be equally ascribed to the drought and health shocks and the associated coping strategies. It is simulated that the coffee price increased poverty by at least 0.7 percentage points, though as argued before this may underestimate the actual welfare loss experienced by coffee growers.

6 Correlates of households' ex post coping capacity

Rural households in Kilimanjaro and Ruvuma largely rely on self insurance (i.e. use of their own savings) and informal mutual insurance (i.e. receipt of aid from

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[16] In the simulations we focus on the use of savings and aid from others as coping strategies. When coping more than offset the effect of the shock, only the effect of the shock is subtracted from the actual consumption.

neighbors and family) to cope with shocks. From tables 3 and 4 we have seen that the use of savings is more efficient in helping farmers cope with rainfall shocks while both savings and aid are used to mitigate the effect of health shocks. To explore who is more likely to be able to cope with shocks either through savings or through aid, we run probit models of having received aid or having used savings in case of a shock on the nature of the shock (drought versus illness or death), its demographic characteristics (educational attainment, gender of head, ethnicity), the household's possession of assets (small and large livestock, land, number of cash crop trees), and a series of village characteristics. This information is critical in targeting social protection interventions. The estimated results for Kilimanjaro and Ruvuma are in tables 9 and 10 respectively.

Consistent with the covariate nature of rainfall shocks, households are more likely to use their own savings to cope with droughts, though savings are also used to cope with illness and death shocks. External formal assistance (e.g. food aid or formal social protection interventions) has been rare in our study areas. When faced with a health shock (especially when it concerns the death of an adult member) which is idiosyncratic in nature, a household is more likely to receive aid. Aid appears not responsive to drought shocks.

There appears no clear pattern of association between the amount of assets possessed by the household and its use of coping strategies. The Ruvuma results suggest that the more coffee trees a household had two years ago, the higher the likelihood was that it coped either through use of savings and the reception of aid. This is consistent with our earlier finding that coffee growing households in Ruvuma are not worse off than non-cash crop growers despite the decline in coffee price during the early 2000s. We do not find a positive association between the number of coffee trees owned in 2000 and the use of self-insurance or mutual insurance in Kilimanjaro, suggesting that overall their coping capacity is by now no different from the non-coffee grower. Yet, when we include the quintile categories of coffee trees owned (as opposed to the number of coffee trees and its squared term) (results not presented), we find that those in the highest quintile are more likely to use savings (though not aid), consistent with the results in table 3 indicating that this group is still better able to cope and that it might still be better off than the non-coffee growers. Cashew tree growers were not found to be different in their coping capacity than the other non-cash crop growers.

While educational attainments do not affect households' coping capacity in Kilimanjaro, in Ruvuma secondary education of the head is associated with a lower probability of receiving assistance, and primary schooling negatively correlated with the use of either coping strategy. Female headed households in Kilimanjaro appear much more likely to receive aid, and much less likely to use savings to cope with shocks. A similar pattern was observed in Ruvuma, though the coefficients were imprecisely estimated. In Kilimanjaro, the probability of receiving aid decreases with the age of the household head up to 36 years, and becomes positively associated with age at 72 years.

In Ruvuma, we see a corresponding increase in likelihood of using savings up to the age of 43.

The availability of bus service in a village positively affect households' likelihood of using savings in Ruvuma, while electirification and cell phone reception in the village, both indicators of general wealth levels, are positively associated with the use of savings in Kilimanjaro.[17]

7 Concluding remarks

This study has explored the immediate effects of drought and health shocks on welfare and poverty in Kilimanjaro and Ruvuma and reflected on the effect of the coffee and cashew price decline since 2000. About one third of the rural population in Kilimanjaro suffered either from drought or health shocks in the survey year and those households suffered on average a direct 18 percent gross loss in their annual consumption in 2003 as a consequence. Yet, through reliance on savings and aid from others they were able to partly smooth their consumption and reduce the immediate negative welfare effect of these shocks to 8 percent loss on average.

The gross joint effect of the health and drought shock in Kilimanjaro on poverty incidence was 2.3 percentage points, while the net effect was estimated at 0.6 percentage point. These seemingly limited poverty effects follow from the low initial level of poverty incidence in Kilimanjaro, estimated at 15 percent. In percentage terms, the health and drought shocks cause poverty incidence to increase by 16 percent before and 4 percent after coping. No immediate (negative) welfare effects were found from the drought and health shocks in Ruvuma. The former result is related to the generally more secure rainfall patterns and the low incidence of drought shocks in Ruvuma in 2003. The lower medical expenditures in case of illness due to limited use of health care providers which is in turn associated with lower access to health facilities, underpins the estimated absence of an immediate welfare loss in Ruvuma. This does not necessarily imply that households in Ruvuma suffer less from illness shocks, but rather that they spend less to deal with them.

In addition, the potential income loss either due to reduced labor supply or reduced return to labor following illness or death, appears sufficiently small to not change this picture for Ruvuma. Also in Kilimanjaro, appears the estimated welfare loss largely associated with the medical expenses and not due to substantive income loss. This is consistent with the relative abundance of labor in both Kilimanjaro and even more so in Ruvuma. Sarris, Savastano, and Christiaensen (2005) estimate for example that the ratio of the marginal product of labor in agriculture to the agricultural wage is only 0.22 in Ruvuma (compared to 0.32 in Kilimanjaro). Finally, while the direct reported expenses

[17] None of the villages in Ruvuma has electricity, and only one village has cell phone reception.

related to death shocks are on par with those related to illness shocks, death shocks have much smaller immediate welfare effects, likely related to the existence of effective group based funeral insurance schemes (Dercon et al., 2004). How such schemes evolve as HIV/AIDs puts increasing pressure on these mechanisms must be closely followed.

Ceteris paribus, coffee growers in Kilimanjaro appear no worse off than non-coffee growers in Kilimanjaro, apart from the smallest ones, whose consumption level is on average 20 percent lower. Similarly, coffee growers in Ruvuma enjoy ceteris paribus similar consumption levels on average as non-cash crop growers, with indications that the larger ones are actually even better off. This suggests that coffee growers (apart from the smallest) have managed to weather the effects of the coffee price decline, at least to the point of not falling below the welfare levels of the non-cash crop growers and most likely at the expense of a depletion of their (cash) savings. Indeed, the decline in coffee prices since 2000 came on the heels of an income windfall from coffee during the late 1990s. In addition, many coffee growers in Kilimanjaro, who have access to the market in Dar es Salaam, have also been able to switch into bananas as an alternative cash crop. Consistent with this hypothesis is the finding that even in 2003 coffee growers in Ruvuma (as well as the richer coffee growers in Kilimanjaro) tend to be more inclined to use their own savings in case of health or drought shocks compared with non-cash crop growers. Cashew crop growers on the other hand, especially the smaller ones, appear worse off than non-cash crop growers in Ruvuma. Consumption levels among the two bottom quintiles of cashew trees are 15 to 20 percent lower than those among non-cash crop growers. Several years of low cashew prices are beginning to take their toll.

While there are few formal insurance or assistance schemes available to help households smooth their consumption, households rely heavily on self insurance through a depletion of their cash savings (and to a lesser extent their assets) as well as informal mutual insurance schemes including group based funeral societies. Aid from others is frequently received in case of death shocks, and to a lesser extent in case of illness, though not in case of a drought shock. Own savings on the other hand are the more important recourse in case of drought shocks, though they are also relied upon to deal with health shocks, especially illness shocks. Somewhat surprisingly, physical asset ownership and educational attainment appear to be poor predictors of the use of savings, pointing to the importance of cash savings in rural Tanzania. Coffee farmers in Ruvuma [as well as the richer coffee farmers in Kilimanjaro) are still more inclined to use their savings to cope with drought or health shocks. Female headed households tend to rely more on aid and less on their own savings. Households in Kilimanjaro in electrified villages and villages with cell phone signals, both signs of wealth, also tend to be more likely to receive aid and use their own savings to cope with shocks.

While these coping strategies help households smooth consumption, not all households have equal coping capacity and as documented in the 2002/03 Tanzanian Participatory Poverty Assessment these strategies may come at the expense of future earnings. Moreover, given that this study has abstracted from estimating the long run effects of shocks on welfare, the ex ante behavioral effects (Binswanger and Rosenzweig, 1993; Dercon, 1996; Dercon and Christiaensen, 2005) as well as their effects on human development outcomes (Ainsworth, Beegle, and Koda, 2005), it must be underscored that our results presented only a lower bound on the actual welfare losses associated with health, drought and price shocks.

In looking for effective vulnerability reducing interventions, public policies aimed at improving health conditions and reducing the effect of droughts emerge as important, especially in Kilimanjaro. This includes the need for continued efforts to combat the HIV/AIDS epidemic, especially as this expanding epidemic may put the traditional funeral societies under increasing pressure to effectively deal with death shocks, as well as concerted efforts to prevent malaria infections. The ability to control water levels for example through irrigation emerges as an important general instrument to help enhance household consumption even though it has lost its effectiveness as an insurance instrument in Kilimanjaro which largely depends on gravitation irrigation. There are substantial uninsured welfare losses due to drought, suggesting role a for weather based insurance schemes, an innovative approach to protect consumption from drought shocks currently piloted in a series of developing countries (Ethiopia, Morocco, India). Farmers also expressed substantial demand for market based coffee price insurance schemes to help them insure against coffee price declines (Sarris, Karfakis, Christiaensen, 2006). Access to non-agricultural employment and enterprise further helps raising overall welfare levels and reduces exposure to drought shocks. Finally, the importance of connectivity in raising overall income levels and thus also households' ability to cope with shocks cannot be sufficiently underscored. Consumption levels were found to be ceteris paribus 15 to 30 percent higher in villages with a tarmac road compared with those without a tarmac road, though the potential presence of some placement effects in these latter estimates cannot be denied.

References

Ainsworth, Martha, Kathleen, Beegle, and Godlike, Koda, 2005, The Impact of Adult Mortality and Parental Deaths on Primary Schooling in North-Western Tanzania, *Journal of Development Studies*, 41-3, pp. 412-439.

Alderman, H., J., Hoddinott, and B. Kinsey. "Long Term Consequences of Early Childhood Malnutrition." International Food Policy Research Institute, Washington D.C., 2004.

Baker, M., Stabile, M., and C., Deri, 2004, What Do Self-Reported, Objective Measures of Health Measure? *Journal of Human Resources,* 39-4: pp. 1067-1093.

Beegle, Kathleen, 2005, Labor Effects of Adult Mortality in Tanzanian Households, *Economic Development and Cultural Change*, 53-3: p. 655-683.

Besley, Timothy, 1995, *Savings, Credit and Insurance*, Handbooks in Economics Vol9, Vol 3A: pp. 2123-2207, Elsevier Science, North Holland: Amsterdam.

Christiaensen, L., and A., Sarris, 2006, eds., Household Vulnerability in Tanzania – An Empirical Perspective, Research on Poverty Alleviation, Dar es Salaam, mimeographed.

Datt, Gaurav, and Hans, Hoogeveen, 2003, El Nino or El Peso? Crisis, Poverty and Income Distribution in the Philippines, *World Development*, 31-7: pp. 1103-1124.

Deaton, Angus, 1992, *Understanding Consumption,* Oxford: Clarendon Press.

Deaton, Angus, 1997, *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*, John Hopkins University Press: Baltimore, MD.

Dercon, Stefan, and Pramila, Krishnan, 2000, Vulnerability, Seasonality and Poverty in Ethiopia, *Journal of Development Studies*, 36-6: pp. 25-53.

Dercon, Stefan, Tessa, Bold, Joachim De Weerdt, and Alula, Pankhurst, 2004, *Group Based Funeral Insurance in Ethiopia and Tanzania*, CSAE Working Paper 227.

Dercon, Stefan, and Luc, Christiaensen, 2005, *Consumption Risk, Technology Adoption and Poverty Traps: Evidence from Ethiopia*, mimeographed.

Dercon, Stefan., John, Hoddinott, and Tassew Woldehanna, 2005, Shocks and Consumption in 15 Ethiopian Villages, 1999-2004, *Journal of African Economies*, 14-4, pp. XXX

Foster, Andrew, (1994), Poverty and Illness in Low-Income Rural Areas, *American Economic Review*, 84-2: pp. 216-220.

Gertler, Paul and Jonathan, Gruber, 2002, , Insuring Consumption Against Illness, *American Economic Review*, 92-1, pp. 51-70.

Groot, W, 2000, Adaptation and Scale of Reference Bias in Self-Assessments of Quality of Life, *Journal of Health Economics*, 19, p. 403-420.

Hall, R., 1978, Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence, *Journal of Political Economy*, 86-6: pp. 971-87.

Harrower, Sarah and John, Hoddinott, 2005, Consumption Smoothing in the Zone Lacustre, Mali, *Journal of African Economies*, 14-4, pp. 489-519.

Morduch, Jonathan, 1991, Risk and Welfare in Developing Countries, Harvard University, Ph.D. Thesis.

National Bureau of Statistics Tanzania, 2002, *Household Budget Survey, 2000/01, Final Report, National* Bureau of Statistics, Tanzania: Dar es Salaam.

Research and Analysis Working Group, 2004, *Vulnerability and Resilience to Poverty in Tanzania: Causes, Consequences and Policy Implications – 2002/03 Tanzania Participatory Poverty Assessment (TZPPA): Main Report*, Research and Analysis Working Group: Dar es Salaam, Tanzania.

Rutherford, S., 2001, *The Poor and Their Money*, Delhi: Oxford University Press for India.

Sarris, Alexander, Sara, Savastano, and Luc Christiaensen, 2005, *The Role of Agriculture in Reducing Poverty in Tanzania: A Household Perspective from Rural Kilimanjaro and Ruvuma*, World Bank, mimeographed.

Sarris, Alexander, Panayiotis, Karfakis and Luc Christiaensen, 2006, *Producer Demand and Welfare Benefits of Minimum Price Insurance for Export Crops in Tanzania*, mimeographed.

Table 1: Comparison of socio-economic characteristics and past coping behavior among quintile categories of coffee and non-coffee growers in Kilimanjaro.

	no trees	lowest quintile[1)]	2nd quintile	3rd quintile	4th quintile	highest quintile	total
Altitude (meters)	3578	4575**	4548**	4694**	4546**	4451**	4177
% Pare	36.2	9.4**	2.4**	8.7**	6.7**	3.4**	17.9
% Chagga	44.8	90.6**	9.7**	90.3**	92.4**	96.6**	74.3
Land (2000)	2.9	1.6**	2.2^{+}	2.4	2.9	3.6^{+}	2.7
Goats/sheep/pigs (2000)	2.8	1.1^{+}	1.3	1.6	1.9	1.5	2.0
Cattle/horses/oxen (2000)	4.4	2.3	3.0	3.5	3.1	2.2	3.5
Value Consumer Durables 1000 TSH, (2002)	264	140**	248	233	234	315	246
Value of compound (2003)	2342	2194	4051***	3243**	$4943***^{+}$	7851***	3681
Remittance income (1000 TSH) (2003)	24.4	25.4	38.9	42.4**	62.1**	44.1**	35.4
Coffee trees (2000)	0	39***	109***	235***	502***	1326***	269
Of those who faced a shock, % who received aid	47.2	44.4	43.6	63.1**	55.7	60.1	50.9
Of those who faced a shock, % who used own savings	67.4	78.3	69.1	81.4	68.0	67.4	78.3
Number of households	74,593	23,287	23,034	23,301	22,974	23,123	190,312

[1)] based on number of coffee trees owned in 2000

[2)] **denotes significance at 1%, * at 5%, $^{+}$ at 10% when comparing characteristics to the non-coffee growers.

Table 2A: Comparison of socio-economic characteristics among quintile categories of coffee growers and non-coffee growers in Ruvuma.

	no trees	lowest quintile[1)]	2nd quintile	3rd quintile	4th quintile	highest quintile	total
Altitude (meters)	2658	4362***	4531***	4660***	4682***	4833***	3275
% Matengo	16.6	91.2***	96.5***	96.6***	100.0***	95.5***	41.6
% Ndendeule	8.8	1.8	1.9	0.0*	0.0*	2.1	6.4
% Ngoni	20.3	5.1*	0.0***	1.6**	0.0***	2.4**	14.5
% Yao	32.5	0.0***	0.0***	0.0***	0.0***	0.0***	22.3
% Nyasa	0.9	0.0	0.0	0.0	0.0	0.0	0.6
Land (2002)	9.76	9.76	9.29	8.94	8.63	9.26	9.57
Goats/sheep/pigs (2002)	2.87	4.14**	5.46***	5.24***	4.33**	4.30**	3.44
Cattle/horses/oxen (2003)	0.16	0.49***	1.04***	0.91***	0.75***	1.39***	0.40
Value Consumer Durables 1000 TSH, (2002)	139.4	109.9	137.4	141.5	125.7	192.4	139.9
Value of compound (2003)	433.3	399.4	931.1***	1196.8***	1168.3***	1024.6***	596.0
Remittance income (1000 TSH) (2003)	169.8	45.1	130.9	94.9	41.0	116.7	144.1
Coffee trees (2000)	0.0	432.5***	847.7***	1304.4***	1592.4***	2084.5***	393.9
Of those who faced a shock, % who received aid	45.2	43.3	41.7	59.1	56.1	58.5	47.0
Of those who faced a shock, % who used own savings	69.7	66.4	70.8	74.8	83.5	82.2	71.3
Number of households	119,022	11,089	10,899	11,159	11,024	10,728	173,921

1) based on number of coffee trees owned in 2002

2) **denotes significance at 1%, * at 5%, + at 10% when comparing characteristics to the non-coffee growers.

Table 2B: Comparison of socio-economic characteristics among quintile categories of cashew growers and non-cashew growers in Ruvuma.

	no trees	lowest quintile[1)]	2nd quintile	3rd quintile	4th quintile	highest quintile	total
Altitude (meters)	3684	1997***	1864***	1991***	1994***	2054***	3275
% Matengo	53.9	13.3***	0.0***	0.0***	0.0***	0.0***	41.6
% Ndendeule	7.5	7.5	3.0	0.0*	1.6*	1.9	6.4
% Ngoni	16.9	5.8*	12.4***	10.1**	4.3***	1.7**	14.5
% Yao	9.6	36.5***	56.1***	62.6***	71.2***	86.3***	22.3
% Nyasa	0.5	0.0	1.8	0.0	1.7	1.6	0.6
Land (2002)	8.87	7.45*	7.48	9.83	13.74***	20.60***	9.57
Goats/sheep/pigs (2002)	3.81	2.31**	1.47***	2.17***	3.32**	2.11**	3.44
Cattle/horses/oxen (2003)	0.47	0.57***	0.00***	0.00***	0.18***	0.00***	0.40
Value Consumer Durables 1000 TSH, (2002)	147.8	139.7	72.4**	111.9	125.9	124.4	139.9
Value of compound (2003)	668.9	212.4	356.1***	317.9***	426.1***	539.9***	596.0
Remittance income (1000 TSH) (2003)	158.6	142.0	27.2	57.6	46.5	83.3	144.1
Cashew trees (2000)	0.0	32.9***	92.4***	157.7***	336.1***	905.9***	72.9
Of those who faced a shock, % who received aid	45.4	50.6	54.3	38.7	60.6	56.9	47.0
Of those who faced a shock, % who used own savings	69.3	78.8	53.5***	87.9**	71.4	93.6**	71.3
Number of households	132,195	8,440	8,307	8,328	8,362	8,289	173,921

1) based on number of cashew trees owned in 2002

2) **denotes significance at 1%, * at 5%, + at 10% when comparing characteristics to the non-coffee growers.

Table 3: Shocks, coping and consumption in Kilimanjaro

Log consumption per adult equivalent (exclusive of health and education expenditures, and expenditures on functions)	*baseline* (1)	*Shocks interacted with coping strategies* (2)	*Health shocks unbundled* (3)	*Village dummies unbundled* (4)
Shocks, exposure and coping				
major illness or death of adult member	-0.020	-0.161		-0.205
	(0.47)	(1.82)+		(2.29)*
used savings to cope with major illness or death of adult member		0.148		0.202
		(1.55)		(2.19)*
received aid to cope with major illness or death of adult member		0.070		0.074
		(0.87)		(0.93)
death of adult member last 2 yrs			-0.150	
			(0.78)	
death of adult member last 2 yrs * received aid			0.025	
			(0.13)	
death of adult member last 2 yrs * used savings			0.271	
			(1.99)*	
major illness of adult member last 2 yrs			-0.170	
			(1.63)	
ill adult member last 2 yrs * received aid			0.068	
			(0.70)	
ill adult member last 2 yrs * used savings			0.101	
			(0.90)	
acres/ae * very low rainfall	-0.104	-0.112	-0.108	-0.116
	(2.82)**	(3.04)**	(2.94)**	(3.24)**
acres/ae * very low rainfall * got aid for drought		-0.243	-0.245	-0.253
		(2.02)*	(2.05)*	(2.07)*
acres/ae * very low rainfall * used savings for drought		0.131	0.131	0.137
		(1.21)	(1.20)	(1.25)
acres/ae * somewhat low rainfall	0.044	0.025	0.027	0.029
	(1.19)	(0.72)	(0.76)	(0.87)
acres/ae * somewhat low rainfall * got aid for drought		-0.214	-0.195	-0.136
		(1.35)	(1.18)	(0.87)
acres/ae * somewhat low rainfall * used savings for drought		0.166	0.165	0.158
		(2.93)**	(2.97)**	(2.70)**
lowest quintile coffee trees 2000	-0.205	-0.217	-0.210	-0.233
	(3.45)**	(3.59)**	(3.47)**	(3.85)**
lowest quintile coffee trees 2000 * remittance income 100,000 TSH/ae		-0.119	-0.124	-0.051
		(1.18)	(1.23)	(0.53)
second quintile coffee trees 2000	-0.065	-0.092	-0.093	-0.085
	(1.14)	(1.60)	(1.61)	(1.58)
second quintile coffee trees 2000 * remittance income 100,000 TSH/ae		0.150	0.148	0.163
		(1.08)	(1.07)	(1.22)
third quintile coffee trees 2000	-0.043	-0.065	-0.062	-0.071
	(0.72)	(1.03)	(1.00)	(1.27)
third quintile coffee trees 2000 * remittance income 100,000 TSH/ae		0.150	0.147	0.207
		(1.18)	(1.15)	(1.75)+
fourth quintile coffee trees 2000	-0.022	-0.051	-0.051	-0.044
	(0.38)	(0.86)	(0.86)	(0.85)
fourth quintile coffee trees 2000 * remittance income 100,000 TSH/ae		0.179	0.172	0.227
		(1.97)*	(1.89)+	(2.68)**
highest quintile coffee trees 2000	0.145	0.114	0.118	0.156
	(2.10)*	(1.56)	(1.63)	(2.48)*
highest quintile coffee trees 2000 * remittance income 100,000 TSH/ae		0.155	0.155	0.111
		(1.15)	(1.15)	(0.92)
irrigated acres/ae * very low rainfall	0.039	0.060	0.053	0.099
	(0.42)	(0.66)	(0.58)	(1.10)
irrigated acres/ae * somewhat low rainfall	-0.265	-0.241	-0.245	-0.234
	(3.10)**	(2.92)**	(2.99)**	(2.90)**
irrigated acres cultivated 2003 per ae	0.188	0.188	0.188	0.195
	(2.89)**	(2.96)**	(3.07)**	(3.36)**
remittance income, 100,000 TSH/ae	0.149	0.060	0.065	0.030
	(2.81)**	(0.68)	(0.74)	(0.37)

Log consumption per adult equivalent (exclusive of health and education expenditures, and expenditures on functions)	*baseline* (1)	*Shocks interacted with coping strategies* (2)	*Health shocks unbundled* (3)	*Village dummies unbundled* (4)
Demographic characteristics				
dependency ratio	-0.186	-0.181	-0.180	-0.178
	(3.00)**	(2.89)**	(2.88)**	(2.89)**
age of head	-0.028	-0.027	-0.027	-0.027
	(4.07)**	(4.00)**	(4.02)**	(4.14)**
age of head squared	0.000	0.000	0.000	0.000
	(3.83)**	(3.74)**	(3.77)**	(3.98)**
female-headed household	0.068	0.063	0.068	0.089
	(1.51)	(1.40)	(1.53)	(1.97)*
yrs primary education of head	0.006	0.005	0.006	0.008
	(0.89)	(0.74)	(0.83)	(1.21)
yrs secondary education of head	0.034	0.033	0.033	0.034
	(1.68)+	(1.65)+	(1.63)	(1.66)+
whether head has post-sec education	-0.206	-0.222	-0.219	-0.238
	(1.80)+	(1.95)+	(1.93)+	(2.09)*
head is Chagga	0.149	0.158	0.152	0.132
	(2.41)*	(2.52)*	(2.43)*	(2.40)*
head is Pare	0.125	0.125	0.112	0.036
	(1.82)+	(1.81)+	(1.64)	(0.59)
proportion of time in non-agricultural activities in 2002	0.185	0.203	0.205	0.212
	(2.80)**	(3.05)**	(3.09)**	(3.12)**
Productive assets and consumer durables				
land owned 3 years ago/ae	0.094	0.095	0.094	0.072
	(2.62)**	(2.64)**	(2.62)**	(2.21)*
land owned 3 years ago/ae sqr	-0.000	0.000	0.000	0.002
	(0.04)	(0.06)	(0.03)	(0.94)
value of productive assets in 2002, 100,000 TSH per ae	0.043	0.042	0.042	0.040
	(3.17)**	(3.04)**	(3.03)**	(2.35)*
value of productive assets in 2002 squared, 100,000 TSH	-0.000	-0.000	-0.000	-0.000
	(3.37)**	(3.24)**	(3.23)**	(2.53)*
relatively easy to obtain seasonal credit for inputs	0.114	0.119	0.119	0.128
	(2.50)*	(2.54)*	(2.53)*	(2.71)**
head of cattle, oxen, horses 3 years ago / ae	0.088	0.091	0.091	0.105
	(4.54)**	(4.70)**	(4.79)**	(5.49)**
head of cattle, oxen, horses 3 years ago / ae sqr	-0.001	-0.001	-0.001	-0.001
	(2.58)*	(2.80)**	(2.85)**	(3.59)**
head of goat, sheep, pigs 3 years ago / ae	0.031	0.032	0.032	0.024
	(2.39)*	(2.48)*	(2.58)**	(1.93)+
head of goat, sheep, pigs 3 years ago / ae sqr	-0.001	-0.001	-0.001	-0.001
	(2.21)*	(2.34)*	(2.41)*	(1.97)*
value of consumer durables in 2002, 100,000 TSH per ae	0.304	0.297	0.297	0.311
	(8.49)**	(8.53)**	(8.57)**	(9.35)**
value of consumer durables in 2002 squared, 100,000 TSH	-0.027	-0.024	-0.024	-0.025
	(4.96)**	(4.72)**	(4.72)**	(5.01)**
Village connectivity, infrastructure and agro-ecological potential				
tarmac road reaches village				0.161
				(2.36)*
village has public phone				0.036
				(0.97)
village has cell phone signal				0.024
				(0.35)
bus service to village				0.010
				(0.25)
village has a market				0.040
				(1.13)
village has electricity				0.102
				(2.14)*
village has health center, dispensary, or hospital				-0.084
				(0.89)
Altitude of village, 1000 m				0.200
				(0.09)
Constant	5.268	5.268	5.260	5.136
	(22.61)**	(22.45)**	(22.53)**	(24.12)**
Observations	914	914	914	914
R-squared	0.49	0.50	0.50	0.47

Models (1)-(3) include village dummies which are not presented to save space. Absolute value of t statistics in parentheses; + significant at 10%; * significant at 5%; ** significant at 1%

Table 4: Shocks, coping and consumption in Ruvuma

Log consumption per adult equivalent (exclusive of health and education expenditures, and expenditures on functions)	*baseline*	*Shocks interacted with coping strategies*	*Health shocks unbundled*	*Village dummies unbundled*
	(1)	(2)	(3)	(4)
Shocks, exposure and coping				
major illness or death of adult member	-0.005	0.030		0.067
	(0.11)	(0.42)		(0.99)
used savings to cope with major illness or death of adult member		-0.083		-0.074
		(1.06)		(0.94)
received aid to cope with major illness or death of adult member		-0.004		-0.024
		(0.05)		(0.29)
death of adult member last 2 yrs			0.075	
			(0.93)	
death of adult member last 2 yrs * received aid			-0.414	
			(2.72)**	
death of adult member last 2 yrs * used savings			0.164	
			(1.15)	
major illness of adult member last 2 yrs			0.003	
			(0.04)	
ill adult member last 2 yrs * received aid			0.057	
			(0.62)	
ill adult member last 2 yrs * used savings			-0.021	
			(0.20)	
acres/ae * very low rainfall	-0.018	-0.020	-0.019	-0.017
	(0.34)	(0.36)	(0.36)	(0.28)
acres/ae * very low rainfall * got aid for drought		-0.078	-0.078	0.014
		(0.69)	(0.69)	(0.19)
acres/ae * somewhat low rainfall	0.031	0.030	0.030	0.036
	(1.83)+	(1.73)+	(1.74)+	(2.11)*
acres/ae * somewhat low rainfall * got aid for drought		-0.326	-0.325	-0.328
		(1.52)	(1.51)	(1.61)
acres/ae * somewhat low rainfall * used savings for drought		0.004	0.006	-0.010
		(0.09)	(0.11)	(0.17)
lowest quintile coffee trees 2002	0.134	0.138	0.131	0.071
	(1.49)	(1.54)	(1.46)	(0.83)
second quintile coffee trees 2002	0.156	0.156	0.158	0.066
	(1.81)+	(1.81)+	(1.86)+	(0.80)
third quintile coffee trees 2002	0.079	0.083	0.075	0.003
	(0.94)	(0.97)	(0.89)	(0.04)
fourth quintile coffee trees 2002	0.336	0.338	0.345	0.243
	(3.87)**	(3.86)**	(3.94)**	(2.85)**
highest quintile coffee trees 2002	0.290	0.289	0.291	0.199
	(3.21)**	(3.17)**	(3.22)**	(2.16)*
lowest quintile cashew trees 2002	0.066	0.068	0.065	-0.148
	(0.79)	(0.81)	(0.77)	(2.01)*
second quintile cashew trees 2002	0.103	0.107	0.110	-0.234
	(0.99)	(1.02)	(1.05)	(3.12)**
third quintile cashew trees 2002	0.312	0.312	0.304	-0.034
	(2.67)**	(2.67)**	(2.60)**	(0.39)
fourth quintile cashew trees 2002	0.312	0.326	0.316	-0.042
	(2.76)**	(2.87)**	(2.79)**	(0.52)
highest quintile cashew trees 2002	0.394	0.401	0.393	0.025
	(3.27)**	(3.32)**	(3.24)**	(0.29)
irrigated acres/ae * somewhat low rainfall	0.039	0.036	0.052	0.037
	(0.16)	(0.15)	(0.22)	(0.16)
irrigated acres cultivated 2003 per ae	0.142	0.141	0.137	0.147
	(1.03)	(1.03)	(1.00)	(1.15)
cultivated tobacco in 2004	-0.160	-0.156	-0.150	-0.091
	(1.46)	(1.42)	(1.37)	(0.84)
remittance income, 100,000 TSH/ae	0.184	0.183	0.186	0.184
	(1.45)	(1.44)	(1.49)	(1.35)
Demographic characteristics				
dependency ratio	-0.196	-0.195	-0.189	-0.162
	(2.44)*	(2.41)*	(2.34)*	(1.94)+
age of head	-0.046	-0.046	-0.046	-0.043
	(5.66)**	(5.67)**	(5.64)**	(5.15)**
age of head squared	0.000	0.000	0.000	0.000
	(4.88)**	(4.89)**	(4.83)**	(4.45)**

Log consumption per adult equivalent (exclusive of health and education expenditures, and expenditures on functions)	*baseline*	*Shocks interacted with coping strategies*	*Health shocks unbundled*	*Village dummies unbundled*
	(1)	(2)	(3)	(4)
female headed household	0.105	0.107	0.110	0.101
	(1.75)+	(1.77)+	(1.83)+	(1.64)
yrs primary completed by head	0.024	0.024	0.024	0.024
	(2.70)**	(2.68)**	(2.72)**	(2.61)**
yrs secondary completed by head	0.015	0.013	0.015	0.007
	(0.61)	(0.55)	(0.60)	(0.29)
head has post-sec education	0.209	0.207	0.182	0.261
	(1.17)	(1.17)	(1.06)	(1.56)
head is Matengo	-0.063	-0.061	-0.057	-0.004
	(0.71)	(0.68)	(0.64)	(0.06)
head is Ndendeule	-0.009	-0.011	-0.009	0.116
	(0.09)	(0.10)	(0.09)	(1.27)
head is ngoni	-0.132	-0.134	-0.137	-0.025
	(1.64)	(1.65)+	(1.70)+	(0.32)
head is yao	-0.062	-0.065	-0.065	-0.056
	(0.78)	(0.80)	(0.79)	(0.85)
head is nyasa	0.010	0.007	0.019	0.024
	(0.07)	(0.05)	(0.13)	(0.17)
proportion of time in non-agricultural activities in 2003	0.218	0.212	0.217	0.286
	(2.39)*	(2.33)*	(2.39)*	(3.05)**
Productive assets and consumer durables				
land owned 1 year ago/ae	0.035	0.035	0.035	0.042
	(3.24)**	(3.19)**	(3.27)**	(3.87)**
land owned 1 year ago/ae sqr	-0.001	-0.001	-0.001	-0.001
	(2.56)*	(2.52)*	(2.57)*	(2.85)**
value of productive assets in 2003, 100,000 TSH per ae	0.047	0.046	0.046	0.039
	(1.76)+	(1.73)+	(1.76)+	(1.47)
value of productive assets in 2003 squared, 100,000 TSH	-0.001	-0.001	-0.001	-0.001
	(2.12)*	(2.10)*	(2.10)*	(1.72)+
relatively easy to obtain seasonal credit for inputs	-0.070	-0.068	-0.072	-0.072
	(1.76)+	(1.72)+	(1.79)+	(1.84)+
head of cattle, oxen, horses one year ago per ae	0.389	0.385	0.401	0.353
	(4.43)**	(4.36)**	(4.55)**	(3.98)**
head of cattle, oxen, horses, one year ago squared per ae	-0.146	-0.143	-0.150	-0.146
	(3.68)**	(3.54)**	(3.88)**	(3.98)**
head of goat, sheep, one year ago per ae	0.080	0.082	0.081	0.101
	(2.88)**	(2.91)**	(2.91)**	(3.58)**
head of goat, sheep, one year ago squared per ae	-0.007	-0.007	-0.007	-0.009
	(1.53)	(1.61)	(1.57)	(1.94)+
value of consumer durables in 2003, 100,000 TSH per ae	0.470	0.470	0.465	0.466
	(5.91)**	(5.92)**	(5.89)**	(5.66)**
value of consumer durables in 2003, 100,000 TSH per ae, sqr	-0.004	-0.004	-0.004	-0.004
	(4.76)**	(4.72)**	(4.65)**	(4.70)**
Village connectivity, infrastructure and agro-ecological potential				
tarmac road reaches village				0.331
				(3.02)**
village has cell phone signal				-0.059
				(0.75)
village has a market				-0.073
				(1.95)+
bus service to village				0.035
				(0.72)
Health facility in village				0.046
				(1.28)
altitude				0.154
				(0.06)
Constant	5.235	5.491	5.477	5.446
	(21.79)**	(23.75)**	(23.61)**	(24.61)**
Observations	878	878	878	878
R-squared	0.47	0.47	0.47	0.42

Models (1)-(3) include village dummies which are not presented to save space. Absolute value of t statistics in parentheses; + significant at 10%; * significant at 5%; ** significant at 1%; rainfall very low * acres cultivated/ae * used savings to cope with drought, rainfall very low * irrigated acres/ae, village electricity, village public phone, are all dropped due to collinearity

Table 5: Expenses incurred as result of an illness or dealth shock, 2002-2004

Average expenses ('000 TSH) incurred per household in case of an illness or death shock over the past 5 years	*Illness of adult member (15-64 yrs old)*	*Death of adult member (15-64 yrs old)*
Kilimanjaro		
- Round 1 [a]	137	143
- Round 2	102	108
Ruvuma		
- Round 1 [a]	38	94
- **Round 2**	49	51

Health expenditures ('000 TSH) per household during 30 days preceding survey	Illness shock		Death shock	
	No	Yes	No	Yes
Kilimanjaro				
- Round 1 [a]	33	68	34	55
- Round 2	35	117	42	40
Ruvuma				
- Round 1 [a]	21	40	23	28
- Round 2	19	55	23	12

[a)] While the reported expenses in case of a shock in round 1 are averaged across the 5 years preceding the survey given a shock, those in round 2 only to the year preceding the survey.

Source: Authors' calculations.

Table 6: Household welfare with and without illness or death shocks.

Expenditures per adult equivalent[1)]	**Illness or death**	# obs	**illness**	# obs	**death**	# obs
Kilimanjaro						
Round 1						
no shock	177.0	832	178.2	881	175.4	893
shock	171.5	115	152.5	66	193.8	54
difference	*5.6*		*25.6*		*-18.3*	
Total	176.4	947	176.4	947	176.4	947
Round 2						
no shock	167.5	806	167.4	836	164.6	883
shock	139.3	109	129.6	79	160.4	32
difference	*28.2*		*37.9*		*4.2*	
Total	164.5	915	164.5	915	164.5	915
Ruvuma						
Round 1						
no shock	152.2	820	153.8	843	151.6	865
shock	158.3	69	144.4	46	166.8	24
difference	*-6.1*		*9.4*		*-15.1*	
Total	152.9	889	152.9	889	152.9	889
Round 2						
no shock	148.5	723	148.2	751	147.8	810
shock	142.7	115	143.3	87	138.1	28
difference	*5.7*		*4.9*		*9.7*	
Total	147.6	838	147.6	838	147.6	838

[1)] Expenditures exclude expenditures on education, health and functions and have been deflated for comparison with HBS expenditures.

Table 7: Welfare and Poverty effect of Shocks and Coping in Kilimanjaro[1)]

	health & rainfall	health only	rainfall only	coffee shock only
Consumption per adult equivalent ('000TSH)				
no shock, no coping	197.0	192.9	195.8	195.7
shock and coping (=actual)	191.8	191.8	191.8	191.8
shock, no coping	185.9	189.0	188.6	191.8
Poverty incidence (%)				
no shock, no coping	14.4	14.8	14.5	14.3
shock and coping (=actual)	15.0	15.0	15.0	15.0
shock, no coping	16.7	16.0	15.8	15.0

[1)] The simulations were performed using the village fixed effect model including interaction terms with households' coping strategies (column 2, Table 3).

Table 8: Incidence of rainfall and health shocks in Kilimanjaro and Ruvuma in 2002-2004

	Kilimanjaro		Ruvuma	
	percent of households	number of households	percent of households	number of households
Adult health shock last 2 years	12.2	23,336	11.9	20,706
Adult illness shock last 2 years	6.9	13,172	8.1	14,105
Adult death shock last 2 years	5.8	11,194	4.0	7,035
Very low rainfall this year	20.8	39,798	3.8	6,547
Somewhat low rainfall this year	41.9	80,234	33.8	58,822
Either very low rainfall or adult health shock	33.0	63,134	15.7	27.253

Table 9: Correlates of use of savings, aid and remittances in case of a shock in Kilimanjaro

	(1)	(2)	(3)
	received aid	used savings	received aid or used savings
Shocks			
shock was any death	1.896	0.559	1.891
	(8.89)**	(3.05)**	(6.01)**
shock was any illness	0.894	0.758	1.057
	(4.47)**	(3.77)**	(4.85)**
shock was drought	-0.053	0.852	0.741
	(0.29)	(4.98)**	(4.33)**
Productive assets			
head of cattle, oxen, horses one year ago per ae	0.365	-0.196	0.185
	(1.89)+	(1.35)	(0.99)
head of cattle, oxen, horses, one year ago squared per ae	-0.057	-0.000	-0.047
	(1.63)	(0.01)	(1.53)
head of goat, sheep, one year ago per ae	-0.134	0.022	-0.033
	(2.24)*	(0.41)	(0.55)
head of goat, sheep, one year ago squared per ae	0.005	0.001	0.002
	(2.27)*	(0.80)	(1.00)
land owned 3 years ago/ae	0.037	-0.119	0.024
	(0.26)	(0.91)	(0.17)
land owned 3 years ago/ae sqr	0.001	0.009	0.000
	(0.14)	(1.01)	(0.03)
coffee trees owned in 2000, hundreds per ae	0.013	0.115	0.054
	(0.16)	(1.05)	(0.52)
coffee trees owned in 2000 per ae squared, hundreds	-0.003	0.002	0.002
	(0.70)	(0.24)	(0.45)
Demographics			
dependency ratio	-0.205	-0.020	0.071
	(0.68)	(0.07)	(0.21)
female-headed household	0.611	-0.432	0.120
	(3.00)**	(2.22)*	(0.54)
age of head	-0.072	0.028	-0.016
	(2.45)*	(1.19)	(0.63)
age of head squared	0.001	-0.000	0.000
	(2.89)**	(1.35)	(0.56)
yrs primary education of head	0.021	-0.006	-0.026
	(0.60)	(0.20)	(0.72)
yrs secondary education of head	0.058	0.021	0.022
	(0.56)	(0.23)	(0.22)
whether head has post-sec education	-0.424	0.170	-0.089
	(0.94)	(0.37)	(0.19)
head is Chagga	-0.505	-0.385	-0.279
	(1.90)+	(1.36)	(0.91)
head is Pare	-0.195	-0.355	-0.167
	(0.67)	(1.17)	(0.52)
Village connectivity, infrastructure and agro-ecological potential			
tarmac road reaches village	0.045	0.070	0.183
	(0.17)	(0.25)	(0.59)
village has public phone	-0.201	-0.248	-0.197
	(0.97)	(1.29)	(0.92)
village has cell phone signal	0.251	0.728	0.910
	(0.68)	(2.09)*	(2.67)**
village has a market	-0.113	-0.158	-0.150
	(0.60)	(0.87)	(0.73)
village has electricty	0.294	0.520	0.631
	(1.21)	(2.11)*	(2.30)*

	(1)	(2)	(3)
	received aid	used savings	received aid or used savings
bus service to village	0.076	0.192	0.046
	(0.38)	(1.02)	(0.22)
village has bank or other formal credit inst.	-0.336	-0.075	-0.181
	(1.52)	(0.31)	(0.70)
altitude	0.003	-0.002	-0.002
	(0.27)	(0.24)	(0.16)
Constant	0.500	-1.273	-0.318
	(0.49)	(1.44)	(0.34)
Observations	484	484	484
F stat	5.41	2.43	3.12
Prob > F	0.000	0.000	0.000
Pseudo R-squared [1)]	0.2873	. 1230	0.2249

Absolute value of t statistics in parentheses; + significant at 10%; * significant at 5%; ** significant at 1%; results presented allow for different correlation structures within districts, except for pseudo R-squared statistics, which are taken from a model which does not.

Table 10: Correlates of use of savings, aid and remittances in case of a shock in Ruvuma

	(1)	(2)	(3)
	receipt of aid	use of savings	receipt of aid or use of savings
Shocks			
shock was death	1.769	0.553	1.321
	(5.37)**	(1.88) +	(3.30)**
shock was illness	0.129	0.773	1.424
	(0.50)	(2.58)*	(3.23)**
shock was drought	-0.377	0.902	0.657
	(0.88)	(1.82) +	(1.31)
Productive assets			
head of cattle, oxen, horses one year ago per ae	-0.676	-0.560	-3.012
	(0.94)	(0.80)	(2.30)*
head of cattle, oxen, horses, one year ago squared per ae	0.485	0.036	1.333
	(1.67) +	(0.13)	(1.77) +
head of goat, sheep, one year ago per ae	0.374	-0.535	-0.322
	(1.53)	(2.16)*	(1.10)
head of goat, sheep, one year ago squared per ae	-0.095	0.075	0.014
	(1.78) +	(1.48)	(0.26)
land owned 1 year ago/ae	0.041	0.141	0.196
	(0.36)	(1.27)	(1.44)
land owned 1 year ago/ae sqr	-0.000	-0.006	-0.008
	(0.04)	(0.82)	(0.99)
coffee trees owned in 2002, hundreds per ae	0.331	0.339	0.902
	(1.29)	(1.29)	(2.81)**
coffee trees owned in 2002 per ae squared, hundreds	-0.056	-0.034	-0.146
	(1.08)	(0.73)	(2.63)**
hundreds of cashew trees owned in 2002 per ae	0.169	-0.770	-1.007
	(0.55)	(0.78)	(0.93)
hundreds of cashew trees owned in 2002 per ae, squared	-0.027	0.663	0.573
	(0.72)	(1.31)	(1.20)
whether produced tobacco this year	0.577	-0.168	-0.272
	(0.77)	(0.24)	(0.35)
Demographics			
dependency ratio	-0.279	0.442	-0.217
	(0.59)	(0.87)	(0.39)
head is female	0.466	-0.578	0.050
	(1.13)	(1.37)	(0.11)
age of head	-0.038	0.086	0.108
	(0.68)	(1.71) +	(1.82) +
age of head squared	0.000	-0.001	-0.001
	(0.53)	(1.99)*	(2.13)*
yrs primary completed by head	0.038	-0.031	-0.145
	(0.72)	(0.54)	(2.10)*
yrs secondary completed by head[2)]	-0.411	0.113	0.235
	(2.30)*	(0.82)	(1.63)
head is Matengo	-0.178	0.144	-0.285
	(0.45)	(0.37)	(0.64)
head is Ndendeule	-0.772	-0.379	-0.311
	(1.47)	(0.76)	(0.60)
head is Ngoni	0.265	-0.110	-0.088
	(0.59)	(0.26)	(0.19)
head is Yao	0.429	0.297	0.648
	(1.16)	(0.76)	(1.38)
head is Nyasa	-0.394		
	(0.57)		

	(1)	(2)	(3)
	receipt of aid	use of savings	receipt of aid or use of savings
Village connectivity, infrastructure and agro-ecological potential			
tarmac road reaches village	-0.134	0.647	0.286
	(0.17)	(0.87)	(0.39)
village has cell phone signal	-0.470		
	(0.89)		
village has a market	0.302	-0.107	-0.099
	(1.14)	(0.39)	(0.30)
bus service to village	-0.007	0.709	0.689
	(0.03)	(2.16)*	(1.96) +
village has bank or other formal credit inst.	-0.020	-0.187	-0.577
	(0.05)	(0.44)	(1.12)
Constant	-1.087	-1.366	-0.373
	(0.53)	(0.69)	(0.16)
Observations	202	195	195
F stat	1.63	1.43	1.53
Prob > F	0.0289	0.0865	0.0550
Pseudo R-squared	0.2025	0.1686	0.2847

Absolute value of t statistics in parentheses; + significant at 10%; * significant at 5%; ** significant at 1%; rainfall very low * acres cultivated/ae * used savings to cope with drought, rainfall very low * irrigated acres/ae, village electricity, village public phone, are all dropped due to collinearity; results presented allow for different correlation structures within districts, except for pseudo R-squared statistics, which are taken from a model which does not.; post-secondary education of head predicts use of savings and no receipt of aid perfectly; differing number of observations between regressions is due to the fact that observations are dropped when a variable is perfectly collinear with the dependent variable.