Households' vulnerability and responses to shocks: evidence from rural Kenya

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ABSTRACT

Empirical investigation on household's responses to sources of vulnerability is important for designing and implementation of social policies. The design of an effective redistribution policy needs to take into consideration existing household and community systems, so as to build on the existing strengths without displacing households' efforts. It is in this context that the current study investigates how farm households in rural Kenya respond to stressful events and the implications of the household's risk management strategies on their welfare.

The study examines two major sources of vulnerability for rural livelihoods: weather and HIV/AIDS. The importance of weather and HIV/AIDS lies in their impact on the most basic human need—food security. Weather uncertainties beget hunger. Hunger begets disease. When health-care provision is inadequate, hunger may interact with health problems to breed nutrition insecurity and therefore, more ill-health. For poor households, health problems present even a bigger threat to their livelihoods as their asset portfolio is highly skilled towards labour power.

While many studies have focused on the extent to which households maintain stable consumption levels under stressful conditions, much less research is on the mechanisms by which consumption is smoothed. Using a framework that represents the interaction of a household's portfolio with risk, this thesis explores both *ex ante* and *ex post* mechanisms for dealing with shocks and their accessibility to both male and females within a household. *Ex post* mechanisms include reliance on collective opportunities such as informal loans and gifts, while individual opportunities include asset and labour sales. While the results show that reciprocal transfers and labour markets are likely to play an important role in consumption smoothing, the effects of HIV/AIDS are similar to a common rainfall shock which is difficult to insure. The results show liquidity constraints to hamper the use of adult labour especially males' as a consumption smoothing device.

The *ex ante* mechanisms often involves building buffers. Buffer stocking often means sacrificing current consumption to secure future consumption. The sacrifice can be in form of holding less risky but low yielding assets or can mean securing consumption for some members of the households at the expense of those with less bargaining power. The study finds that households buffer stock in health and that a more uncertain future is associated with more liquid assets. The finding illustrates the existence of a link between risk, poverty and inequality. Demonstrating empirically the effect of risk and possible risk-coping strategies on inequality and poverty is a central challenge in the development literature. This thesis contributes to this literature and provides evidence at the intra-household level.

Key words: Vulnerability, HIV/AIDS, weather shocks, risk management, coping strategies, rural households, gender.

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1 Introduction

1.1 Poverty vulnerability and rural households

People living in low-income households in developing economies face a double misfortune: difficulties in generating income, and vulnerability to economic, political, social and environmental crises. Recession, inflation, drought, illness and civil unrest tend to hit hardest those households and individuals least well equipped to handle such shocks. Furthermore, the two types of misfortunes may reinforce each other; with poverty being a source of vulnerability and repeated exposure to downturns reinforcing poverty.

Despite being a country full of promise and potential of being a middle income economy, Kenya typifies the situation of many low-income environments. The performance of the economy was on a downward trend in the 1990s which resulted in a marked increase in the extent and depth of poverty. The worsening poverty status is revealed by a number of indicators. Kenya's Human Development Index declined from 0.53 in 1990 to 0.49 in 2004 (UNDP, 2006). The Human Poverty Index (HPI) rose steadily from 26.1 percent in 1997 to 35.5 percent in 2004. Estimates by Mwabu *et al.* (2003) show that between 1997 and 2000, income poverty increased from 52.2 percent to 56 percent. The poverty problem is particularly acute amongst the traditionally marginalised groups such as the rural population, especially those in arid and semi-arid regions of the country. For instance, in the period analysed by Mwabu *et al.* (2003), rural income poverty increased by 6.6 percent, while that of urban areas rose by 2.3 percent.

The deterioration of the economy, which may have been fuelled by poor implementation of macroeconomic reforms in the late 1980s and early 1990s, resulted in a steady increase in unemployment rates accompanied by inflation and high and unstable interest rates. Increased fiscal constraints led to cutbacks in public expenditure for social services such as health and other formal safety nets. The spread of HIV/AIDS further threatens the economy by weakening its human capital base. Although the prevalence rate have been on a decline from a peak of 14 percent in 1999, to about 6 percent in 2005 (NASCOP, 2006), the maturity of old infections and the risk of new infections presents another form of vulnerability for poor households. While urban areas record higher prevalence levels, it is the rural areas where over 70 percent of the population lives, which are likely to bear the brunt of AIDS. This burden of illness is bound to be felt more by women, due to their care-giving role.

Some studies on management of other household shocks have indicated that poor and rich households may respond differently to various shocks. Rich households have better access to insurance and credit facilities and a larger asset base, which may help cushion them against the impact of an income shock (Jalan and Ravallion, 1998). The absence of such risk management arrangements for people on low incomes may lead to significant welfare costs for their households. The spread of HIV/AIDS in such environments may lead to a considerable increase in welfare costs and this is a major concern for both the national government and the international community. The urgency of combating HIV/AIDS and its debilitating effects is articulated in the 6th Millennium Development Goal, which has obvious links with goal number one on eradication of extreme poverty.

Over the last one decade, a body of literature has been emerging examining the mechanisms agrarian households in low-income countries are using to cope with HIV/AIDS (Gillespie, 2006; Mutangandura *et al.*, 1999). This study contributes to this literature by investigating the availability and effectiveness of mechanisms that assist households to maintain stable consumption levels. In addition, given that HIV infection poses a risk to future income, we use short-term seasonal variation in consumption to examine the precautionary saving behaviour. The present study follows other research that has used short periods observations based on seasonal data in assessing forward-looking behaviour (Deaton, 1991; Paxson, 1992; Udry, 1995). Forward-looking behaviour and precautionary motives are central hypotheses implied by consumption theory. Evidence of such behaviour has implications for poverty reduction policies, especially the efficacy of interventions meant to boost savings and investment. The fact that HIV/AIDS affects most the younger and more economically active population makes examination of saving behaviour very relevant.

1.2 Problem statement

The high prevalence of risks in developing economies implies that people's ability to manage uncertainties is critical both for productivity and for their mere survival. A number of studies have examined income and consumption patterns in the risky environments of developing economies lacking formal safety nets (Agarwal, 1991; Deaton, 1991; Kinsey *et al.*, 1998; Paxson, 1992, 1993; Platteau, 1991; Udry, 1994)[1]. Several mechanisms have been shown to

[1] Alderman and Paxson (1992) and Besley (1993) provide a comprehensive review of the mechanisms households use to share risk.

smooth consumption *ex post* over a range of income fluctuations. They entail cross-sectional risk pooling among communities, to consumption smoothing over time through participation in savings and credit arrangements (Bardhan and Udry, 1999: pg. 94-106). Households may also make compensating changes in labour market participation in response to income shocks (Kochar, 1999; Rose, 2001). In order to assess the desirability of implementing policies to cushion households from adverse effects of shocks, it is critical to understand how households use such savings, other informal mechanisms and labour markets to smooth consumption.

The current dearth of such studies in Kenya may preclude the design of effective policies. Currently, a number of programmes aim at providing savings and credit services to individuals affected by HIV/AIDS. Yet the HIV/AIDS shock may exhibit characteristics of a covariant shock, which then violates one of the fundamental principles of successful group-lending. Kinsey *et al.* (1998) provide evidence that under covariant risk, informal credit mechanisms may break down[2]. The stigma associated with HIV/AIDS may act to ensure that HIV/AIDS-affected individuals group together, thus rendering the insurance mechanisms ineffective. Furthermore, the fact that a loan taken to protect consumption may have to be repaid at a point in the future when consumers have struck bad luck (for instance due to illness) raises questions about the viability of such programmes. Carroll (1997) demonstrates why improved availability of credit may be of limited value to consumers whose precautionary motives are important. Quoting Zeldes (1989), Carroll observes that, the possibility of incomes falling to subsistence levels together with the assumption that consumption must remain strictly positive, would ensure consumers do not borrow. Deaton (1997: pg.363) provides further elaboration.

While acknowledging the importance of other household shocks on the income of rural households, this study mainly focuses on the HIV/AIDS while controlling for weather shocks. There are several reasons why the risk of ill health provides a more serious threat to the livelihood of the rural poor than many other risks. First, because impoverished rural people often lack land and other physical and financial assets, their only option of earning a living may be to supply labour. Second, labour effort is important as a complementary input to other productive assets. Third, the health risk posed by HIV/AIDS is irreversible and poses a risk of mortality.

[2] Another example of the breakdown of the effectiveness of coping strategies under covariant shocks is provided by Drèze and Sen (1989).

Irreversibility is important for wealth dynamics (Barrett and McPeak, 2005) and its implications may vary depending on gender. This can be seen through the following:

a. While a household that loses part of its cattle herd can rebuild it with time, it may be difficult for a poor household to recover its labour resource, if its working age adults are infected with HIV/AIDS.

b. The mitigation strategies adopted by households may affect activity choice and consumption patterns in two ways. Firstly and quite straightforward, poor health may limit ability to work, which may mean less income, and hence less accumulation of assets. Secondly, infection with a terminal illness may alter the discount rate that an individual places between present and future consumption – specifically lowering the present value of future consumption. The strength of this incentive to consume now may depend on factors such as how much income will be lost due to death, the presence and size of social security, bequest motives and probably, aspects such as gender (several studies suggest that women are more likely to have higher precautionary motives[3]).

c. Faced with the irreversibility of a health shock, the poor may forego high-return investments that would demand greater short-term sacrifices in consumption, for fear of coming too near the threshold of permanent impairment (death). Zimmerman and Carter (2003) refer to this situation as disaster avoidance or subsistence constraint. Individuals under subsistence constraint strive to smooth consumption more on which future income (and hence future consumption) depends and willingly destabilise current consumption. This destabilisation in consumption is then likely to differ between members of the household, depending on their productivity and on gender[4] and can lead to health poverty traps for some members.

Little empirical work has been done on intra-household resource allocation when resource-poor households are faced with the threat of irreversible ill health such as that posed by HIV/AIDS. This study examines labour responses by gender in the face of illness of adult household members. It also investigates the dominating incentive in intra-household resource

[3] Some intra-household studies indicate that women tend to spend more of their income on food, child health and education, which are forms of precautionary savings e,g. (Jianakoplos and Barnasek, 1998; Quisumbing and Maluccio, 2000)

[4] Hoddinott and Kinsey (2000) provide some evidence that women bear more of the burden of a drought shock than men.

allocation under the risk of ill health. Intra-household resource allocation can be driven by either equality concerns or productivity concerns. Either incentive has consequences for welfare outcomes.

The above *ex post* risk mechanisms for mitigating the negative effects of shocks may, however, fail to achieve an entirely smooth consumption path. By a learning process, risk-averse households may self-insure *ex ante* by adopting income-generating strategies that reduce fluctuations in their incomes. The above mentioned destabilisation of consumption for some members of the household or existence of a productivity incentive in intra-household resource allocation, are cases of an *ex ante* mechanism. Dercon and Krishnan (2000b) provide evidence that reserves of fat are used to buffer against the effect of seasonal food shortages. While the need for holding precautionary balances in the face of uncertainty is a long established fact[5], there is evidence that it may lead to higher poverty levels (Jalan and Ravallion, 1998). As noted earlier, there is minimal research on risk and poverty for Kenya. Exceptions include studies on pastoral risk management and poverty (Barrett *et al.*, 2006; Little *et al.*, 2001) and Christiansen and Subbarao (2005). Among the first quantitative study which can be linked to HIV/AIDS is by Yamano and Jayne (2004). They show that household enterprises may change following the death of prime age adults. Another study, using data from Kagera Tanzania describes savings behaviour preceding death (Lundberg *et al.*, 2003). There is little evidence on savings behaviour during the illness phase. Donovan and Bailey (2006) observe that, failure to account for the adjustments during illness may lead to the repercussions of death being underestimated.

According to consumption theory, fatal illness is expected to motivate people to save. This is because a higher probability of ill health in future increases the uncertainty of income as well as reducing its expected mean. Holding current income constant, a household's savings would increase because of aversion to expected fluctuation and due to expected higher marginal utility. Previous studies of precautionary savings have examined changes in savings in response to uncertainty in weather, which is strictly exogenous (Alderman, 1996; Deaton, 1991; Paxson, 1992). In the case of HIV/AIDS, the illness can be endogenous and if someone knows their HIV status, illness is anticipated. Where illness is anticipated, precautionary savings should increase with anticipated declines in permanent income as well as transitory

[5] Keynes (1961) identified a precautionary motive 'as a desire for security ....as to the future cash equivalent of a certain proportion of total resources'. He also believed that India was 'a country impoverished by a preference for liquidity', which stifled the 'growth of the real wealth.' (also quoted in Jalan and Ravallion, 1998)

income i.e. savings may increase in response to the need to smooth future consumption and because of bequest motives. However, being ill demands higher current consumption, in which case, households may dissave to meet the required expenditure on food and medication (to smooth the health stock). Therefore, the effect of HIV/AIDS on savings behaviour cannot be determined a *priori*. It is, however, expected that the consequences of trying to achieve a balance between consumption smoothing and asset smoothing would be more volatile consumption for HIV/AIDS-afflicted households.

1.3 Research objective and questions

Following on from the preceding discussion, the objective of this study is to examine the usage and effectiveness of household responses to sources of vulnerability with a focus on HIV/AIDS and weather stress. Given that in much of rural Kenya there are no formal mechanisms for insurance, the study pays special attention to the roles of savings and credit in the management of risk. The analysis is cognisant of the fact that different members of the household face different constraints and fall back positions, and may also have different preferences. Consequently, the effects of stressful conditions are addressed separately for males and females. To achieve these objectives, answers to the following questions are sought:

i. How vulnerable is a household's consumption to different types of shocks? Which institutions enable the household to manage the consequences of negative shocks on consumption? Are the institutions equally available for men and women illnesses?

ii. To what extent does the farm households' labour allocation adjust to adverse shocks and stressful events? Is the impact different on the labour responses of men and women? What is the role of credit constraint?

iii. Are there intra-household gender inequalities in health outcomes?

iv. Do households exhibit any precautionary behaviour towards AIDS-related illnesses and weather variability?

1.4 Outline of the study

The above questions are addressed in Chapters 3, 4, 5 and 6. Chapter 2 describes the context in which the research took place, the sampling strategy and the type of data used. This chapter also presents the conceptual framework that shapes the perspective on risk coping and risk management as analysed in this study.

Chapter 3 seeks to answer the first question. Information on informal transfers or gifts from kin and friends, informal loans and livestock transactions is used to investigate how households deal with weather and health shocks. The focus is on the effects of illnesses on changes in gifts, loans and livestock sales. Recognising that the most important asset for the poor is their labour, Chapter 4 investigates how labour responds to variability in weather and health outcomes. In this chapter, we explore the possibility that men and women may respond differently to sources of income variability. We use a model that accommodates *ex ante* and *ex post* labour responses to stress.

Following leads from previous literature, e.g. Dercon and Krishnan (2000a) and Behrman (1988), Chapter 5 proceeds to examine intra-household differences in health outcomes. By examining changes in health of individual members over time, we start examining the link between risk, poverty and inequality. We follow the literature on the relationship between nutrition and productivity (Barrett, 2002; Bliss and Stern, 1978; Dasgupta, 1993). Chapter 6 continues assessing the link between risk and poverty by examining the precautionary behaviour of households. It is expected that households that face greater uncertainties about health and weather would have more precautionary savings and their portfolio of assets would also be more liquid. This chapter also provides the test for effectiveness of financial markets in smoothing consumption. The conclusions are given in Chapter 7.

1.5 Relevance of the study

The effect of risk and risk-coping strategies on inequality and poverty is a central issue in the development debate. This thesis sets out to contribute to this debate and provide evidence at the intra-household level. HIV/AIDS is central to this discussion as a major contributor to household vulnerability and poverty for countries in Sub-Saharan Africa. It should also be noted that three of the MDG goals have to do with health and one of the key objectives of the

ambitious 2005 campaign on "making poverty history" was the need to provide the necessary aid for countries to develop their social and health care systems. Socio-economic analysis can be helpful when setting priorities in order to develop sustainable social security systems. If they understand the operations of the existing household and community coping systems, decision-makers are better able to make choices about the allocation of resources. Such an evaluation therefore helps to achieve value for money, by targeting interventions at and investing resources in the most vulnerable population groups. The analysis provides some insights into possible outcomes of introduction of publicly provided health or financial policy. It is important that publicly provided interventions do not displace household and community coping mechanisms.

The study also aims to contribute to the understanding of the nature of poverty and its underlying causes. If the nature of poverty and causes of episodes of poverty are understood, interventions can be deployed effectively to counteract deprivation. By examining seasonal changes in health disparity between individuals within a household, the study seeks to identify the dominating incentive in intra-household allocation of health goods. Households can be motivated by equality of health outcomes among its members or productivity concerns. A dominance of productivity concerns has implication for intra-household persistence of poverty, while a dominance of equality concerns may mean a sacrifice in generation of income, at least in the short-run. Empirically, identification of the dominating incentive is difficult because of the possibility of mutually reinforcing interactions between income and health (Smith, 1999), and lack of consumption data at the individual level. The study uses a methodology that circumvents some of these shortcomings.

The study also examines households' precautionary behaviour towards weather and health uncertainties. Evidence of such behaviour has implication for poverty reduction policies, especially the efficacy of interventions meant to boost savings and investments. This is more so given that HIV/AIDS tends to be concentrated among the economically active population.

Although we use three seasons' observations to perform the subsequent analysis, for people living near the subsistence level, a one season upset to their income may mean the loss of several years of accumulated savings and a loss of capacity to do work in subsequent periods. Therefore, even short-term seasonal changes in health outcomes or savings should not be ignored.

2 Study area and methodology

2.1 Study area, sampling, data

2.1.1 Study area

To investigate the existing mechanisms for dealing with household shocks and assess their effectiveness in the presence of HIV/AIDS, one needs a sample containing a sufficient proportion of households with HIV/AIDS-related illnesses. The data used in this study come from a three-round survey that collected information for one and a half years from 196 households in Thika and Maragua districts of Central Kenya. The average HIV prevalence in the two districts was 8.5 percent, which was slightly above the national average of about 7 percent at the time (Kenya, 2004). The surveyed households are located in the middle and lower agro-ecological zones and include some of the poorest households in Central Kenya with poverty levels in some cases being over 60 percent. The area is a catchment zone for the Thika district hospital, which by 2002 had 60 percent of its bed capacity occupied by patients suffering from HIV/AIDS-related illnesses.

In addition to some parts of the study area being marginal and prone to drought, the area has also experienced macroeconomic shocks in the last ten years. Before the 1990s, it was a major coffee-growing zone and the collapse of the coffee industry was largely responsible for a rise in poverty levels over the decade. The area provides a good case study for household responses to shocks since diverse livelihood strategies exist, both on-farm and off-farm (Kenya, 2000). This is attributable to the proximity to commercial farms and a major urban centre —Thika town — which is only 30 km from the capital city, Nairobi. Figure 2.1 shows the precise locations of the study sites. The commercial farms and the Thika industrial sites attract a lot of migrant workers, and according to the District's Medical and Development officers, the sites provide nodal points from which HIV infections spread to neighbouring rural areas.

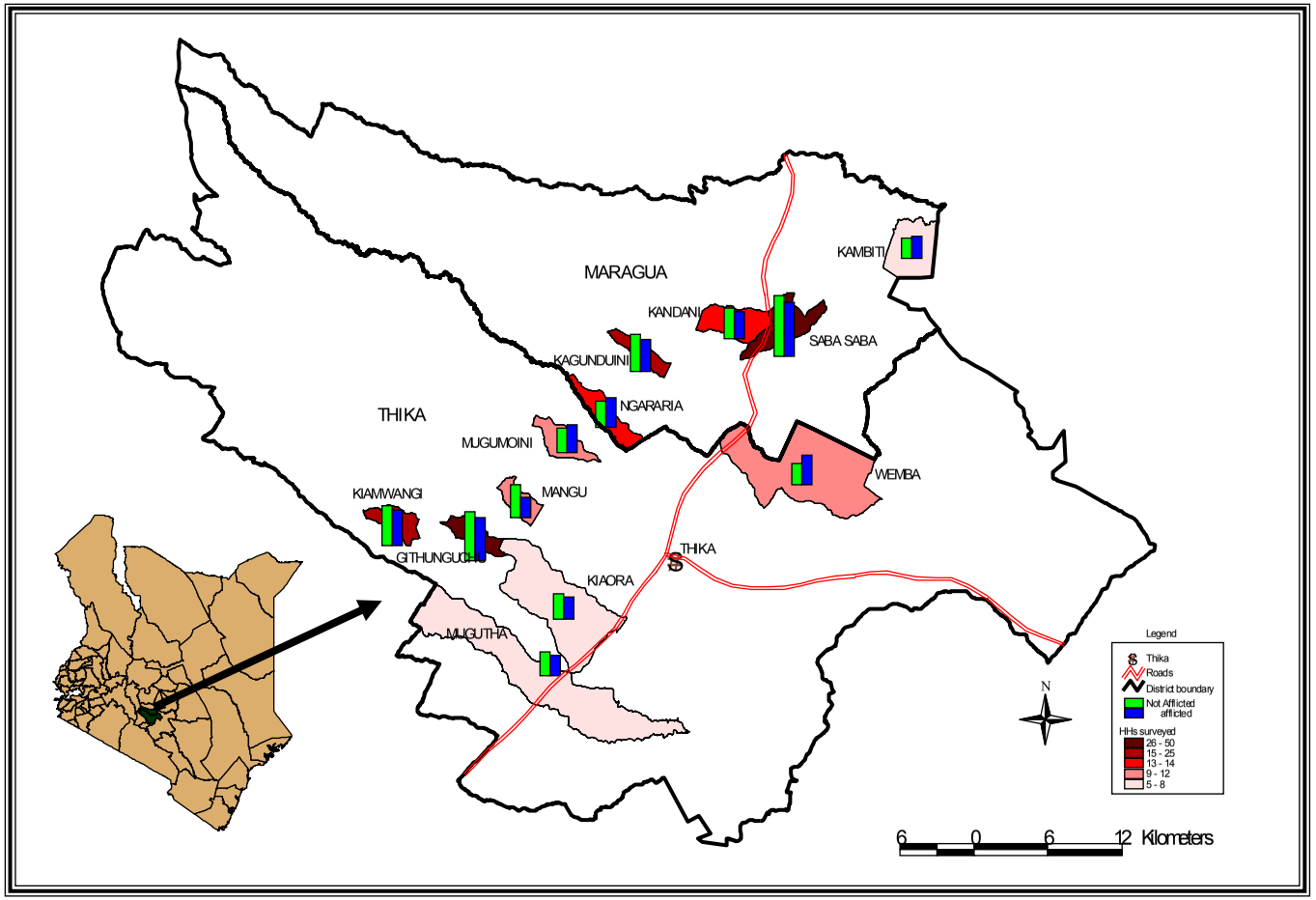

Figure 2.1 Location and study villages

2.1.2 Sampling

One of the biggest challenges in HIV/AIDS research is identification of infected people. The link between HIV status and morality means that in the study area HIV-positive people are highly stigmatised, so people very rarely openly declare their HIV status. As a result, the prevalence statistics are not very reliable. These facts rule out straight random sampling or a clear stratified sampling. In HIV/AIDS research there now seems to be a consensus that unless one is dealing with clearly proven cases of zero positive HIV status, one cannot conclusively state that the illnesses are due to HIV infection. These difficulties have limited large-scale studies of the impact of HIV illnesses on people's livelihoods. The existing studies have dwelt more on the impact of prime age adult death (Mather *et al.*, 2004; Yamano and Jayne, 2004).

In an attempt to overcome the identification problem and obtain sufficient numbers of households experiencing HIV illnesses, the only feasible alternative was to work via community health groups (CHG) working with people living with HIV (PLWH). Through the efforts of the National AIDS Control Council (NACC), a number of CHG have been set up throughout the country. The workers in the CHG, some of them HIV patients, provide training to communities on HIV-related issues and sometimes give financial help and counselling to PLWH. A listing of the CHG was obtained from the District Development Officers who are the HIV/AIDS information focal points in the districts. Thirteen active groups were identified and their distribution within the two districts determined the distribution of the households covered. A list was made of all HIV/AIDS afflicted households (hereafter referred to as AIDS-afflicted) under the care of the thirteen groups or whom the group members knew to be ailing from AIDS-related illnesses. The name of the household head was marked against a list of households from the national Central Bureau of Statistics (CBS). Whenever possible, we tried to remain within the national household clusters demarcated by the CBS to be able to relate the findings to the regional situation. For each HIV-afflicted household, the nearest household on the CBS list with the following characteristics was sampled: (i) the household was not known to have a member suffering from AIDS-related ailments (ii) had not experienced death related to AIDS (iii) had similar demographics especially with regard to young children. This category is referred to as the non-afflicted. The households were visited in three rounds of surveys. In the first round, 215 households were visited of which 114 were AIDS-afflicted and the rest 101 non-afflicted. By the third survey, the number had fallen to

196 with 101 afflicted and 95 non-afflicted. Of the 194 households in the final sample with complete data, 178 comprised couples living together.

This selection method imposes a potential bias since it resulted in AIDS-afflicted households being over-represented. In order to be able to extrapolate the findings to the general population, sampling weights are used whenever possible to correct for the bias imposed by the sampling method.

2.1.3 Data

The three-round survey was undertaken between May 2004 and April 2005. The timing for each survey round was after a harvest season. The region has bimodal rainfall and two planting seasons in a year. The first survey collected recall data for the short rainy season of 2003/2004. The season runs from October to March. The second round, in November to December, obtained information for the main cropping season that runs from March/April to August/September. The third round collected information for the 2004/2005 short rains as for the first survey.

Ideally, tests of hypotheses on intertemporal behaviour require longitudinal data. Kenya generally lacks panel data sets for households. The lack of such data has limited studies of poverty dynamics in the country, yet policies on poverty reduction rest on understanding these dynamics. In the absence of long panels — especially those that track HIV/AIDS-afflicted households from the illness stage, we used the seasonal cross-sectional data collected in this study to identify how seasonal fluctuations in consumption may be an initiator of poverty for households. This study borrows methods from other work that have used short panels and cross-sectional data to study consumption and savings behaviour under uncertainty. These include Udry (1995), who uses a one-year nine-round survey in Northern Nigeria, Deaton (1991) who uses a two-year panel for Côte d'Ivoire, and Dercon and Krishnan (2000a; 2000b) who use three-round information collected over 18 months from rural Ethiopia. Paxson (1992) uses cross-sectional data combined with time series rainfall variations to proxy for source of income variability.

In order to analyse the role of short-term income fluctuations in explaining consumption smoothing, data was collected on the amount of assets, their value and asset transactions within the survey period. Also collected was information on loans and transfers in each season. The survey also sought information on: the economic activities of all family members;

incomes; expenditure; types of other shocks such as crop failures, animal diseases; any action taken in response to each stressful event/shock; types and symptoms of illnesses experienced by family members; labour time lost due to illness; and a record of the physical capacity of household members aged 18 or above to perform activities necessary for daily life. The qualitative information on weather induced crop failures was complemented with 14 years of monthly rainfall data from 10 recording points in the study zone.

To assess credit constraints, a direct elicitation approach based on household responses to qualitative questions on credit was used. This approach is adopted from Zeller (1994) and Boucher *et al.* (2005). Among the questions were those asking whether any credit had been sought, and if so, the sum desired and whether the application had been successful; and if no credit had been applied for, why not.

This quantitative data set was complemented with qualitative information collected from focus group discussions and five case studies. The focus groups consisted of community leaders and community health workers. The qualitative information was intended to (i) reveal how the community health workers and leaders identify HIV patients (this allowed us to gauge the likelihood of misdiagnosis); (ii) complement data on how HIV/AIDS-affected households deal with the negative effects of the shocks. For example, according to the key informant's observations, how do people deal with HIV/AIDS illnesses? Do people dispose of assets? If they do, which ones are they likely to sell? From the case studies, a record of the history of actions and costs incurred by the HIV patient since diagnosis was obtained. In addition to these case studies and discussions, the enumerators were instructed to suspend the formal interview whenever the respondent started providing deeper information on their personal experiences and instead to note down as much of such narratives as possible. This extra information was used to confirm health status wherever there was doubt of diagnosis. It was important that the diagnosis was correct, both for ethical reasons and for correct impact analysis.

2.2 Descriptive statistics of the survey households

2.2.1 Demographic and socio-economic profile

The total population covered in the 215 households was 1,120, which gives an average family size of 5.1 members (Table 2.1). This household size compares well with the average size for rural households in Kenya: 5.6 (latest available census of 1999). Although there was an

attempt in the sampling design to sample household of similar demographics, especially with regard to dependants, afflicted households have a statistically smaller household size with about one member less (4.6 versus 5.5). They also have younger heads than the non-afflicted. However, the number of children below 5 and the dependency ratio does not differ significantly.

Table 2.1 Household demographics

	All households	Non-afflicted	Afflicted	Difference between afflicted and Non-afflicted
	Mean (std dev)	Mean (std dev)	Mean (std dev)	t-statistics
Household size	5.05 (1.84)	5.51 (1.95)	4.64 (1.65)	3.49***
Number below 5	0.80 (0.87)	0.84 (0.96)	0.77 (0.79)	0.54
Dependency ratio	0.81 (0.74)	0.82 (0.72)	0.81 (0.71)	0.16
Age of head	45.91 (14.2)	48.7 (15.0)	43.5 (12.74)	2.7***
Education of head	7.6 (2.92)	7.7 (2.92)	7.50 (2.93)	0.51
N=215				

*** Significance 1%.

2.2.2 Sources of livelihoods

As expected, the main livelihood for the majority of the households is farming. Half of the household heads and three quarters of the spouses reported that farm work was their main occupation. This represents less than the average of 75–80 percent for the rural population in Kenya, but confirms the observation made earlier that this area has diverse economic activities. Other economic activities like wage employment are substantial. About 17 percent of the members of the household were in skilled formal employment and another 24 percent reported their main activity as casual off-farm work.

Despite the main economic activity being farming, the importance of agriculture in terms of its contribution to per capita household income is quite low (Table 2.2). Wage income has the highest share of per capita income (50 percent), followed by livestock production. In this community, informal transfers seem to be as important as crop income. This sectoral contribution to total income is reasonably close to official statistics especially for wage work which is about 43 percent. Agriculture official contribution is about 17 percent and rural self-employment 20 percent (Kenya, 2002).

It can also be observed from Table 2.2 that crop income is quite variable. This is especially true for the second-round survey which was undertaken in what was generally a very dry season. Most households experienced crop failure. However, total income is much less volatile compared to individual sources of income. The least volatile source of income is wage income; this suggests that off-farm labour could be playing an important role in buffering fluctuations in total income.

Table 2.2 Monthly per capita income composition and variability for the three rounds

	1st round (2003/2004 short rains)	2nd round (2004 long rains)	3rd round (2004/2005 short rains)	Average for the survey period
Total Income (Ksh)[1]	1740	1335	1773	1616
	(1.28)[2]	(1.54)	(1.18)	
Crop share (%)	0.08	0.02	0.19	0.10
	(3.29)	(16.49)	(1.49)	
Livestock share (Live animal and products sales)	0.20	0.22	0.07	0.16
	(3.05)	(3.4)	(4.50)	
Wage share	0.50	0.51	0.56	0.52
	(1.50)	(1.92)	(1.67)	
Self-employment share	0.04	0.06	0.04	0.05
	(5.56)	(6.12)	(6.94)	
Transfers/gifts share	0.14	0.15	0.10)	0.13
	(3.21)	(2.57)	(3.65)	
Other unearned income (e.g. pension, rent) share	0.03	0.03	0.04	0.03
	(9.62)	(6.40)	(9.80)	
N	215	199	194	194

[1] 1 US$ ≈ KSh. 75 in 2004.

[2] Coefficient of variation in parentheses.

2.2.3 Consumption levels

As one of the most important variables that determine welfare, average per capita consumption is reported in Table 2.3. Consumption consists of expenditure on food plus expenditure on non-food. Expenditure on food was constructed from purchased foods and imputed values of home production and informal transfers/gifts. Mean consumption is estimated at about KSh.1,961 (US$ 26.14) per person per month. This mean is roughly consistent with the rural average of KSh. 1,836 per month (Kenya, 2000). AIDS-afflicted households have higher food and non-food consumption than non-afflicted, but also face higher volatility. Despite the volatility in incomes shown in Table 2.2, it is clear that households try to protect food consumption from fluctuations. The volatility of food consumption is much less than either the non-food expenditure or the total expenditure throughout the three seasons.

Table 2.3 Mean and variability of monthly per capita consumption by season and HIV/AIDS status

	1st round (2003/2004 short rains)		2nd round (2004 long rains)		3rd round (2004/2005 short rains)		Average for the survey period	
	Afflicted	Non-afflicted	Afflicted	Non-afflicted	Afflicted	Non-afflicted	Afflicted	Non-afflicted
Food consumption[1]	1180 (0.75)[2]	1071 (0.62)	1188 (0.54)	1031 (0.51)	941 (0.67)	851 (0.52)	1112 (0.67)	987 (0.62)
Non-food consumption	973 (1.52)	777 (1.09)	992 (1.21)	616 (1.46)	1291 (2.64)	806 (1.41)	1074 (1.61)	737 (1.26)
Total consumption	2153 (0.85)	1849 (0.73)	2079 (0.70)	1647 (0.73)	2200 (1.18)	1656 (0.87)	2185 (0.92)	1725 (0.79)
N	114	101	103	94	101	93		

[1]Consumption in Kenya Shillings (KSh): 1 US$ ≈ KSh. 75 in 2004.
[2]Coefficient of variation in parentheses.

2.2.4 Shocks

The above variability in income and consequently consumption might be linked to shocks experienced by the households. Information on shocks is presented in Table 2.4. The table reports the severity of crop and livestock losses reported by the households. During the interviews, data was collected on events in the past cropping season that could have affected crop and livestock production. An index similar to that of Dearcon and Krishnan (2000b) was constructed from the responses. The indices ranged from 1 to 4 depending on severity of loss (1 being least severe and 4 representing total loss). The most reported loss is crop loss due to insufficient rainfall: this was reported by about 55 percent of the households. This loss was most severe in the second round of survey: 64 percent of households reported such a loss. Very few households (about 10 percent) reported other losses. For most of the reported cases of loss, the afflicted households reported on average higher severity than the non-afflicted. For example, the severity of crop loss due to illness is 1.42 for the non-afflicted compared to 1.5 for the afflicted (one sided t-test, p=0.13). The higher index for crop loss for AIDS-afflicted households may point to lower resilience and greater sensitivity to shocks.

In addition to the household qualitative measure of crop loss due to rain failure, a measure of rainfall shock experienced during the seasons is calculated from the rainfall data. The observed monthly rainfall at two critical periods in the crop cycle; namely planting and weeding, is compared to the average rainfall for 14 years for the normal planting and weeding periods in each region. The percent rainfall deviation of observed rainfall from the 14-year average is considered as the measure of rainfall shock; the higher the deviation of observed rainfall from the mean, the drier the season. In general, the survey period was drier than normal. The variable is therefore regarded as percent rainfall shortfall in the subsequent

chapters. The weeding period, which also represents the plant growth phase, was much drier in all the survey rounds with the long rains season being the worst.

Table 2.4 Means and standard deviations of income and health shocks

	1st round (2003/2004 short rains)		2nd round (2004 long rains)		3rd round (2004/2005 short rains)	
	Afflicted	Non-afflicted	Afflicted	Non-afflicted	Afflicted	Non-afflicted
Index of Severity of Crop and Livestock losses						
Crop loss due to insufficient rainfall	1.60 (1.48)*	1.4 (1.42)	1.94 (1.56)	2.09 (1.38)	0.98 (1.37)	0.76 (1.24)
Crop loss due to pests & diseases	0.46 (1.05)	0.33 (0.85)	0.05 (0.38)	0.04 (0.29)	0.26 (0.79)	0.23 (0.74)
Livestock death	0.50 (1.16)	0.62 (1.2)	0.18 (0.75)	0.19 (0.79)	0.10 (0.50)	0.14 (0.60)
Livestock illness	0.31 (0.91)	0.28 (0.75)	0.12 (0.65)	0.03 (0.31)	0.04 (0.29)	0.02 (0.21)
Poor markets	0.22 (0.68)	0.28 (0.79)	0.04 (0.31)	0.06 (0.46)	0.21 (0.92)	0.16 (0.62)
Health variables						
Work days lost due to illness of female head	2.55 (6.99)	1.65 (5.87)	2.37 (6.59)	1.62 (5.43)	2.82 (7.07)	1.10 (3.95)
Work days lost due to illness of male head	6.99 (11.78)	3.53 (7.92)	4.55 (8.54)	2.50 (6.13)	4.43 (9.21)	1.68 (5.10)
Female head ADL	58.78 (31.74)	69.17 (29.35)	58.50 (29.48)	65.89 (27.30)	64.48 (29.88)	74.86 (26.96)
Male head ADL	68.90 (29.80)	74.03 (28.37)	63.92 (25.96)	70.90 (25.04)	68.14 (30.87)	74.55 (27.90)
Rainfall shock						
% rainfall shortfall planting season	0.25 (23.15)		-17.89 (25.72)		- 9.55 (18.20)	
% rainfall shortfall weeding season	36.67 (33.08)		53.18 (19.00)		6.11 (0.62)	

*Standard deviation in parenthesis

To assess the impact of health shocks, quantitative and qualitative criteria are used: working days lost due to illness and an index score of ability to do physical activities important for daily living (ADL) for the people in the surveyed households. The ADL index ranges from 0–1, in line with the RAND-36[6] health surveys; with 0 being unable to do the physical activities examined and 1 being able to do all. The RAND-36 has many other criteria, which also include mental conditions. In this study, only the physical limitations were considered, because of the importance of physical strength for the livelihoods of rural people in the survey area.

[6] http://www.rand.org/health/surveys/MOS, downloaded 10/11/2005.

As would be expected, the health indices are worse for the afflicted than the non-afflicted households. Working days lost due to illness were higher for the afflicted households and the ADL indices are also lower. Although the female head seems to have a lower ADL index than the male head, in both afflicted and non-afflicted households the female head lose fewer days of work due to own illness than the male head.

2.2.5 Savings and loans

Table 2.5 provides information on savings and loans as well as the sources of loans. In this rural area, households' savings are quite low. The amount held at the beginning of the first survey translates to about Ksh.1,367 per capita (about US$ 20). However, given the average earnings of Ksh1,616 in Table 2.2, the amount held as cash saving is quite substantial. The households were net savers during the survey period despite having experienced two poor harvests. The long rains season was the worst and consequently, net savings were almost a quarter of the other two.

Households receiving loans are in the minority: about 40 percent reported having received any loan in the survey period. The majority of the loans are informal. Of those who had loans, about 63 percent borrowed from informal groups or friends and relatives. On average, net loans in the first period are about 50 percent of savings.

Table 2.5 Loans taken in and paid back/given out during the three seasons

	1st round (2003/2004 short rains)	2nd round (2004 long rains)	3rd round (2004/2005 short rains)
Savings (Ksh)			
Savings held at beginning of 1st round	6972		
Three months net savings	1284	401	1940
Loans (KSh)			
Loans taken	3761	1931	2438
Loans given out	202	1006	427
Net loans	3559	925	2011
Source of loans (%)			
Informal group	32.6		
Friends/relatives	30.2		
Formal MFI	9.3		
Co-operatives	27.9		

1 US$ ≈ KSh. 75 in 2004.

2.3 The conceptual framework

The literature dealing with household savings and consumption typically adopts a model consistent with either the permanent income hypothesis (PIH) or the Arrow Debreu (AD) approach. The two models yield similar predictions in the short-run: that individual household consumption is independent of idiosyncratic shocks over the short-run.

In the PIH model, household consumption follows a permanent (lifetime) income process. Complete credit and assets markets are assumed, and this allows the household to use credit or assets to smooth consumption over time. Households are relatively unaffected by common village level shocks that do not affect the households' expected permanent income. Only negative idiosyncratic shocks strong enough to affect permanent income will lower individual consumption (Rosenzweig, 2001). Thus, household consumption is a function of the individual income process, not aggregate village income (Ligon, 1998), and consumption is smoothed through time.

This is in contrast to the AD type model, where consumption is smoothed through cross-sectional means by risk being pooled across village members. Assuming perfect markets, households within a village, kinship group or other social network share each other's risk through institutional arrangements, which approximate the Pareto-efficient allocation of risk. Consequently, individual household income follows aggregate village consumption, and is independent of the household's idiosyncratic shocks (Mace, 1991; Townsend, 1994). This can be shown through the following mechanisms:

Let i=1,…,N index the households[7] within a group (village). There are T periods indexed by t, and S states of nature indexed s with a probability of occurrence π_s. In state s, each household receives an income of y_s>0, assuming exogenous income (i.e. household do not foresee income shocks). Let c_{st}^i represent the consumption of household i if state s occurs in period t. Suppose that each household has a separable utility function of the form:

$$u_i = \sum_{t=1}^{T} \delta^t \sum_{s=1}^{s} \pi_s u_i(c_{st}^i) \qquad (2.1)$$

where $u(.)$ is twice continuously differentiable with u′>0, u″<0. δ represents the rate of time preference. A Pareto-efficient allocation of risk within the group can be found by maximising

[7] For exposition, we will use the term household, but the term may be applied to individuals within a household

the weighted sum of the utilities of each of the N households, where the weight of the household i in the Pareto programme is ω_i (Bardhan and Udry, 1999; p.96; Mace, 1991; Townsend, 1994); $0 < \omega_i < 1, \quad \sum \omega_i = 1$:

$$\max(c_{st}^i) \sum_{i=1}^{N} \omega_i u_i \tag{2.2}$$

Subject to the resources available to the group in each time and state *s*:

$$\sum_{i=1}^{N} c_{st}^i) \geq \sum y_{st}^i \forall s,t \tag{2.3}$$

For a group with positive resources at any one time,

$$c_{st}^i \geq 0 \quad \forall i,s,t \tag{2.4}$$

The first order conditions corresponding to c_{st}^i and c_{st}^j imply (Mace, 1991):

$$\frac{u'(c_{st}^i}{u'(c_{st}^j)} = \frac{\omega^j}{\omega^i} \forall i,j,s,t \tag{2.5}$$

This is the outcome of the full insurance theory under the AD model: that the marginal utilities and therefore consumption levels of all households in the group or village move together. There is no incentive to diversify income at the household level, because after controlling for aggregate consumption, household consumption is unaffected by shocks to its income. In contrast to the PIH models then, individual consumption is unaffected by even large idiosyncratic shocks that alter lifetime income. In a pure AD model, households with individual income falling to zero continue to receive a constant portion of average village consumption (Alderman and Paxson, 1992).

Predictions of the full insurance model have been tested using modified versions which alter the assumption of perfect information and perfect commitment. In the first case, imperfect information is substituted for perfect information. These models yield second best non-Pareto efficient allocations, which are consistent with strong but imperfect smoothing (Ligon, 1998; Townsend, 1995). In the second case, limited commitment models substitute for unlimited commitment. This includes the quasi-credit models of Udry (1994) and Ligon *et al.* (2000). These models yield near Pareto-efficient consumption smoothing outcomes relative to the pure version of AD model, and allow for features often observed in village economies (e.g. zero interest loans without specified repayment period, consumption-based loans, loans based

on reciprocity) to be accounted for within the models. These models would also be consistent with Scott's note of a 'moral economy' guaranteeing a minimal subsistence to individuals, in so far as the village resources makes this possible (Scott, 1976: pg. 40). They allow for non-separability of consumption and production decisions in environments where households are not fully able to mitigate risk through insurance or its complementary inter-temporal credit.

The literature on risk coping has highlighted the importance of informal mechanisms such as the consumption-based loans or loans or transfers based on reciprocity, in aiding rural households deal with adverse effects of shocks. Often, such mechanisms have been found to be quite efficient and to operate effectively together with formal mechanisms. Correctly identifying the relevant coping strategies for a particular group or region is important for policy makers. This is the issue analysed in Chapter 3. In communities with strong informal risk-sharing arrangements, effective strategies aimed at reducing risk may take different forms compared to those in communities where households are relatively independent and rely on asset, credit or labour markets to smooth consumption.

The above models assume that households act as a single unit and that the burden of coping may fall equally among all family members. Perhaps Sen's conceptualisation of the family as embodying both co-operative and conflicting arrangements and his entitlement approach to famine and starvation (Sen, 1981) provide prove for an analysis of any intra-household inequalities on the impact of contingencies, and therefore the inability of the household not to act as a unit at all times. While it is expected that household members provide some insurance for those who cannot provide for themselves, like the sick, the old and the disabled, recent evidence using data from Ethiopia on the effects of ill-health refutes full insurance at the household level (Dercon and Krishnan, 2000a). Agarwal (1991) draws from empirical material from rural India to examine intra-household inequalities in coping with seasonality and calamity.

The unitary model is unable to discern differences in intra-household responses to shocks. Most of the models in the literature on alternatives to the unitary approach can be classified under the collective household models. The fundamental assumption underlying the collective models is that households consist of a collective of individuals, each of whom is characterised by particular preferences and among whom a collective decision process takes place (Bourguignon and Chiappori, 1992). The unitary model is a class of the broad collective

models and assumes that discriminatory forces exogenous to the household explain gender differences.

A more restrictive class of the collective models comprises those that represent intra-household allocation as the outcome of a cooperative bargaining process (McElroy and Horney, 1981). This approach provides a framework for the analysis of power. The treatment of income is important in the bargaining process, for what matters is who controls the income; this is in contrast to the unitary model where only pooled income matters. Also, unlike in the unitary model, the allocation process is endogenous. Asymmetrical power relations between the members determine allocation. Shocks that have a relative differential effect on the control of income of men and women will have an effect on their relative bargaining power. Consequently, such shocks determine how risk affects the individual's welfare.

Conflict resolution may be important in the decisions about what strategies a household should use to deal with a shock, e.g. which asset to sell or whether a spouse or child should work. This study acknowledges these possible differences within the household and therefore responses to shocks are differentiated for men and women. Specifically, in Chapters 4 and 5 we investigate how male and female labour responds to weather stress and ill-health and whether there is efficient risk sharing of a health shock within a household. Limitations in the data hinder the explicit use of a collective model that would allow an assessment of how the bargaining process distributes the cost of adjustment to a shock within a household.

An examination of the decisions on labour allocation allows us to start examining what happens when the above *ex post* mechanisms for mitigating the adverse consequences of income fluctuations fail. There is ample evidence that *ex post* strategies do not wholly cover losses associated with shocks. Time allocation and labour allocations decisions, for instance, may be a result of past decisions and bargaining, and may entail inter-temporal trade-offs. Over the long run, the effects of adjustment may erode the household's ability to cope with future shocks. Given the lack of access to complete credit and insurance markets, risk-averse individuals/households may invest in *ex ante* means of reducing income fluctuations. This can be achieved by means of the choice of productive activities, which in turn depends on available assets.

It is expected that households facing more uncertainties in their income would hold less risky assets and be involved in activities that reduce the fluctuation of their incomes, but which may imply lower returns. While credit constraints may cause this behaviour, prudence too may

cause farmers to save more when anticipating lower income draws in future (Carroll, 1997; Deaton, 1991). Households' prudence behaviour is examined in Chapter 6. Figure 2.2 provides a schematic representation of the foregoing relationships analysed in this study.

The framework represents a household's portfolio of resources consisting of various assets: human labour power and skills, social networks, physical (livestock, land, equipment) and financial (savings); which may be owned jointly or individually by household members. The household resources are used as inputs in the production activities of the household and/or of an individual member of the household, in order to generate outputs which are then used for consumption or saved for further investment or future consumption. A dynamic interpretation of the model helps explain the role of risk and other sources of stress in household decision-making. At the beginning of each period, the household makes the key economic decisions in production, consumption, savings and investments. Resources are allocated to selected productive activities. At the end of the productive period, what flows back to the household resource base are the resources generated minus the resources consumed, and the whole process is repeated in period two. The next period's resources may be more or less than in the previous period, depending on the risk environments under which the household operates.

Dry weather, for instance, may yield less crop income and, if the household is unable to shift resources to another activity, there would be less resource flow for the next period's activities and probably less consumption in the current period. Also, the household's resource base may itself be affected: for instance, in the case of illness. When human capital is so adversely affected that it affects the capacity to work, even other productive resources may fail to generate output. Illness may lead to loss of working days, higher medical expenditure and probably less savings. If the income generated from current activities is not enough to meet current needs, households may liquidate assets or borrow to cover such expenditure. These responses to a negative outcome are the coping strategies. A household may also take the riskiness of its environment into account when making decisions in the initial period. Such *ex ante* actions may include diversification and self-insurance through holding of liquid assets like cash or other easy to liquidate assets.

Although a risk analysis approach is adopted in this study, the analysis pays attention to the particular context in which the risk-coping strategies take place, as a livelihood approach would do. The risk model used provides the ways in which households responds to stressful events while accommodating the range of assets that influence consumption outcomes.

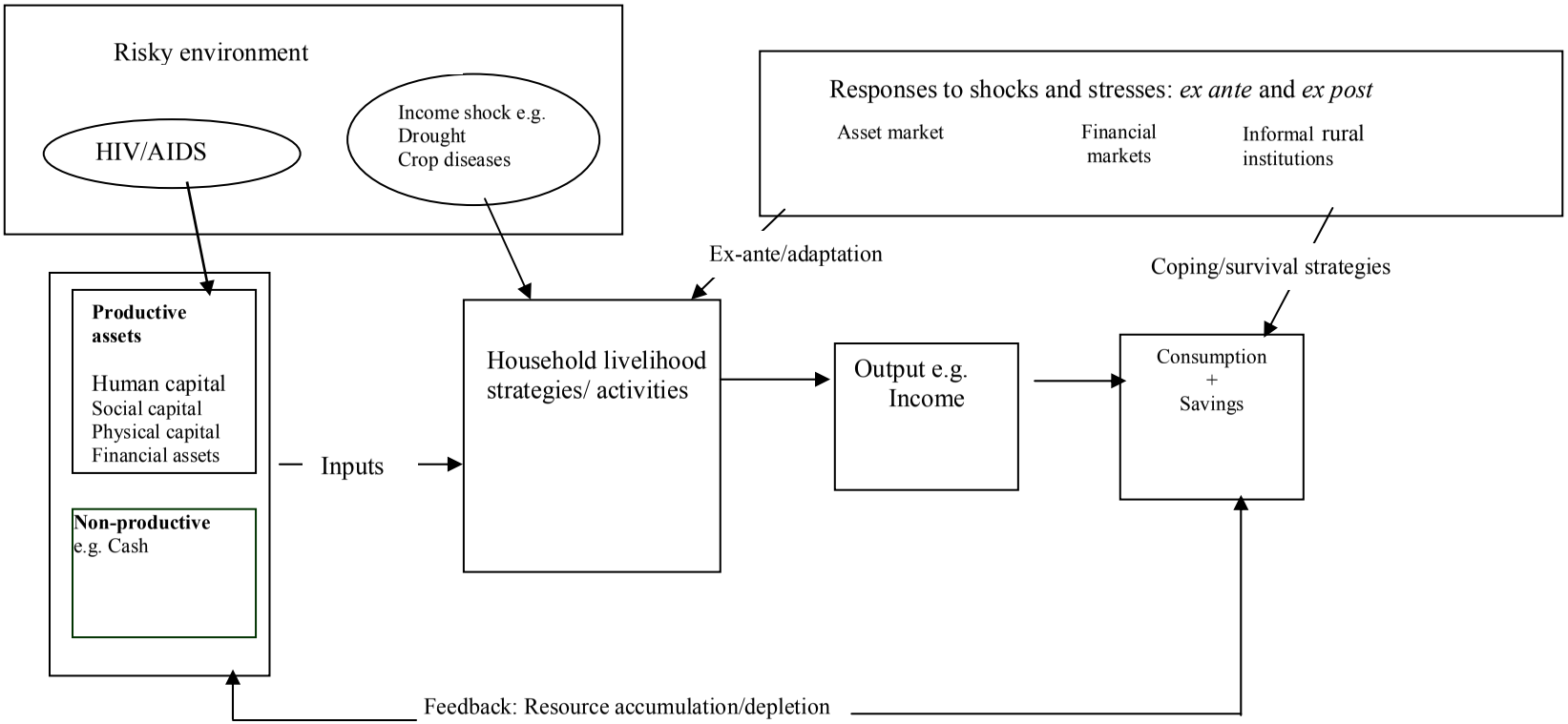

Figure 2.2 Conceptual diagram for household's portfolio interaction with risk

3 Consumption mobility, HIV/AIDS and weather shocks

3.1 Introduction

This chapter explores the risk-coping mechanisms of smallholder farmers beset by various weather and health shocks. The analysis takes a lead from earlier studies that recognize that in spite of the incompleteness or absence of asset, credit, insurance and labour markets in low income economies, households experiencing large individual and aggregate shocks do maintain relatively smooth consumption (Deaton, 1992; Morduch, 1991; Paxson, 1992; Townsend, 1994).

Two threads common in most of the literature are the insurability of the different types of risk and the mechanisms that exist for coping with the consequences of various shocks. Relating to the first thread, there is evidence of ability to insure against individual shocks (Dercon and Krishnan, 2000b; Harrower and Hoddinott, 2005; Townsend, 1995). However, this ability varies from one community to another, as the magnitude of risk pooling may vary. This is especially so for the HIV-related illnesses. Even though illnesses are categorised as idiosyncratic, chronic illnesses related to HIV may be different due to the stigma associated with HIV/AIDS, even when the prevalence rates are moderate. The stigma may diminish the insurance pool, thus affecting the extent to which this shock can be shared.

The second thread running through the literature is the issue of which institutions and markets are available to manage risks and shocks. This latter question has been the focus of more recent research (Fafchamps and Lund, 2003; Harrower and Hoddinott, 2005; Kurosaki, 2001). These authors explore the formal and informal *ex post* coping mechanisms in a variety of set-ups. They examine the effectiveness of transfers or gifts, informal borrowings and asset sales. Informal transfers and borrowings are community institutions which can be regarded as insurance or risk pooling mechanisms, if they lead to realistic expectations of transfers and loans in times of need.

Although theory is unclear as to which of the institutions or mechanisms are most effective in dealing with shocks, and thus providing insurance, effectiveness is likely to depend on completeness of markets. The choice is more relevant where markets are imperfect and incomplete. For instance, where formal insurance markets are missing and gift giving is absent, insurance primarily takes the form of precautionary accumulation and liquidation of

assets (Deaton, 1991; Moll, 2005). The ability to use savings depends in turn on whether agents have accumulated wealth (Deaton, 1992). If there is insufficient wealth, the capacity to deal with shocks depends on ability to borrow (Udry, 1994; Zeldes, 1989). When households are altruistic, insurance against idiosyncratic shocks can take the form of gifts or transfers. Where self-interests are involved, exchange takes the form of self-help mutual arrangements: for example, rotating savings and credit associations. Correctly identifying the relevant coping mechanisms for a particular society is important since it allows interventions to build on existing arrangements. Effective policies aimed at reducing risk or the impact of shocks will be different for communities with strong informal risk-sharing arrangements compared to those where households are relatively independent and rely on labour and/or assets markets to smooth consumption. Accessibility to coping mechanisms may also differ depending on gender. The following analysis examines how household composition determines usage of each mechanism and the relevance to male and female illnesses.

This chapter aims to contribute to the understanding of coping with risk in rural Kenya by seeking to answer the following questions; (1) What coping mechanisms or institutions are in use and (2) How effective are the institutions in enabling households insure against specific stressful events and the role of wealth in usage of the coping mechanisms. But before seeking to answer these questions, we first determine the extent to which household consumption is vulnerable to shocks. A household is defined as vulnerable if it has to reduce its consumption level when hit by a negative income shock. This definition is close to what Chambers (1989; 2006) described as exposure to contingencies and stress and difficulty in coping with them, or what the World Development Report 2001 has described as the likelihood that a shock will result in a decline in well-being (World Bank, 2001).

3.2 Characterising consumption vulnerability

Consumption transition matrices are used to examine the extent to which a household's consumption is vulnerable to shocks. Household or individual welfare indicator fluctuates around its expected value due to shocks such as weather or diseases. When observations of a welfare indicator are available for several periods, movement in the welfare indicator can be observed and compared for different welfare categories. The analysis is done by constructing transition probabilities across quantiles of per capita adult equivalent consumption. Consumption is considered as the sum of food and non-food expenditure. The non-food

expenditure includes medical costs which constitutes on average, 13 percent of total expenditure (Table 3.1). To account for the possibility that the incidence of spending on medical care is heightened in households experiencing a health shock, we examine consumption mobility with and without medical expenditure.

Table 3.1 Per capita medical expenditure for afflicted and non-afflicted households (in KSh. and as proportion of total consumption expenditure (%).

	AIDS-afflicted		Non-afflicted	
	KSh.	%	KSh.	%
Period 1	1049	0.15	279	0.10
Period 2	1079	0.14	185	0.09
Period 3	729	0.11	191	0.07
Average	958	0.13	219	0.09

1 US$ ≈ KSh. 75 in 2004

The theory of full insurance as given in section 2.3 implies the absence of consumption mobility between any two time periods, regardless of the individual income shock. From this it follows that if one observes people moving up and down in the consumption distribution, one can conclude that some people are not insulated against idiosyncratic shocks. In environments with incomplete insurance, individuals may use savings as self-insurance. If people behave according to the permanent income hypothesis (PIH), consumption reacts to permanent income shocks, but is almost insensitive to transitory ones. Households will then move up and down the consumption distribution only in response to permanent shocks. It is therefore expected that AIDS-afflicted households will experience higher mobility than the non-afflicted ones since HIV/AIDS is a persistent shock.

Ideally, examination of welfare mobility requires a long panel: first, to be able to identify any movement, and secondly, to be of much relevance to poverty dynamics. However, the available data is reasonably suited to study short-term movements in income and consumption. The data set contains substantial information on shocks to income, seasonal changes in health status and various income sources; which can to a certain extent compensate for the lack of a long series of longitudinal data. Questions about the vulnerability of consumption to seasonal changes in income and health can easily be addressed and provide indications about the extent to which such seasonal changes can cause short run poverty.

3.2.1 The mobility index

An appropriate index of mobility is built on an approach proposed by Shorrocks (1978); and is defined as:

$$S(P) = \frac{q - trace(P)}{q - 1} \tag{3.1}$$

where P is a $q \times q$ matrix of household consumption, q being the number of quantiles[8] in the distribution. The generic element of P is p_{ij}, which is the probability of moving from quantile i in period t to quantile j in period $t+1$, i.e. $p_{ij} = \frac{n_{ij}}{n_i}$. Where n_{ij} is the number of households that move from quantile i in period t to quantile j in period $t+1$ and $n_i = \sum_i n_{ij}$ is the total number of observations in each row i of P. If the probability of being in quantile i in period t is independent of that of being in quantile j in period $t+1$, the typical entry of the transition matrix is $p_{ij} = q^{-1}$ for all i and j, and $trace(P) = 1$. If the probability of being in quantile i in period t equals that of being in quantile j in period $t+1$, the entry for the transition matrix is $p_{ij} = 1$ for all $i = j$ and zero otherwise. In which case, $trace(P) = q$ and $S(P)=0$. Shorrocks proves that the mobility index satisfies the condition $0 \le S(P) \le 1$. *S(P)* is interpreted as the proportion of households moving across the consumption distribution between t and $t+1$.

To test whether the transition between quantiles are by chance, a random transition χ^2 statistic proposed by Anderson and Goodman (1957) is computed as:

$$\sum_{i=1}^{q}\sum_{j=1}^{q} n_{ij} \frac{(p_{ij} - \tilde{p})^2}{p_{ij}} \sim \chi^2_{q(q-1)} \tag{3.2}$$

The statistic compares estimated and theoretical transition probabilities and is used to test the null hypothesis that the probability of being in quantile i in period t equals that of being in quantile j in period $t+1$, i.e. $p_{ij} = 1$ for all i, j. Where $\tilde{p} = p_{ij}$ under the null hypothesis and is equal to q^{-1}.

[8] Strictly speaking, the statistical meaning of the term quantiles are a set of 'cut points' that divide a sample of data into groups containing equal numbers of observations. We use the term quantile to refer to the number of groups.

3.2.2 Results on household consumption mobility

Table 3.2 shows the estimated consumption mobility for the sample households based on the Shorrock's index. The quartile ($q = 4$) transition matrices are shown in appendix Table 3.1.

Table 3.2 Consumption mobility index for the AIDS-afflicted and non-afflicted households between the three survey periods

	Periods 1–2			Periods 2–3			Periods 1-3		
	Medical cost included								
	Afflicted	Non-afflicted	All households	Afflicted	Non-afflicted	All households	Afflicted	Non-afflicted	All households
Shorrock's Index	0.67	0.68	0.66	0.81	0.61	0.72	0.91	0.73	0.81
Random transition χ^2	219.76***			198.77***			102.36***		
	Medical cost excluded								
Shorrock's Index	0.78	0.64	0.70	0.70	0.71	0.69	0.82	0.73	0.77
Random transition χ^2	298.65***			234.51***			239.28***		

*** Significant 1%

The test of whether the observed transitions are by chance is strongly rejected. Even with this short period of study, substantial mobility is observed. On average, close to three quarters of the households move between consumption quartiles from season to season regardless of whether medical expenditure is included or not. Although mobility for AIDS-afflicted and non-afflicted is almost the same between periods 1 and 2 when medical expenditure is included, overall, AIDS-afflicted households are generally more mobile as would be expected for shocks affecting permanent income. For instance, between the first and the third periods, only about 10 percent of AIDS-afflicted households remained in their first period's quartile compared to 27 percent of the non-afflicted households when medical cost is included. Without medical cost, a higher proportion (18 percent) of AIDS-afflicted is immobile while the proportion of the immobile households among the non-afflicted remains the same.

In Chapter 2, Table 2.3 showed that consumption is relatively stable on average despite large variation in income shown in Table 2.2. The results in this section indicate that this average analysis may mask considerable mobility across consumption distribution between the seasons. A possible explanation for differences in mobility could be differences in the availability and use of *ex post* consumption smoothing measures. Use of various coping

mechanisms may also differ with the source of income variability, as the presence of AIDS illnesses already indicates. The subsequent sections deal with these issues.

3.3 Theoretical aspects for risk sharing and empirical issues

3.3.1 Theoretical aspects

The conceptual framework for examining consumption-smoothing measures is derived from the model of risk sharing (Townsend, 1994) as given in equation (2.5):

$$\frac{u'(c_{st}^{i})}{u'(c_{st}^{j})} = \frac{\omega^{j}}{\omega^{i}} \forall i, j, s, t$$

where c_{st}^{i} and c_{st}^{j} denotes consumption of household i and j in state s in period t. The important information contained in this equation is that, if risk is shared efficiently within a group, ratios of households' marginal utilities should be equalised across states of nature. Thus an individual household's consumption is independent of idiosyncratic shock such as illness or death since it follows the group average. For households with constant absolute risk aversion (CARA) of the form:

$$u(c\theta) = -\frac{1}{\gamma} e^{-\gamma(c-\theta)} \tag{3.3}$$

Townsend (1994) and Mace (1991) demonstrates that equation (2.5) can be written as:

$$c_{st}^{i} = \theta_{st}^{i} - \frac{1}{N}\sum_{j=1}^{N}\theta_{st}^{j} + \frac{1}{N}\sum c_{st}^{j} + \frac{1}{\gamma}\left(\log\omega^{i} - \frac{1}{N}\sum_{j=1}^{N}\log\omega_{st}^{j}\right) \tag{3.4}$$

where θ represents a preference shock meant to capture the need to cover expenditures such as medical bills or funeral expenses; γ is the coefficient of the constant absolute risk aversion. N is the number of households within a group, ω^{i} is the weight given to household i in the Pareto programme (Bardhan and Udry, 1999: pg.96; Mace, 1991; Townsend, 1994). The weight ω^{i} is time invariant and so, an individual household share of aggregate consumption does not vary with time. Equation (3.4) implies that consumption of the household varies positively with aggregate consumption. Household consumption will only fluctuate over time and across states because of fluctuations in aggregate consumption.

One point needs to be noted. The assumption of CARA is used in this chapter only because it yields a consumption function that is amenable to the analysis of transfers, loans and savings. However, the fact that CARA functions neglect the possibility that household's expected wealth matters in responses to risk makes it an undesirable preference structure. Also, the type of preference in the exponential utility function is undesirable in that it yields possibilities of negative consumption which are likely to be unrealistic. A more appropriate preference form is the constant relative risk aversion (CRRA). However, a CRRA formulation would yield a log consumption function of equation (3.4), which is not suitable for this analysis.

To return to equation 3.4: while this equation provides the extent of risk sharing, it fails to provide the mechanisms through which risk is shared and the reasons for lack of full insurance. To be able to identify the mechanisms by which household insure consumption, we follow the method elaborated by Fafchamps and Lund (2003). Consumption is considered at any period t to be derived from the sum of income earned (y_{st}^i), changes in household assets (A_{st}^i), net transfers (g_{st}^i), and net borrowing (b_{st}^i) in state *s* in time *t*. The full income constraint for each household (i) can then be written as:

$$c_{st}^i = y_{st}^i + g_{st}^i + b_{st}^i + A_{st}^i \tag{3.5}$$

Combining equations (3.4) and (3.5), household's consumption is written as:

$$y_{st}^i + g_{st}^i + b_{st}^i + A_{st}^i = \theta_{st} - \frac{1}{N}\sum_{j=1}^{N}\theta_{st}^i + \frac{1}{N}\sum c_{st}^j + \frac{1}{\gamma}\left(\log\omega^i - \frac{1}{N}\sum_{j=1}^{N}\log\varpi_{st}^j\right) \tag{3.6}$$

To allow empirical estimation of equation (3.6), and therefore answer the question of what coping mechanism are in use, the household's income (y_{st}^i) is decomposed into a permanent component and a transitory component. The permanent component together with the welfare weights ω^i are taken as functions of a vector of household characteristics and initial assets (Z). The transitory component depends on observed shocks s_t^i, for household i in time t. The aggregate variables $\frac{1}{N}\sum_{j=1}^{N}\theta_{st}^j$ and $\frac{1}{N}\sum_{j=1}^{N}c_{st}^j$ are unobserved and so the village–time dummies (VD_t) are used as proxy.

With these assumptions and taking y_{st}^i to the right-hand side, equation (3.6) can be written as:

$$g^i_{st} + b^i_{st} + A^i_{st} = \beta_0 + \beta_1 VD_t + \beta_2 Z^i_{st} + \beta_3 s^i_t + \varepsilon^i_t \quad (3.7)$$

where ε_i is a disturbance term. The equation implies that if risk is efficiently shared using loans, remittances and assets within the community, the coefficients β_3 on the vector of idiosyncratic shocks should be positive and significant. A negative coefficient would indicate that the shock serves to reduce such a transaction within a community. However, shocks that are common within a village would have a negative effect on the level of net transfers, net loans and asset changes if these transactions mainly take place within a village or community.

3.3.2 Estimation issues

Even if we find that transfers, loans and assets are together effective as coping mechanisms, that is, a significant β_3 in equation (3.7), we still cannot tell which specific mechanism allow households to deal efficiently with a particular shock. Equation (3.7) combines loans, transfers with asset changes. As such it may be difficult to see the exact direction in which each shock impacts on each coping strategy and therefore, cannot say in which market policy should intervene. Furthermore, the theory behind the use of gifts and loans differs from the use of assets in the risk-coping literature. While the latter is more consistent with the permanent income model and would apply more to environments with reasonably developed asset markets, the former is more consistent with the full insurance model, which applies to communities with tight networks but lacking in formal insurance. Even when particular markets may exist in general, they may fail for some categories of the community. In this regard, in addition to estimating equation (3.7), we also estimate separately the effect of shocks on net transfers, net loans and the two combined; and the net asset changes. We use net livestock transactions as proxy for asset changes. Lastly, the usage of various coping mechanisms differentiated by wealth and HIV/AIDS status is examined using descriptive statistics.

Another estimation concern is that, the data presents a potential problem in that loans and livestock sales are concentrated at zero. Several households did not participate in the credit and livestock market during the survey period. Udry (1994) and Fafchamps and Lund (2003) report similar findings for informal lending in the Nigeria and Philippines respectively. The concentration of observations around zero would be similar to that which occurs with truncation or censoring. Ordinary least squares or fixed effects estimation would thus be biased. The large number of zeros may signal the presence of transaction costs that limit

participation in informal credit markets and constrain exchange of gifts and use of assets for consumption smoothing. The presence of transaction costs can lead to selection for participation in local markets. Selection may also occur for HIV patients in the credit market. While being a HIV patient may increase the likelihood that one needs finance, the higher probability of falling ill would increase the probability of being unable to repay. This would limit the amount borrowed.

To overcome this possible bias, we could first estimate the probability of having negative, positive and zero outcomes on livestock transactions, loans and gifts using a multinomial logit model and follow Lee (1983). Lee extends the classical Heckman's probit-OLS two-step estimate to a multinomial logit-OLS two-step estimate to allow selection correction for polychotomous choices. However, the assumption underlying the multinomial logit is that various outcomes are independent. McFadden (1974) quoted in Verbeek (2004) refers to this property as the independence of irreverent alternatives (IIA). While independence of sales and purchases of livestock can be expected to hold, the assumption may not hold for informal loans and gifts. Informal loans and transfers are likely to be in form of quasi-credit and mutual reciprocity arrangements (Fafchamps and Lund, 2003; Udry, 1994); the probability that one gives is unlikely to be independent on the probability that once receives. Among the models suggested that relax the IIA assumption is the multinomial probit model (Wooldridge, 2001). One of the practical limitations of the multinomial probit model is that it is difficult to estimate when there are more than four choices (Verbeek, 2004; Wooldridge, 2001). Since we have only three choices, the estimation is feasible.

The analysis using the Heckman two-stage model is complicated further by the requirement of an instrument to identify the selection equation; that is, we would need a household characteristic correlated with the use of a coping mechanism, but uncorrelated with the household's ability to smooth consumption. To avert this problem, only the household-level participation in each market is estimated. The analytical model is specified as follows:

$$\Pr(Y_i = j) = f(VD, Z, s), \qquad j = 0,1,2 \tag{3.8}$$

Equation (3.8) is a multinomial probit model estimating the probability that a household is a net recipient of loans/gifts or net seller of livestock *(j=1)*; a net giver of loans/gifts and purchaser of livestock (*j=2*) or does not participate (j=0) in this markets. Y represents net loans, net transfers and net livestock sales; *Z* is a vector of household demographics and wealth level as recorded in period 1; *s* are the identified stressful events which include a

household-specific crop loss index due to insufficient rains, percent rainfall shortfall at planting and weeding/growth periods, days not worked due to illness of either of the spouses, the dummy for AIDS-related illnesses; *VD* is the village-time dummy.

3.4 Results

Table 3.3 below provides the descriptive statistics on transfers, net borrowings and net livestock sales for the survey period. The sample households were net recipients of transfers and loans, and net sellers of livestock over the period. Net transfers and loans are higher for the AIDS-afflicted households than for the non-afflicted ones, while livestock sales are greater for the non-afflicted. The variability in the three sources of income for the two groups also differs. Though all are quite variable, the transfers and loans are less variable for the AIDS-afflicted households, suggesting that they may be important sources of income for this group. The table also shows the means and coefficient of variation for earnings from casual work and net cash savings as they are also mentioned in the proceeding text as possible instruments for managing stress and shocks. The regression results below provide further details on these differences in consumption-smoothing mechanisms.

Table 3.3 Value of transfers, loans and livestock sales in the three survey periods

	All households (N=194)	AIDS-afflicted (N=101)	Non-Afflicted (N=93)
		Mean (CV)[2]	
Transfer[1]	1521	2067	1009
	(3.33)	(2.98)	(3.69)
Net Loan	1672	2361	1026
	(6.30)	(2.98)	(4.70)
Net livestock sale	1700	1547	1845
	(3.33)	(3.69)	(3.06)
Net cash savings	1509	972	5208
	(9.24)	(10.85)	(8.06)
Earnings from	1439	1568	1320
casual work	(1.93)	(1.96)	(1.87)

[1] Values in KSh: 1 US$ ≈ KSh. 75 in 2004
[2] Coefficient of variation in parenthesis

3.4.1 Coping mechanisms and their effectiveness as insurance against shocks

Transfers, loans and livestock sales are related to household stressful events in the previous period. The results are shown in Table 3.4. Columns 1–3 report the results of the separate regressions for net transfers, loans and the two transactions combined, while the fourth column shows estimates for livestock sales. These four estimations allow us to examine which mechanisms are available and for which source of stress. The fifth column presents estimates

for equation (3.7) which show the effect of each stressful event on net household cash flow from loans, transfers and livestock sales. This estimation provides an indication of the effectiveness of available institutions in enabling households deal with health and weather stress.

Table 3.4 Marginal effects of shocks on net transfers, loans and livestock sales (Multinomial Probit estimates)

	Column 1		*Column 2*		*Column 3*	
	Transfers		Loans		Transfer +loans	
	Receive[1]	No transactions	Borrow	No transactions	Receive	No transactions
Household Characteristics						
Education	.002	0.001	.05	-.02	0.01	-0.01
head	(-0.14)	(0.06)	(2.74)***	(2.85)***	(.30)	(-0.72)
Age of head	-.02	-.02	.05	.01	-.01	.01
	(-0.99)	(-1.07)	(0.63)	(-0.62)	(-.43)	(0.65)
Age squared	.001	-0.001	-.001	-.002	0.0001	0.001
	(1.07)	(-1.17)	(-.77)	(0.78)	(.57)	(-0.83)
# male adults	.01	-0.01	-0.04	.05	-0.02	.02
	(.18)	(-0.29)	(-2.53)***	(2.57)***	(-.59)	(.0.51)
# female adults	-.07	0.08	0.08	.01	-.05	-.09
	(1.91)*	(1.66)*	(0.49)	(.52)	(-1.72)*	(1.57)
Dependency	-.08	0.09	-.22	-0.03	-0.06	0.09
ratio	(-1.56)	(1.65)*	(-1.13)	(-1.30)	(-1.21)	(-1.77)*
Log assets	-0.03	0.3	.21	-0.03		
	(-.71)	(0.76)	(1.95)**	(-1.95)**		
Log land	.06	-.05	-0.02	.0.01	.05	-0.04
	(1.16)	(-1.07)	(-0.74)	(0.69)	(0.94)	(-0.91)
Log livestock	-0.01	.01	.0.09	-0.01	-.02	.0.003
	(-.86)	(0.53)	(1.74)*	(-1.77)*	(-1.21)	(0.26)
Shocks						
AIDS dummy	-.08	-0.01	0.32	.-0.05		
	(-0.89)	(-1.76)*	(1.08)	(-1.01)		
AIDS dummy	0.01	-0.01	0.04	-0.01	0.01	-0.01
* ill days	(1.68)*	(-1.76)*	(1.73)*	(-1.87)*	(1.73)*	(-2.17)**
Husband ill	0.01	-0.01	-0.02	.004	.003	-0.002
days	(1.20)	(-0.71)	(-1.36)	(1.54)	(0.48)	(-0.33)
Wife ill days	-0.05	0.01	0.01	-.001	-.01	.02
	(-1.96)**	(2.00)**	(0.05)	(-0.32)	(-2.43)**	(3.03)***
Index for	-.05	.05	-.10	.01	-.06	.05
severity of	(-1.85)*	(1.78)*	(-1.06)	(1.02)	(-2.24)**	(1.95)**
crop loss						
% rainfall	-.18	.17	0.26	-.03	-.27	.21
shortfall	(-1.45)	(1.36)	(0.56)	(-.54)	(-2.01)**	(1.72)*
planting						
% rainfall	-.09	0.14	0.01	-.01	-0.04	0.20
shortfall	(-.39)	(0.61)	(0.15)	(-0.13)	(-0.18)	(0.87)
weeding						
Log likelihood		-242.30		-256.39		-269.38
Wald χ^2		97.22***		117.13***		85.34***
N		346		346		346

Note: z-statistics in parenthesis. *** Significant at 1%, ** significant at 5%,* significant at 10%.
The negative outcome is the base outcome

Table 3.4 continued
Marginal effects of shocks on net transfers, loans and livestock sales

	Column 4		*Column 5*	
	Net Livestock sales		Net Cash flow	
	Sales	No transactions	Positive	No transactions
Household Characteristics				
Education head	0.02	.01	.003	-.006
	(1.22)	(-0.40)	(.23)	(-.52)
Age of head	0.04	-.004		
	(1.51)	(-1.20)		
# male adults	0.01	-.0.002	0.02	-0.001
	(0.41)	(-0.08)	(0.54)	(-0.04)
# female adults	-0.11	0.13	-0.07	0.08
	(-2.02)**	(2.53)***	(-1.65)*	(2.32)**
Dependency ratio			-0.03	-07
			(-0.55)	(-1.64)*
Log assets	-0.07	0.05	-0.3	-0.003
	(-2.28)**	(1.61)*	(-0.99)	(-0.12)
Log land	.06	-0.08	0.05	-0.04
	(1.32)	(-1.75)*	(1.22)	(-1.68)*
Shocks				
HIV/AIDS dummy			-0.05	0.10
			(-0.64)	(1.25)
HIV/AIDS dummy *	0.001	-0.02	0.01	-0.02
ill days	(-0.10)	(-3.02)***	(0.79)	(-2.54)***
Husband ill days	0.01	0.01	.004	0.01
	(1.07)	(2.02)**	(0.62)	(0.90)
Wife ill days	0.01	0.02	.004	0.01
	(0.95)	(-2.50)**	(0.51)	(1.79)*
Index for severity of	-0.03	-.02	-.07	.0.01
crop loss	(-1.40)	(0.85)	(-2.84)***	(0.69)
% rainfall shortfall	-0.18	0.21	-0.19	0.08
planting	(-1.67)*	(1.89)*	(-1.69)*	(0.84)
% rainfallshortfall	-.19	0.14		
weeding	(-0.91)	(0.75)		
Log likelihood	-306.27		-293.54	
Wald χ^2	58.20***		50.25***	
N	346		346	

Note: z-statistics in parenthesis. *** Significant at 1%, ** significant at 5%,* significant at 10%.
The negative outcome is the base outcome

If informal loans and transfers serve to smooth consumption, the coefficient of a household-specific shock should be positive and significant. In addition, if transfer and loan exchanges assist households to share risk at the community level, low precipitation should impact negatively on the probability of using loans and transfers. This is because the ability of the community to pool risk is also weakened by a common shock. A positive significant effect or an insignificant one would suggest that loans and transfer exchanges, and therefore risk pooling, take place predominantly outside the community. We may also find an insignificant effect if the specific mechanism is not used for coping with a particular shock.

Household-specific sources of stress include crop loss due to insufficient rainfall, days not worked due to illness by either of the spouses, and the presence of HIV/AIDS represented by

the HIV/AIDS dummy[9]. To differentiate the effect of AIDS related illnesses from that of other illnesses, the HIV/AIDS dummy is interacted with lost workdays due to illness for both partners. Conditioning household characteristics include number of adult males, adult females and the dependency ratio; value of assets and owned land.

From Table 3.4, it is observed that households may resort to different mechanisms when faced with different types of shocks. Crop loss due to insufficient rainfall reduces receipts of informal transfers. Loans are unaffected by this type of an idiosyncratic shock although they are also likely to decline as the coefficient is negative. Crop loss significantly reduces the sum cash flow from transfers and loans (column 3). Consistent with the negative effect of crop loss on the sum of transfers and loans are the negative signs of the rainfall variables in column 3. Low precipitation at planting time significantly reduces the sum of net transfers and loans. This may suggest substantial localised transactions of transfers and loans within the community. More evidence that the community could be important for risk pooling is shown by the effects of low rainfall on livestock sales. Examination of column 4 indicates that, even for those with assets, the community may matter. Albeit significant at 10 percent, low precipitation at planting time negatively impacts on the probability that households will sell livestock. The overall effect of low rainfall at planting time on total cash flow is a reduction of 0.19 percent for a percentage increase in rainfall deviation from its long-term average (column 5).

If low precipitation at planting time means a reduction in cash flow from transfers, loans and livestock sales, households must then find other mechanisms for dealing with rain failure. An alternative mechanism cited in the literature is the use of labour markets (e.g. Sen, 1981). Increasing labour market participation has been shown to be a coping strategy in certain circumstances. Sen (1981) notes that when households experience crop failure, they may migrate to nearby cities in search of work.

Appendix Table 3.2 column 1 shows probit estimates for earnings from casual work. Low rainfall reduces the probability that household will resort to casual work and the reduction is significant at plant growth stage. The reduction in the probability that people will work off-farm in response to a rainfall shock is expected, if off-farm work is largely agricultural. The implication of the reduction in gift transactions and the use of casual labour is that households

[9] Other shocks tested but found not to be statistically significant include low input and output prices, too much rainfall, crop and livestock loss from diseases and pests.

may be unable to insure against common shocks. Chapter 4 provides more details on labour adjustments to household shocks.

Turning to the proxies for health shocks, the results indicate that household responses to illness of the male spouse may differ somewhat from the response to illness of the female counterpart. While female illness significantly reduces the probability that households will receive transfers, male illness has a positive but insignificant effect. The overall effect of female illness on net inflow of loans and transfers is a significant reduction and an increase in the probability that no such transactions occur. The effect of male illness is insignificant (column 3). If gift and loan exchanges take place within community networks, a possible implication of the negative significant effect is that, community resources may be unavailable for dealing with female head illnesses. This may happen if gift-giving operates through the female spouse and reciprocity is anticipated. An ill female head may not guarantee such reciprocity.

Not surprisingly, household response towards illness while AIDS-afflicted may be different from household behaviour in the case of other illnesses. AIDS-afflicted households which also have an ill spouse are likely to receive more transfers and incur debts. Unlike much of the work in the existing literature (e.g. Mutangandura *et al.*, 1999), we find that being afflicted with AIDS has no impact on the probability that livestock will be sold. The effect of both the AIDS dummy and the dummy interacted with ill days are not significant suggesting that households may not resort to livestock sales to deal with AIDS-related illness. In fact, the effect of AIDS dummy interacted with ill days significantly reduces the likelihood of any livestock transactions. From column 5, we find that the net effect of illnesses and the presence of HIV/AIDS is a significant reduction on all transactions. The indication is that neither the community nor individual household's mechanisms may be able to insure against HIV related illnesses. In this manner, HIV/AIDS behaves like a covariant rainfall shock.

While this result is not unexpected, the fact that formal insurance mechanisms are lacking and that public health policy in Kenya is guided by a cost sharing strategy, may imply that many health problems may go unattended. Indeed, a recent nationwide survey on health expenditure and utilisation show more than a third of the poorer households in Kenya seek no treatment (Kenya, 2005a). From columns 1 and 2, we note that the effect of the HIV dummy interacted with ill days is larger on loans (0.04) than transfers (0.01). This may suggest that households turn to their own resources to deal with AIDS illnesses. Recourse to the household's own

resources may imply that illnesses of the poor may not be treated as the national survey cited above shows. While the results shown in Appendix Table 3.2 indicate that AIDS-affliction is associated with a significant increase in the probability that people will resort to casual work, households that are poor in the labour resource will then be unable to take advantage of the casual labour market. Illness is likely to reduce the effective labour resource. Consequently, days of illness interacted with the HIV dummy, although having an insignificant coefficient, is negatively associated with the likelihood that households will resort to casual work.

Various studies have reached different conclusions on how AIDS-affected households cope with illnesses. Oni *et al.* (2002) conclude that affected households draw down on assets and borrow more than the non-affected. Tsafack and Maitra (2004) show no evidence that households in rural Malawi borrow more when faced with demographic shocks. If the purpose of loans and transfers is to increase liquidity for consumption, we would expect afflicted households to have more cash savings. We explore this possibility with the caveat that cash savings may not be measured accurately.

The results are also shown in the appendix Table 3.2, column 2. Only illness of the female spouse has a significant (*p=1.88*) and positive effect on savings. Being AIDS-afflicted has a negative sign but the HIV dummy interacted with ill days is positive though not significant. Theoretically, positive effect of being afflicted and ill on cash savings would be expected if there is an increased need for precautionary balances to meet inevitable medical expenditure. Holding of precautionary balances is expected to differ by wealth. The effect of health uncertainty on precautionary savings is examined in detail in Chapter 6. In the following subsection, we only provide an exploration of possible differences in household coping mechanisms by wealth and HIV/AIDS status.

3.4.2 Coping mechanisms differentiated by wealth and HIV/AIDS status

As mentioned above, precautionary behaviour is expected to differ with wealth, with the poor being more risk averse. We would therefore expect poorer afflicted households to hold proportionately higher cash balances. We differentiate poor and non-poor households by livestock holding, because of the importance of livestock as a store of wealth in many rural communities (Moll, 2005). A household is considered poor if it has less than the median value

for the sample. This is calculated to be about KSh. 10,000, which turns out to be equivalent to the local price of a heifer at the time of the survey.

Using t-statistic, we find that the poor among the AIDS-afflicted have significantly more cash balances than the non-afflicted poor (Table 3.5). As noted by Deaton (1992), wealth is important in aiding households and individuals to deal with shocks. The fact that wealth may matter for the sample households raises doubt about the assumption of CARA preferences. To the extent that we use pooled regressions rather than fixed effects that would sweep away time-invariant characteristics, errors generated by this assumption remain. Table 3.5 provides further tests for differences in the use of various other mechanisms by wealth group for AIDS-afflicted and non-afflicted households. Various studies have documented that even when informal insurance mechanisms work, they may lead to greater divisions between the rich and the poor (Fafchamps, 1992).

Comparison of the proportion of livestock sales between the two groups shows that the non-afflicted among the non-poor sell more livestock than the AIDS-afflicted. This could be a signal that while those who have accumulated livestock trade in livestock, the sales may not be so much for dealing with negative shocks due to illnesses. During the survey period, (which also included one year of retrospective data) only about 28 percent of the households who recorded sales had sold to raise money for medical or funeral purposes. By contrast, about 48 percent sold to purchase other household assets or farm inputs and another 34 percent sold to raise money for education. It seems likely that more sales could be for meeting investment needs. This is in line with information from focus group discussions in which key informants observed that people no longer sold assets to deal with illnesses associated with HIV/AIDS. This is because given the certainty of death the sick tend to focus on their children's future. In-depth discussions with two HIV patients attest to this view. This may also explain the insignificant effect on livestock sales.

On loan usage, the afflicted asset-poor have statistically significantly higher debts than the non-afflicted. No such difference exists for the non-poor. Lundberg *et al.* (2000) also found debts to be higher for the poorer households experiencing an adult death in Kagera, Tanzania. Earnings from casual labour also show a difference by wealth. As would be expected, many more afflicted poor seek casual work than the better off. But while the non-poor afflicted can earn more from labour markets, the poor afflicted earn significantly less than poor non-afflicted. Their lower earnings were more visible in the second and third rounds of the survey,

with t-ratios of 1.43 and 1.45 respectively, both with a p-value of 0.08. Round 2 covered the main rains, which had a poor harvest. As expected, two relatively poor harvests combined with HIV/AIDS can have substantial implications for the welfare of people living at subsistence level. The poorer among the afflicted can easily get into a health poverty trap, such that even when seasons improve (round 3 was a better season), they are not able to earn much from the improved markets. Chapter 5 explores the possibility that even very short-term seasonal changes in health status can be important for productivity.

Table 3.5 Coping mechanisms adopted by the AIDS-afflicted and the non-afflicted households, sorted by asset poverty for the survey period

	Not asset-poor			Asset-poor		
	Mean (s.e)		t-value (p-value)	Mean (s.e)		t-value (p-value) [1]
	Non-afflicted	Afflicted		Non-afflicted	Afflicted	
Cash savings (KSh)	11293.70 (7063.90)	1504.25 (1313.80)	-1.38 (0.91)	-35.75 (239)	525.35 (175.60)	1.83** (0.03)
Livestock sale as a proportion of total livestock value	0.10 (0.02)	0.05 (0.02)	-1.70* (0.05)	0.91 (0.30)	0.93 (0.272)	0.04 (0.48)
Transfers (KSh)	1097.40 (377.70)	2740.0 (654.60)	2.16** (0.02)	943.50 (256.51)	1717.60 (271.00)	2.00* (0.05)
Loans (KSh)	3661.90 (1953.74)	3627.60 (1606.35)	-0.01 (0.49)	305.60 (146.70)	914.20 (482.95)	1.21* (0.10)
Earnings from casual work (KSh)	543.70 (13.64)	1130.73 (213.30)	2.3*** (0.01)	2519.40 (313.90)	1548.80 (217.75)	-2.54 (0.99)

[1]The null hypothesis is that the afflicted have larger cash flows than the non-afflicted

3.5 Conclusions

The chapter began by examining short-term consumption mobility for the sample households using transition matrices. The results reveal substantial seasonal mobility. Consumption mobility for AIDS-afflicted households is observed to be higher as the permanent income hypothesis would predict for households experiencing a permanent shock. Differences in consumption mobility can partly be explained by access to consumption smoothing measures. Regression analysis was used to examine the use and effectiveness of various coping mechanisms. The role of transfers, loans and livestock sales was investigated. An emphasis was laid on AIDS-related illnesses and rain failure given their importance to household vulnerability. The study finds that informal transfers play an important role in consumption smoothing. A negative effect of low rainfall at planting time on the sum of transfers and loans suggests that these transactions are likely to occur through localised exchanges. While loans seem to play a minimal role, they are important for AIDS-afflicted households. The possibility that afflicted households incur more debts has implications for poverty if resources are diverted from other investments to deal with AIDS-related illnesses. The overall effect of affliction with AIDS on transfers, loans and livestock transactions is negative. This may point to the inadequacy of the examined mechanisms in assisting households to cope with ill-health associated with HIV/AIDS.

The findings also suggest that households may result to different coping mechanisms depending on whose health is at risk: the male or female spouse. Female spouse illness significantly reduces the probability that households receive informal transfers, while male spouse illness has no effect. Contrary to findings by Hoddinott and Kinsey (2000) who show livestock to protect women's health against the effects of drought in rural Zimbabwe, in this population, livestock sales are not a recourse. What may assist households to deal with female illness are reserves of cash savings. Both cash savings and livestock wealth are, however, forms of *ex ante* private mechanisms.

Descriptive statistics give indications that the use made of various mechanisms also differ with wealth levels. The AIDS-afflicted among the asset-poor have significantly more debts, but no difference exists for transfers by wealth. The opposite is the case for transfers: with more transfers for the afflicted who are better off, but no difference in loans. This suggests that gift giving may take the form of self-help mutual arrangements with a higher probability

of self-interest dominating over altruism. As such, while an implicit payment is implied for the better-off whose assets guarantee some form of future reciprocity, an explicit payment is demanded for the AIDS-afflicted with few assets. If this is so, such a finding presents a gap for public sector intervention. Since community resources are less accessible or are more expensive for the poorer AIDS-afflicted households, the limited formal assistance should target this group while the better-off can be targets for example of group lending schemes. Being an environment where self-interest motives may dominate altruism, it makes sense to promote group financial schemes. The finding that generalised shocks like rain failure tends to impact negatively on the sum of transfers and loans point to existence of local networks which formal financial institutions can exploit.

The predominance of self-interest in giving is similar to what Plateau (1997) describes as balanced reciprocity. Balanced reciprocity is applied to transactions that involve calculating the counter-obligation and is suggestive of the existence of a quasi-credit model for a population. Such a model accommodates constraints that would limit the enforceability of voluntary *ex post* risk sharing (Coate and Ravallion, 1993; Fafchamps, 1992; Ligon *et al.*, 2000; Thomas and Worrall, 2002). This is also against what the Arrow Debreu model would hypothesise or what the Townsend (1994) risk-sharing model would predict if informal lending is an efficient mix of perfectly enforceable credit and insurance contracts. Evidence from elsewhere shows that giving that considers the counter-obligation is more common than simple transfers (Fafchamps and Lund, 2003; Platteau, 1991). This is because, an insurance arrangement based on simple transfers lacks incentive and would easily break down (Platteau, 1997), unless giving is accompanied by accumulation of social status (Scott, 1976: pg. 41). Other empirical explorations that also uncover self-interest motives dominating altruism in giving include Cox (1987), Cox *et al.* (1998) and Dekker (2004). Where self-interest motives dominate altruism, Becker (1974) observes that, public transfers are unlikely to displace community mechanisms and would therefore have a positive impact.

4 Labour response to health and weather variability under credit constraints

4.1 Introduction

For people lacking in assets or having limited access to credit, selling their labour may be their only viable choice for making a living and dealing with negative effects of shocks. Examination of labour supply adjustments of households is also of importance to policy makers. This is because the extent to which benefits of rural investments strategies are transmitted to poor households crucially depend on how farm households adjust their members' labour (Singh *et al.*, 1986). This chapter examines the labour response of farm households to adverse shocks in their income under credit constraints. It explores whether the effects of rainfall shocks and ill-health, especially due to HIV/AIDS are similar for men and women within a household. Both *ex ante* and *ex post* responses are addressed.

Most of the existing literature examining labour adjustment within families has concentrated on the effects on the wife's time allocation following the husband's unemployment (Heckman and MaCurdy, 1980; Lundberg, 1985; Mincer, 1962). In the labour literature, the increase in female labour supply as a response to fluctuations in household income (mainly due to unemployment of the husband who is considered the primary earner) is referred to as 'the added-worker effect' (AWE). However, this smoothing role of a secondary earner within the household need not be confined to wives or to unemployment of the male spouse. In the rural area where this study took place, many ills afflict the households and most families live with their grown-up children and other members of their family, all of whose labour can be called upon in times of need.

A few studies have extended the analysis to income shocks other than unemployment. Coile (2003) addresses health shocks of couples at retirement age in a developed country where retirement benefit schemes exist and credit constraints are less likely to bind. Kochar (1999) estimates adult male and female hours of work responses to idiosyncratic crop shocks without accounting for liquidity constraints. Malapit *et al.* (2005) extend Kochar's analysis of the role of secondary earners to other members of the family by distinguishing labour supply by gender, while taking into consideration the role of a credit constraint. Like Malapit *et al.* (2005), this chapter analyses labour response to shocks in an environment of imperfect credit market, and where unemployment benefits and health insurance are non-existent. In the next

two sub-sections, a brief literature review is presented on family labour supply and the AWE. The theoretical framework for farm household labour supply and the empirical issues are presented in section 4.3. Section 4.4 provides the results and 4.5 concludes. Only data from the second round survey is used since it contained disaggregated information on labour supply by sex and age.

4.2 Literature review

4.2.1 Some considerations of labour supply decisions of families

Most of the studies on labour supply in agricultural households use a one-person model. As a household normally constitutes of more than one person, this approach may fail to capture the aspect of interdependence in the labour supply decisions. The extension of the analysis on labour supply to a multi-person household has some theoretical implications and is briefly discussed before proceeding to the main analysis of household labour supply. The analysis needs to address the question of how to model the way economic decisions of household members are made. According to the typology of Lundberg (1988), there are three groups of models: "traditional family" models, joint utility models, and bargaining models.

The traditional model treats the labour decision of one person (usually the husband) separately from the attributes and decisions of other members. The decisions of one person are treated as exogenous to the decisions of other members. This approach has typically been chosen in empirical studies on female labour decisions. On the other hand, the joint utility model assumes a utility function which is to be maximised by a household. The joint model begins with a two-person household, consisting of a husband and a wife, making joint decisions about consumption and time allocation. Samuelson (1956) shows that if the spouses agree to maximise a family social welfare function, subject to a pooled family budget constraint, then the family's expenditure pattern would look like the expenditure pattern of a utility-maximising individual. This conveniently implies that family demand will possess all the standard properties of individual demand functions and depend only on prices and total family income, and not on the distribution of this income.

The aggregation of income and the restrictions imposed by the model has been criticised on both conceptual and practical grounds. It departs from the economist's preferred methodological individualism and can be justified only under restrictive assumptions e.g. the

existence of consensus on the welfare of the members (Samuelson, 1956) and the existence of a member who cares about the welfare of the other members and, therefore, transfers general purchasing power to other members. The implied symmetry of cross wage effects on the compensated labour supply of each household member has been rejected in a number of studies (Kooreman and Kapteyn, 1986; Udry, 1996). Despite these limitations and due to the advantage that theoretical results from one-person utility maximisation model functions can be readily applied, the joint utility approach serves as the main theoretical framework for empirical studies on off-farm labour supply in multiple-person agricultural households.

Several alternatives have been suggested which include non-cooperative bargaining models (Lundberg and Pollak, 1994), cooperative bargaining models (Lundberg and Pollak, 1993; MacElroy and Horney, 1981; Manser and Brown, 1980), and a "collective" approach that assumes that couples jointly choose an efficient outcome on the utility-possibilities frontier (Chiappori, 1988, 1992). What these approaches have in common is that they begin by assigning preferences to individual family members rather than a "consensus" utility function to the family as a whole. These models have a theoretical appeal especially if it is believed that the individual and not the household is the basic decision making unit. However, they also have their problems. On the bargaining model, firstly, there seems to be no standard way to formalise the structure of the "game" of intra-household resource allocation. The prediction from a theoretical game model is influenced by the structure of the game. For example, MacElroy and Horney's (1981) "utility gain production function" which is assumed to be maximised by the married couple, can be subject to empirical difficulties due to the need to define the threat point. Secondly, to operationalise the bargaining model, we must specify the empirical counterpart of "bargaining power" i.e. we must determine the variables that determine the threat point.

Four factors have been considered in the literature as determinants of bargaining power: exogenous non-labour income, wage rates, household production and distributional factors such as the divorce laws, and the sex ratio. When well identified and under egoistic or caring preferences, these variables have been used to explain intra-household decision process over time and consumption (Chiappori, 1992; Chiappori *et al.*, 2002). However, collective models have not been generalised to the case where at least one member is not working (i.e. corner solution) (Chiappori, 1992; Fortin and Lacroix, 1997). The problem is that the reservation wage determining whether an individual will work or not within the bargaining framework may not be unique as in the unitary model. The outcome of the intra-household bargaining

e.g. the amount of non-labour income an individual receives following intra-household transfers, also depend on his/her wage through the sharing rule. Hence there can be as many wage rates for which the individual is indifferent between working and not working. Furthermore, the sharing rule is likely to be affected by the fact that one member is absent from the market. For this reason, the subsequent analysis adopts the unitary model because several households record zero off-farm and on-farm labour time for one of the spouses. However, an attempt is made to assess the appropriateness of the unitary model by testing one of the restrictions it imposes that the compensated own wage effects are non-negative. Data limitations preclude testing the restriction on equality of compensated cross-wage effects.

4.2.2 Literature on the added-worker effect

There is a lack of consensus in the literature on the "added-worker effect" (AWE) as empirical results are mixed. Several factors have been put forward in rejection of AWE and other factors are in its support. Arguments put forward in its support include: the substitutability of leisure of husbands and wives in home production (Lundberg, 1985; Maloney, 1987); an income effect (Maloney, 1987; Pietro-Rodriguez and Rodriguez-Gutierrez, 2000); and liquidity constraints (Garcia-Escribano, 2004; Mincer, 1962). The factors against the AWE include: the wife's employment may also be affected by the same factors causing the husband's unemployment or the discouraged worker effect (Lundberg, 1985; Maloney, 1987; Pietro-Rodriguez and Rodriguez-Gutierrez, 2000); complementarities of leisure between spouses and care-giving needs (Coile, 2003; Maloney, 1991); assortative matching in tastes for work between spouses (Lundberg, 1985; Maloney, 1991); crowding-out effects from social insurance programmes (Cullen and Gruber, 2000; Finegan and Margo, 1994) and the existence of perfect credit markets and an environment of perfect certainty (Heckman and MaCurdy, 1980).

The presence of liquidity constraint is one of the main arguments put forward in support of the existence of the AWE (Cullen and Gruber, 2000; Finegan and Margo, 1994; Garcia-Escribano, 2004; Lundberg, 1985). The arguments for AWE in these papers build on Mincer (1962) who showed that cyclical and random variations in income and employment of other family members, particularly of the head, are likely to induce temporal variations in the allocation of time between home, market and leisure. This effect is likely to be stronger when the family has few consumption-smoothing alternatives: "…if assets are low or not liquid, and access to the capital market costly or non-existent, it might be preferable to make the

adjustment to a drop in family income on the money income side rather than on the money expenditure side" (Mincer, 1962: pg.75).

Despite the importance of the roles of access to credit and income shocks in influencing a household's demand for and ability to smooth resources over time, the link between labour supply, shocks and credit constraint remains largely empirically unexplored. The few studies that have addressed the link between household labour response to income shocks and access to credit include Coile (2003) and Garcia-Escribano (2004) .

An examination of labour response to income shocks also has implications for the permanent income hypothesis (PIH). According to the literature on consumption and savings, shocks can be distinguished into transitory and permanent. The effect of these shocks on time allocation and borrowing are hypothesised to be different. The PIH suggests that temporary shocks will be smoothed through credit and savings and only permanent shocks should affect labour decisions. Contrary to the PIH, the AWE hypothesises that temporary negative shortfalls in income will result in a contemporaneous increase in days worked off-farm, all things equal. This research attempts to bridge the two strands of the literature on PIH and AWE by controlling for credit constraint in the analysis. In her work on married couples, Lundberg (1985) notes that the AWE is not expected to be large unless in the presence of credit constraints. As such, contemporaneous movements in the labour supply of a married couple will reflect only cross-substitution effects, which are expected to be small. For a credit-constrained household, the income effect will reinforce the substitution effect in driving the spousal labour response. A challenge for this study is how to identify credit constrained households. This issue is discussed in sub-section 4.3.3.

Shocks that are transient are represented by a household specific crop loss arising from rain failure, percent rainfall shortfall from a long term mean at planting and weeding (growth) stage, and lost work days due to illness. Persistent shocks are represented by rainfall variability and affliction with HIV/AIDS. If the credit constraint binds, both types of shock are expected to result in positive labour supply adjustments.

4.3 Modelling farm household labour supply

Prior to the work of Jacoby (1993), most studies on labour supply of farm households relied on empirical advantages offered by separability between production and consumption (Singh *et al.*, 1986). However, this approach may sacrifice considerable information contained in the observations on households not selling labour to the market. Jacoby's innovation was to derive an approach that allows estimation of labour supply of farm household members under the assumption of non-separability. The latter can arise for several reasons: binding time constraint (Benjamin, 1992), family and hired labour may be imperfect substitutes (Deolalikar and Vijverberg, 1987), and preferences towards working on or off the family farm (Lopez, 1986). Under any of the above circumstances, consumption and production decisions must be treated as nonseparable. In these cases, it is the "shadow wage" rather than the market wage that determines the labour supply and demand decisions of the household.

The model presented below is a version of Jacoby (1993) with non-separability mainly arising from binding constraints in off-farm employment or non-substitutability of family and hired labour inputs in the production process. We assume that each household has an endowment of time T. The household may allocate some of its member's time endowment to leisure l or to own farm work (on-farm) L^f to produce output Q in each planning period t corresponding to an agricultural season. The farm's quasi profit function may be represented as:

$$\pi = pQ(L^h, L^f; A) - w_h L^h \qquad (4.1)$$

where p is price of farm output Q, A represents fixed inputs, L^h is hired labour and w_h is wages for hired labour. Equation (4.1) disregards purchased inputs for the sake of clarity of the theoretical model. Hired workers may only be used for specific types of job and cannot realistically be used for all types of farm work. In this case then, demand for hired labour is responsive to wage rates, but the same wage rate does not so much regulate the family farm labour supply. In addition to farm production, the household can also allocate some of its members' time to off-farm employment using an amount of labour L^w at a wage rate w_w. However, labour supplied to off-farm work may be restricted by availability of off-farm employment so that:

$$L^w \leq \overline{L}^w \qquad (4.2)$$

In each planning period consumption C, is given by:

$$C = pQ(L^h, L^f; A) - w_h L^h + w_w L^w + B \quad (4.3)$$

where B is the non-labour income or other external funding that can be used for current expenditure (e.g. transfers, reciprocal loans). Noticing that $L^w = T - l - L^f$, equation (4.3) can also be written as:

$$C = pQ(L^h, L^f; A) - w_h L^h + w_w (T - L^f - l) + B$$

or

$$C + w_w l = (pQ(L^h, L^f; A) - w_h L^h - w_w L^f) + w_w T + B = \text{Y} \quad (4.4)$$

where Y is full-augmented income which is the sum of the farm profit and the full income and which should equal the value of consumption and leisure for all household members. We will come back to this notation in section 4.3.1.

Turning to the household maximisation problem, the household is assumed to maximise:

$$\begin{aligned} &\max U(C, \ell; Z) \\ &s.t. \\ &C = pQ(L^h, L^f; A) - w_h L^h + w_w L^w + B \quad (4.5) \\ &L^f + L^w + \ell = T \\ &L^w \le \overline{L^w} \end{aligned}$$

The Lagrange equation is:

$$\begin{aligned} \max L = U(C, \ell; Z) &+ \lambda(T - L^f - L^w - \ell) - \gamma(C - pQ(L^h, L^f; A) \\ &+ w_h L^h - w_w L^w - B) - \delta(L^w - \overline{L^w}) \end{aligned} \quad (4.6)$$

where Z is a vector of individual and household characteristics, λ is the Lagrange multiplier associated with the time constraint, γ is the Lagrange multiplier associated with the income constraint and δ is the Lagrange multiplier associated with the constraint for off-farm work. The First-order-conditions (FOC):

With respect to C

(1) $U_1 - \gamma = 0$

With respect to leisure

(2) $U_2 - \lambda = 0$

With respect to on-farm family labour

(3) $-\lambda + \gamma p Q_2 = 0$

With respect to off-farm labour

(4) $-\lambda + \gamma w_w - \delta = 0$ if the restriction is binding

With respect to hired labour

(5) $\gamma(pQ_1 - w_h) = 0$

In addition the equalities should hold (if the inequality is binding).

The first condition sets the marginal utility of extra income equal to γ, and the second condition sets the marginal utility of time equal to λ. The third condition shows that the marginal product of family labour pQ_2 should equal the ratio of U_2 and U_1, or the money value of extra time. The fourth condition shows that the value of extra off-farm work (w_w) equals the same ratio U_2/U_1 with an additional term δ/γ. This extra term reflects the higher value of extra work over and above the extra wage. The 'shadow price'(w^*) of labour can be inferred from this condition. If ample off-farm labour is demanded, w^* is equal to the prevailing wage rates (w_w). In contrast, if employment is restricted, w^* will be, in general, greater than w_w since $\delta \geq 0$. Demand for hired labour follows from the usual equality of wage and marginal labour product (condition 5).

Shocks to the household can be represented by shocks in income or shocks in time availability. The first type is similar to shocks in *B*, while the second type is similar to shocks in *T*. An increase in *B* (or any other positive shock to income) typically reduces the corresponding shadow price of the constraint γ, and thus U_1, with the corresponding increase in consumption and likely lower values for δ (extra income from off-farm work is less needed) and λ (somewhat more leisure is taken). If more leisure is taken with the same off-farm work, then on-farm work is reduced. This increases Q_2 and is likely to increase Q_1 too, so that more labour is hired to restore the equality of Q_1 and w_h. A decrease in *B* or an increase in liquidity constraint would have the opposite effect. Households would supply more labour. The presence of binding liquidity constraints narrows the set of coping strategies available to the household. Consequently, the importance of labour supply adjustments as a coping strategy increases. It is therefore important to incorporate the effect of a credit constraint in our analysis of labour supply.

A shock in *T*, for example a sudden drop in available labour capacity in the household, leads to a higher shadow price of this constraint, λ, which is met by both less leisure and reduced labour supply. This leads, as above, to increased demand for hired labour. On the consumption side, the reduced leisure calls for reduction of other consumption too, so that U_1 and γ are likely to rise. The income restriction becomes more stringent therefore.

Now consider a further distinction of labour into male and female labour. The distinction enters into the utility function in which both female and male leisure must be distinguished. We keep consumption still at the household level. The model now has all the labour variables twice, both for male and for female members of the household. The Lagrange formulation also has two parameters for the two labour constraints and, if applicable, two inequality constraints on off-farm work. The production function includes male and female labour on the farm, next to hired labour. The FOCs (1) and (5) will still apply but the conditions (2)-(4) will be duplicated and feature male and female versions of the conditions.

Suppose that male and female labour are complete substitutes on the farm. In this case the marginal products of their labour are the same. First-order condition (3) then shows that the shadow prices of their time constraints λ_{female} and λ_{male}, for example, should also be the same (note that the parameter γ applies to the whole household). Even when the off-farm availability of labour for men and women differs, or their wages off-farm are different, as long as off-farm labour is restricted, this will only influence the total supply of labour and the share of female and male labour in the family farm work, while maintaining the equality of two shadow prices.

If we would have a negative shock in time availability of women, for example, we should see the shadow price of this constraint rise. Less leisure is taken by women, and less labour supplied (unless income considerations dominate this effect). The equality of marginal products dictates a rise in the shadow price of men's time too. This partly compensates the shortage of female time. In the new equilibrium all shadow prices rise, including that of the off-farm work constraint and income. Demand for hired labour is likely to rise because of the rise in the marginal product induced by the reduction of total labour input by the household.

A further refinement in the model can be made by making the off-farm employment not merely rationed in a quantitative sense, as we did in the model. More realistically, the off-farm jobs are available during some part of the season. The higher the wage that is offered, the more people will be interested in taking up this employment. This makes supply of labour off-farm a function of the wage, but the quantitative restriction still holds in the sense that during other parts of the season such work is unavailable. Some time will still be devoted to on-farm work, and there is no equality between the on-farm marginal product and the off-farm work, even though such equality may exist during the short period in which off-farm work is available.

The appropriate model distinguishes the two periods. If we indicate the two periods by the subscripts *f* and *m*, and we suppose that off-farm work is available only in period *f*, we have:

$$
\begin{aligned}
&\max U(C, \ell_f, \ell_m; Z) \\
&s.t. \\
&C = pQ(L^h, L_f^f, L_m^f; A) - w_h L^h + w_w L_f^w + B \\
&L_f^f + L_f^w + \ell_f = T_f \\
&L_m^f + \ell_m = T_m \\
&L_f^w \le \overline{L^w}
\end{aligned}
\qquad (4.7)
$$

If off-farm work is not restricted, we should have equality of the marginal product of on-farm work and that of off-farm work during period *f*, but not during the other period. If the labour efforts of both periods are substitutes for one another in the production function, we should see that higher off-farm wage rates in one period, which increases the price of labour in that period, leads to more use of labour in the other period. Depending on the substitution elasticity between the two labour inputs, total on-farm labour may respond negatively or positively to market wage changes in one period.

In the empirical implementation, we first estimate the production function. In the specification of the production function, we have used various measures of labour input. While in the theoretical model, hired labour and male and female labour, or labour in various periods, are imperfect substitutes, such distinction was not possible in the estimation of the production function. We tested various distinctions, and arrived at a specification that assumes perfect substitutability between the various forms of labour (hired, male, female, child), but accounts for differences in their productivities. The labour supply functions are, however, separately estimated for male and female farm and off-farm work.

4.3.1 The shadow wages

As mentioned above, if δ>0, and the constraint on off-farm labour is binding, the 'shadow price' for family labour is determined within the farm household itself. The shadow wages and therefore shadow income vary across levels of labour allocation. Jacoby (1993) shows that one can linearise the budget constraint at the point of tangency with the household indifference curve. The gradient of this linearised budget constraint is the shadow wage (w^*) and equal to the slope of the farm production function. The linearisation also yields the "shadow full-income" (Y^*) which is the sum of the shadow farm profit π^*, with the

opportunity cost of family labour properly deducted, the total value of family time (w^*T) and any non-labour income (B):

$$Y^* = \pi^*(w^*, w^h; A) + w^*T + B \qquad (4.8)$$

which is similar to equation (4.4). If off-farm labour is bound at $\bar{L}^w$, a further amount of $(w_w - w^*)\bar{L}^w$ should be added. The linearisation of the budget constraint at the optimum allows one to reformulate the leisure hours for family members as the solution to a traditional model of family labour supply. The maximisation of the utility function subject to the linealised budget constraint yields the estimable labour supply functions (or Marshallian leisure demand) of the form:

$$L^* = L\ (w^*, Y^*; Z) \qquad (4.9)$$

Since shadow wages are the prices of leisure, the farm marginal productivity provides a reasonable measure of the value of time to all productive activities including cooking, caring for children and the sick.

Noting that leisure is just another good and its price (*w**) just another price, the "full" cost (expenditure) function and the indirect utility function V can be defined:

$$c(u, w^*; Z) = Y^* \qquad (4.10)$$

$$u = V(Y^*, w^*; Z) \qquad (4.11)$$

and the Hicksian demand functions for leisure is derived:

$$l = l(u, w^*; Z) = \partial c(u, w^*; Z) / \partial w^*$$

Substitution of (4.11) for *u* in the Hicksian demand leads to the Marshallian demand, while substituting (4.10) in the Marshallian demand leads back to the Hicksian demand (Deaton and Muellbauer, 1980: pg 91). The two demand functions and therefore labour supply functions can then be equated:

$$L(w^*, u) = L(w^*, c(w^*, u); Z) = L(w^*, Y^*; Z) \qquad (4.12)$$

The Slutsky equation may now be derived to test for the restriction imposed by maximisation theory, that the compensated wage effect $\partial L / \partial w^*\big|_u$ is positive:

$$\frac{\partial L}{\partial w^*} = \frac{\partial L}{\partial w^*}\Big|_u + L\frac{\partial L}{\partial Y}\Big|_{w^*} \qquad (4.13)$$

The compensated wage effect or the substitution effect can be derived by eliminating the last term (the income effect) from the term on the left hand side.

4.3.2 Empirical analysis

4.3.2.1 Estimation of shadow wages and shadow income

The first step in the empirical analysis is to obtain estimates of the marginal productivity of family labour. This is done by estimating a Cobb-Douglas production function of the form:

$$Q = \alpha L^{\beta_1} x^{\beta_2} \qquad (4.14)$$

where Q is the value of farm output, L is the labour input and x other inputs. The Cobb-Douglas is used despite the well known technological limitations it imposes because of the ease of estimation and interpretation of its coefficients.

In the estimation of the production function, we consider total labour in the production function. We control for possible productivity differences of male, female, child and hired labour by including shares of female, child and hired labour in total labour. The inputs denoted by x include cultivated land, value of fertilisers, seed, pesticides and livestock inputs. Expenditure data rather than quantities are used for the variable inputs because most households had information on input quantities missing. The age and education of the head are included as proxies for the management input. Because the dependent variable Q is in monetary terms, we include the share of high value farm products in order to pick up the higher values that may be imposed on the value of the farm output. The high value products include horticultural crops, coffee and milk. Also included are regional rainfall variables to proxy for rainfall shock. The production function is estimated using instrumental variable approach. The variable inputs are considered endogenous and so is the share of high value crops and the labour input. The shadow wage rate is calculated as:

$$w^* = \frac{Q}{L}\beta_2 \qquad (4.15)$$

where Q and L denotes the observed value of output labour supplied for farm work, β_2 is the estimated coefficient of total labour in the production function**.** The household shadow income is derived from the observed output minus the amount of family labour on-farm valued at this shadow wage, minus cost of variable inputs including the cost of hired labour. The total time endowment valued at the shadow wage, transfers and rent income are also added.

4.3.2.2 The labour supply functions

The male and female labour supply functions for on-farm and off-farm work are estimated separately. Several households record zero days for both males and females for on-farm and off-farm work. About 38 and 11 percent of the households report zero days on-farm for men and women respectively, and about 45 percent and 66 percent of the households report no market days for males and females respectively. Ordinary least square estimations would therefore be inappropriate (Amemiya, 1984). Consequently, the labour supply functions are estimated using tobit regressions.

The shadow wage rates and the full income are endogenous to the model. The shadow wage rate is a function of shadow value of time and income. Hence any change in the exogenous variables in the system will lead to a new value for the shadow value of household's time and thus in turn lead to a new optimal value for shadow wage rate. To obtain consistent estimates for labour supply, the predicted values of the shadow income and shadow wage are used (Jacoby, 1993; Skoufias, 1994). Refer to Appendix Table 4.1. Predicted values may induce heteroskedasticity in the estimations. A modification of the data allows the use of the interval regression procedure which allows for correction for heteroskedasticity in censored data (Hardin, 2005; UCLA, 2007).

Some of the variables used in the prediction of shadow wage and income are excluded in the labour supply estimation for model identification. The number of adult males and females between 18-64 years, head's education, amount of land owned and the value of assets are used as instruments in the various regressions. Intuitively, an additional adult male farm worker in the household for example, should affect the labour supply of adult males only by lowering their marginal product and raising the family profits from farming. If, however, demographic variables are also taste shifters, they cannot be excluded from the labour supply equation. In the empirical estimation, highly insignificant variables are dropped from the second stage estimations.

The variables in the labour supply equations include the shadow wage and those factors that may affect wages. Variables that lower the reservation wage and those that raise market wage-rates increase the probability of off-farm participation. Human capital and level of assets may affect both the shadow wage and off-farm wage in either direction. If off-farm work is due to distress, assets can provide an alternative coping strategy to off-farm work especially if earnings from such activities are low — and of course if asset markets exist. On the other

hand, assets may reduce liquidity constraints thus increasing the likelihood of self-employment. So the estimation includes livestock wealth, human capital variables such as education and age. Household composition and location variables such as distance to the market and regional dummies are included to capture opportunities provided by the environment as well as the observed off-farm wages. The coefficient of variation (CV) is used for rainfall variability. Following Rosenzweig and Binswanger (1993) the effect of wealth on household behaviour towards risk is captured by interacting CV at planting time with livestock wealth.

4.3.3 Credit constraint and identification of constrained households

An additional challenge in this estimation is the identification of credit-constrained households. As mentioned earlier, it is not easy to establish credit-constrained status. This is even more so for households that may exhibit precautionary motives, since it is difficult to differentiate between the two (Deaton, 1997: pg. 371).

One common method used to test credit constraints is the consumption-smoothing hypothesis. This hypothesis postulates a household to be credit-constrained if the growth rate in household consumption co-varies with the growth rate in household income (Hayashi, 1985; Zeldes, 1989). However, a simple examination of smoothness in consumption fails to identify which mechanism is at work. If labour income can be used to smooth consumption, consumption will still appear to be insured even in the presence of credit constraints. Hence the need for identifying constrained households (Deaton, 1997).

To identify such households, this research uses self-reported credit constraint status similar to the work of Jappelli (1990), Diagne *et al.* (2000) Guarcello *et al.* (2003), Godquin and Sharma (2005), Boucher *et al.* (2005), and Quisumbing (2005). Such direct elicitation methods on credit constraints use responses to qualitative survey questions on the perception of borrowing constraints, history of household's access to credit, and current credit demand. As in these earlier studies, the respondents were asked whether any member of the household had applied for credit in the year prior to the survey. All respondents answering no to this question were then asked the reason for not applying for credit. Following Jappelli (1990) and Zeller (1994), those who had applied were then asked if the loan had been granted. If it had not, the reasons for loan denial were elicited. The reasons given for the credit denial were divided into supply side induced or demand side induced: see Table 4.1.

Table 4.1 Household reasons for not applying for credit and type of credit constraint

Credit status and reason given	Proportion reporting (%)	
Constrained		**Type of constraint**
Lack of collateral	13	Supply side
Fear of losing collateral/inability to pay	29	Demand side
High interest rates	11	Supply side
Do not know where to seek loan	11	Demand side
New to group	1	Demand side
Application for credit unsuccessful	11	Supply side
Total constrained	**66***	
Not Constrained		
Not interested in borrowing	12	-
Application successful, desired amount received	22	-
Total not constrained	**34**	

*Total constrained households adds up to more than 66% because a household can be constrained in more than one way.

The division between supply side induced and demand side induced is only indicative, as suppliers might set the contract stipulations in such a way that they result in self-screening by prospective borrowers (Hoff *et al.*, 1993). The possibilities for overcoming these constraints are specific to each side respectively, hence the reason to maintain this division. Households that stated they were not interested in borrowing are considered not to be credit constrained, although they may refer to the state of the current supply and could become interested if credit conditions improve in their perception. The status of being constrained or not thus refers to the current situation in the credit market.

The credit constraint status constructed in the above manner cannot be simply included as a regressor in a labour supply equation as it is endogenous. Some of the variables determining labour supply may also determine the constraint status; for example if assets can be used to cope with shocks, the need to use labour markets to cope with a negative income shock may be less for those with more assets. At the same time, assets improve credit worthiness. Since the credit constraint status is a binary variable, the estimation uses the predicted variable as the instrumental variable. Examples of work that have used predicted values of categorical variables as instruments are Pender et al. (2004) and Dubin and McFadden (1984) cited therein.

Table 4.2 Descriptive statistics used for estimation of credit constraint status, the production function and labour supply.

Variable	Mean	Std. error
Household characteristics		
# males 18-64 years	2.26	0.23
# females 18-64 years	1.33	0.11
# below 5	0.89	0.06
Dependency ratio	0.80	0.07
Years of education male head	7.70	0.38
Years of education female head	5.92	0.38
Age male head years	47.87	1.44
Age female head years	42.32	1.60
Head female (if yes=1)	0.10	0.02
Assets		
Livestock value (KSh)	5440.30	550.66
Asset value (KSh)	94240	15487.17
Owned land (Acre)	0.93	0.08
Farm labour days per season		
Female	14.35	1.73
Male	9.44	1.70
Hired	7.24	1.94
Child	1.44	0.43
Total labour	32.00	40.40
Female share	0.53	0.32
Child share	0.04	0.13
Hired share	0.18	0.30
Off-farm labour days per season		
Male head	37.52	3.21
Female head	13.22	1.90
All females	19.30	2.70
All males	40.31	4.19
Observed wages and income (Ksh/day)		
Average hired farm wage	90.16	1.95
Male off-farm wages	166.54	15.29
Female off-farm wages	101.40	12.52
Farm income	7530.55	1258
Shadow wage and income		
Shadow wage	107.20	11.33
Sahdow income	53417.43	5900.27
Shocks		
ill days wife	1.78	0.40
ill days husband	2.90	0.47
ill all members (if yes=1)	0.49	0.03
AID-afflicted (if yes=1)	0.52	0.04
% rainfall shortage planting	-0.18	0.28
% rainfall shortage weeding	0.40	0.33
Rainfall coefficient of variation (CV)		0.002
planting period, long rains	0.69	
Average rainfall CV long rains	1.33	0.004
Other variables		
Distance to market (Km)	2.88	0.09
Credit constrained (if yes=1)	0.55	0.05
Bank/group account (if yes=1)	0.77	0.04
Horticulture/Coffee/dairy cattle (if yes=1)	0.39	0.06
Skilled employed/self employed (if yes=1)	0.22	0..03

4.4 Results

This section presents two sets of results. The results of the credit constraint status are first considered because the predicted variable is used in the subsequent labour supply estimations. This is followed by the discussion of the effects of shocks on labour supply for adult males and females. The descriptive statistics of the variables used in the estimations are presented in Table 4.2 above.

4.4.1 Credit constraint

Table 4.3 shows the results of the credit constraint estimation. The explanatory variables included are those likely to influence both the demand for and supply of credit. The demand variables include number of adult males and females aged between 18 and 64 (all individuals considered members of the household whether present or absent at the time of survey in the first round), the age of the household head and its square, years of education for the husband and wife, the value of household assets, a dummy variable if the head or the spouse's main occupation is permanent or self-employment and a dummy variable if high value crops like coffee or horticulture are grown or dairy cows are kept. The variable for affliction with HIV is considered a demand and supply side variable. While affliction with HIV/AIDS may increase the probability that a household will need finance, from the lender' perspective, a HIV patient is a risky borrower given the higher likelihood of illness and possibility of default. The HIV/AIDS dummy is interacted with illness dummy to differentiate the effect of other illnesses not related to HIV. Other supply side variables include whether the head or spouse has a bank account or belongs to a savings and credit group; and distance to the market. Distance may influence both demand and supply as it affects access from either side. The coefficient of variation for rainfall for the long rains season is also included. High rainfall variability (CV) is expected to increase the possibility of credit constraint for risk-averse households. It may also affect placement of financial institutions, with less of them being placed in environments of high rainfall risk. Rainfall variability is interacted with wealth as wealth is likely to be negatively related with risk aversion. The expected effect should be opposite to that of rainfall variability alone.

Table 4.3 Probit estimates for credit constraint
Dependent variable: Binary variable for credit constrained status

	Coefficient (z-value)	Marginal Effect
High value crops/dairy cattle (yes=1)	-0.18	-.0.07
	(-0.70)	(0.70)
Permanent/ self employment (yes=1)	-0.77	-0.30
	(-2.29)**	(-2.39)**
Log physical assets	-0.21	-0.08
	(-1.75)*	(-1.74)*
HIV dummy (if AIDS-afflicted=1)	0.36	0.14
	(1.35)	(1.34)
Ill member	-0.65	-0.24
	(-2.38)***	(-2.56)***
HIV*ill	0.11	0.05
	(0.37)	(0.37)
Education male head	-0.06	-0.03
	(-1.22)	(0.78)
Education female head	-0.04	-0.02
	(-0.94)	(-0.78)
Age	0.06	0.02
	(0.96)	(0.99)
Age squared	-.001	-0.001
	(-0.61)	(-0.59)
# of females 18-64 years	-0.17	-0.07
	(-1.71)*	(-1.71)*
# of males 18-64 years	0.06	0.02
	(0.71)	(0.73)
If head female	0.52	0.17
	(1.09)	(1.10)
Bank account or savings & credit group	-0.17	-0.06
	(-0.59)	(0.60)
Distance to market	0.10	0.05
	(1.01)	(1.01)
Rainfall CV	16.38	6.27
	(3.38)***	(3.37)**
Rainfall CV * livestock wealth	-0.45	-0.17
	(-2.25)**	(2.05)**
Constant	-2.78	
	(-0.91)	
Log likelihood	-87.68	
χ^2	54.17***	
Pseudo R^2	0.24	
N	170	

Robust standard error estimates
*** significant 1%, ** significant 5%, * significant 10%
Correctly predicted: 73.5%
Hosmer-Lemeshow $\chi^2(8)=3.84$: p-value=0.21

The probit model correctly predicts about 73 percent of the actual self-reported credit status. Most of the significant variables have the expected signs. Households are likely to be credit unconstrained the higher the assets, if the head or spouse is in permanent employment or is self-employed. High rainfall variability increases the likelihood that households will be credit constrained. While households with an ill member are unlikely to be constrained, being afflicted with HIV/AIDS has an insignificant effect. The positive sign, however, is in line with the prediction that from a lender perspective, a HIV patient is a risky borrower. Credit constrained status seems to be influenced more by the more persistent source of income variability represented by rainfall variability (CV). It is possible that lenders would be unwilling to lend to people facing an uncertain future. However, wealthier households in areas with high income variability are unlikely to be constrained because wealth interacted with the coefficient of rainfall variation reduces significantly the likelihood of being constrained.

4.4.2 Effects of shocks on labour supply

The production function estimation from which the shadow wage and income are derived is shown in Table 4.4. Instruments used for the endogenous variables; labour, variable inputs and the share of high value products are owned land, value of physical assets, whether either of the spouses is in skilled employment, number of adult working males and females. The Anderson canonical correlations likelihood-ratio test rejects the null hypothesis of weak instruments, while the Hansen-J statistics test does not reject the null hypothesis that the instruments are valid.

The results show the female share to be insignificant. The insignificance of the female share would be in line with empirical evidence that is not supportive of productivity differences in family male and female labour inputs (Quisumbing, 1996; Saito, 1994). The elasticity of family labour is about 0.40, which is close to the average of 0.42 estimated for Ugandan farm households (Bagamba, 2007) and 0.43 estimated for Tigray region in Ethiopia (Woldehanna, 2000). The coefficient for hired labour share is negative as would be expected since it is hypothesised that hired labour has less incentive compared to family labour on the family farm. The results show variable inputs to be important determinants of output value. The variable accounting for the high value farm products is also positive and significant. As would be expected, rainfall shortage at weeding time lowers output.

Table 4.4 Two stage least squares estimates for crop production function estimates
Dependent variable: Log output value

	Coefficients (z-value)
Log labour days	0.40
	(1.79)*
Female share	0.09
	(0.27)
child share	-0.87
	(-0.82)
Hired share	-0.65
	(-0.97)
Log variable inputs	0.54
	(2.48)***
Share high value crops	2.30
	(2.24)**
Age of head	-0.10
	(-2.02)**
age squared	0.001
	(2.14)**
% rainfall shortage planting	-.1.50
	(-1.92)*
constant	-4.48
	(-2.71)***
F	6.09***
R^2	0.47
N	171
	Coefficients (P-value)
Anderson canon. Corr. LR stat.	31.9(0.00)
Hansen J statistic	1.12 (0.57)

Robust standard error estimates
*** significant 1%, ** significant 5%, * significant 10%
Identifying instruments: Owned land, value of physical assets in round 1 of survey, and whether either of the spouses is in permanent or skilled employment.

Table 4.5 Summary statistics for shadow wages for participants and non participants in off-farm work compared to observed wages

	Mean (KSh/day)	Std. error
Non-participants	128.90	17.04
Participants	98.40	14.30
Hiring in labour	139.10	20.50
All households	107.20	11.33
Observed hired wages	90.20	1.95

The summary statistics for estimated shadow wages are presented in Table 4.5 above. Consistent with the theory, the mean shadow wages for non-participants in off-farm activities are higher than those for participants in off-farm work for whom shadow wage should be the observed wages $(w^* = w_w)$. However, the mean household shadow wage is slightly higher than the observed hired farm wages as would be the case if employment is constrained. This fact is taken into account in the calculation of shadow income.

The estimations for on-farm and off-farm labour supply are presented in Tables 4.6 and 4.7. The analysis is focused on affliction with HIV/AIDS, days of work lost due to illness, crop loss, rainfall variability and rainfall shortfall at planting and weeding periods. The weeding period represents the growth stage for crops. Also examined are the effects of the credit constraint and the wage effect on days of work. The male and female work days are computed as the sum of an eight hour day worked on either the on-farm or off-farm. Since it was not possible to separate on-farm labour supply for male and female heads from that of other males and females, there are two estimations for farm labour supply. This separation was, however, possible with off-farm work and therefore four estimations for off-farm labour supply are done.

Starting with the sources of weather stress, the results show labour supply to be generally more responsive to the permanent source of weather stress than the transitory ones. This is in line with the PIH that household labour decisions respond more to permanent shocks. Rainfall variability measured by the coefficient of rainfall variation (CV) has a significant effect in all the equations. With regard to transitory shocks, rainfall shortfall generally has an insignificant effect on the on-farm labour supply. Females, however, may to a certain extent work more in response to a rainfall shock at planting time. This positive response is insignificant at weeding time, probably as no weeding needs to be done. The farm specific qualitative crop loss index has a negative effect on the on-farm labour supply. The higher the index, the drier the weather and the lower the labour supply especially for males. The off-farm labour supply shows almost a similar effect. The crop loss index is generally associated with a negative labour response to off-farm work, which is significant for the male head. The negative effect would be excepted if crop loss is covariate within the communities and if most of the off-farm work is agricultural based. Consequently, the rainfall variables have a significant negative effect on the off-farm labour supply for the male head. While at planting time some off-farm work may still be available for all females, by weeding time, rainfall shortage reduces all off-farm work.

This effect is significant for both male and female heads. These results strengthen findings in Chapter 3 that households are unable to use the labour market to deal with a rainfall shock.

Table 4.6 Parameter estimates for male and female family farm labour supply
Dependent variable: Number of days worked on the family farm

	Males	Females
	Coefficient (z-value)	
Shadow income (‘000)	-0.11	-0.53
	(-1.93)*	(-0.53)
Shadow wage	0.05	0.05
	(2.03)**	(1.91)*
Log Livestock value	14.19	-5.00
	(1.47)	(-0.80)
Observed hired wages	-0.95	-0.47
	(-1.08)	(0.66)
Crop loss Index	-4.14	-1.42
	(-3.60)***	(-1.54)
% rainfall shortage planting	5.16	17.93
	(0.52)	(1.68)*
% rainfall shortage weeding	-7.65	6.99
	(-0.61)	(0.62)
Rainfall CV planting	-238.38	-192.90
	(2.00)**	(-2.49)**
Rainfall CV * livestock wealth	21.70	7.53
	(1.57)	(0.80)
credit	-19.29	31.57
	(-1.94)*	(3.13)***
Credit* % rainfall shortage weeding	-2.99	-50.85
	(-0.18)	(-2.92)***
HIV dummy (if AIDS-afflicted=1)	9.24	-5.18
	(2.53)***	(-1.68)*
HIV dummy * ill	-0.65	-0.20
	(-4.32)***	(-1.80)*
Age	0.1.66	0.12
	(3.36)***	(1.29)
# Males 18-64		-1.04
		(1.45)
# Females 18-64		4.13
		(2.92)***
Constant	191.37	138.78
	(2.20)**	(2.83)***
Log likelihood	-487.86	-647.50
Wald $\chi 2$	192.41***	174.94***
N	166	169
Uncensored	103	153
Compensated wage effect	0.06	

Robust standard error estimates. *** significant 1%, ** significant 5%, * significant 10%

Table 4.7 Parameter estimates for off-farm labour supply
Dependent variable: Number of days worked off-farm

	Male head	All males	Female head	All females
	Coefficient (z-value)			
Shadow income ('000)	-7.91	-5.51	-14.34	-3.42
	(-2.36)**	(-1.71)*	(-3.18)***	(-2.84)***
Shadow wage	0.04	0.04	0.44	0.28
	(0.18)	(2.06)*	(3.24)***	(3.17)***
Hired wages	5.51	4.34	-1.14	
	(1.70)**	(1.63)	(-0.45)	
Log Livestock value	70.19	57.83	-52.73	-36.64
	(2.05)**	(2.10)**	(-1.67)*	(-1.71)*
Crop loss Index	-8.04	-3.57	-2.99	2.91
	(-2.73)***	(-1.05)	(-0.97)	(1.04)
% rainfall shortage planting	-116.42	12.87	-139.65	47.73
	(2.23)**	(-0.30)	(-0.54)	(1.87)*
% rainfall shortage weeding	-111.09	-55.52	-122.27	-24.76
	(-2.23)**	(-0.70)	(-1.72)*	(-0.43)
Rainfall CV planting	2177.26	1054.93	-1237.90	-866.88
	(3.79)***	(2.01)**	(-3.54)***	(-2.60)***
Rainfall CV * livestock wealth	-199.84	-83.28	80.72	52.13
	(-2.02)**	(-2.09)**	(1.75)*	(1.72)*
Credit constraint	-87.92	-29.36	91.63	28.69
	(-2.56)***	(-0.80)	(1.67)*	(0.49)
Credit constraint * % rainfall shortage weeding	156.64	90.83	79.09	-13.77
	(2.14)**	(1.05)	(0.97)	(-0.14)
HIV dummy (if AIDS afflicted=1)	-38.33	-33.49	-3.38	-8.39
	(-3.13)***	(-3.03)***	(-0.28)	(-0.63)
HIV dummy * ill	0.22	0.23	0.95	0.83
	(0.51)	(0.37)	(1.97)*	(1.45)
Education	-6.78	-4.99	4.77	-0.94
	(-1.98)**	(-1.72)*	(2.99)***	(-0.62)
Age	4.19	3.21		2.52
	(1.45)	(1.31)		(1.83)*
Age squared	-0.06	-0.05		-0.02
	(-2.03)**	(-2.13)**		(-1.90)*
# males 18-64 years	-11.75		-10.85	
	(-1.36)		(2.91)***	
# females 18-64 years			15.82	
			(1.34)	
Constant	-1385.67	-640.04	-787.18	559.01
	(-3.46)***	(-1.70)*	(-2.88)***	(2.39)***
Log likelihood	-560.93	-561.66	-170.66	-413.34
Wald $\chi 2$	98.53***	69.49***	76.15***	232.08***
N	170	170	170	170
Uncensored	95	109	60	68
Compensated wage effect		0.25	0.43	0.34

Robust standard errors estimates obtained by interval regression
*** Significant 1%,** significant 5%,* significant 10%

As noted above, if off-farm employment is largely agricultural, the demand for labour is expected to decline with a dry spell. Evidence that is suggestive of lack of demand for labour can be provided by qualitative information from the surveyed households. A question was asked whether anyone in the household would have wanted to work but did not. About 48 percent of the households expressed such desire. Table 4.8 shows the responses given to a question why someone could not work despite the desire to do so. Lack of job opportunity is recorded by close to 60 percent of the households. This response can be corroborated by the country's average unemployment rate which is about 40 percent (World Factbook, 2006).

Table 4.8 Reasons for not working for those who wished to work

Reason	% reporting
Ill health	32.2
Lack of job	59.8
Lack of capital	5.8
Busy at home/farm	6.9
Other reasons e.g. Too busy on farm, spouse working	6.9

The above analysis shows labour supply responses to weather shock *ex post*. The *ex ante* response is provided by the coefficients of rainfall variability. Unlike the *ex post* responses where the male and female labour responses are somewhat similar, the *ex ante* responses may differ by gender. High rainfall variability is associated with a higher male labour supply response to off-farm work but with lower female off-farm labour supply. Wealth attenuates this *ex ante* responses to rainfall variability for both sexes as the effects of the CV interacted with livestock wealth are the opposite to that of the CV alone. On the family farm, high rainfall variability reduces labour supply. The wealth effect does not significantly modify the negative effect of rainfall variability.

Another effect of wealth is shown by the livestock value. It is expected that since livestock may offer an alternative coping mechanism to labour markets, more livestock wealth may mean a reduction in liquidity constraint. Taking into consideration the effect of the CV interacted with livestock wealth, males in households with high livestock wealth may not use off-farm labour market as a coping mechanism. This is consistent with the negative effect of education which is significant at 10 percent for male head. The opposite is the case for females. A more educated female head in a wealthier household may also be working more off-farm.

Examining the credit constraint variable, only the female's on-farm labour supply has the expected positive and significant response. The effect is also positive and significant at 10 percent for head female's off-farm work. A credit constraint has a negative effect on males' labour supply to both on-farm and off-farm work. In the presence of a negative income shock, we would expect credit constrained households to supply even more labour. The effect of the credit constraint interacted with rainfall shock at weeding stage is generally positive as expected for off-farm work and is significant for the male head. Nevertheless, the overall effect of a credit constraint which takes into account the interaction term with rainfall shortfall is a reduction of about 18 days off-farm for the male head. This effect on male head is consistent with the observation by Reardon (1997), and Woldehanna and Oskam (2001) that labour supply depends on both incentive and capacity to participate. A negative income shock provides the incentive but lack of liquidity may constrain labour supply. If off-farm employment requires high working capital, lack of liquidity would then limit off-farm activities. On the family farm, however, females in credit constrained households show a positive labour supply response to low rainfall.

Moving to the health variables, the presence of HIV/AIDS which is represented by the HIV dummy also impacts differently on male and female labour supply just as the persistent rainfall stress. While males in AIDS-afflicted households respond by working less off-farm and more on-farm, females work less on-farm. According to Desmond *et al.* (2000), one of the first phase responses to HIV/AIDS infections is a re-allocation of work to more flexible jobs or from formal to informal jobs. Off-farm work may be less flexible for males than farm work. AIDS-afflicted households that also have an ill member experience a reduction in labour supply on the family farm. From the theoretical model, a shock in time availability leads to a rise in shadow prices. The rise in the marginal product induced by the reduction in labour input by the household members is likely to lead to a rise in demand for hired labour. Indeed, the data reveals that AIDS-afflicted households which also have an ill member have 26 percent (9.4 days versus 7.5 per acre) more hired labour days than other households. With regard to off-farm work, female's labour shows an "added-worker effect" towards illness interacted with HIV/AIDS.

Turning to the effects of shadow income and wages, the income effect is negative in all the equations. This indicates that leisure is a normal good for both males and females. The negative effect is also indicative of *ex post* labour responses to shocks. Both the observed hired wages and shadow wage are included in the estimations. Only the male off-farm labour

supply is significantly responsive to observed wages. All the shadow wage effects are positive which show upwards sloping labour supply curves. The magnitudes of shadow wage effects for off-farm work are larger and more significant for females than males. This difference is, however, not obvious on the family farm. It could be the case that women have a higher reservation wage to off-farm work. Men are working more off-farm and less on the family farm (see descriptive statistics in Table 4.2). Such a finding may be suggestive of family members who allocate their members labour as if to maximise a joint utility function. To examine whether this is so, the signs of the compensated wage effects are examined. This is done for the equations where both the income and the substitution effects are significant or nearly significant. The results are reported at the bottom of Tables 4.6 & 4.7. The signs are positive in conformity with the utility maximisation theory.

4.5 Conclusions

This chapter examines farm and off-farm labour supply responses of male and female adults to rainfall and health shocks. The hypothesis that credit constraint drives these responses is tested. One of the objectives was to examine how households respond to transitory and persistence sources of income variability. A model that accounts for both *ex ante* and *ex post* responses to sources of income variability is used. Rainfall variability and information on whether either of the household head is a HIV/AIDS patient are used as the persistent sources of stress. Crop loss, rainfall shortage and illness are used as proxies for transitory shocks and their effects on labour supply are considered *ex post* responses.

The results show some evidence that under credit constraints, some household members' labour respond to transient rainfall shocks and illness as the 'added-worker effect' hypothesis would predict— that is, by working harder in case of a negative income shock. But as would be expected of a covariant shock, under credit constraint off-farm labour market is unlikely to serve as an insurance mechanism against rainfall shock. This is in line with findings elsewhere that show households to have difficulties in insuring covariant shocks (e.g. Townsend, 1994).

We find that labour responds more to the persistent effects of rainfall variability as hypothesised by the permanent income hypothesis. Evidence of *ex ante* response to rainfall risk is indicative of risk avoidance behaviour. The results show this behaviour to differ

between men and women, which may point to a disaggregated labour market by gender. The fact that livestock wealth attenuates the effect of rainfall variability especially towards off-farm work shows the importance of assets in mitigation of risk *ex ante*. Labour responses towards the presence of HIV affliction may also differ by gender. While males retract from off-farm work and work more on-farm, females' on-farm labour supply decline.

Using estimates of marginal productivities of household labour as measures of shadow wage, we find evidence partly supporting the behavioural assumption that the farm households allocate their members time as if to maximise a family utility function. The calculated compensated wage effects are positive as postulated by utility maximisation theory. However, since only labour responses to a household wage are examined and not separate responses to male and female wages, a second restriction imposed by the unitary model of equality in compensated cross-wage effects was not tested as in Udry (1996) for Ghanaian households. Therefore, we cannot confirm whether the unitary model applied in this analysis is the most appropriate. Nevertheless, based on the findings of positive compensated household wage effects, it can be concluded that the family can be a useful tool in intermediating between public policy and individual welfare.

5 Seasonal changes in intra-household health inequality

5.1 Introduction

Rural areas of low-income economies are characterised by an occupational distribution in which activities requiring high levels of energy and endurance predominate. In such environments, the marginal productivity of physical health is likely to be highly valued, probably more than would be the case for societies where mechanised activities dominate.

If better health is associated with better physical productivity, more investments may be made on those whose productivity gains are greatest. In this sense, the allocation of health goods can induce or deepen inequalities. Indeed, there is evidence to suggest that in some instances, the link between health inputs and health status is nonlinear. Nutritionists compute energy requirements as having a fixed and variable component. The fixed component represents the basal metabolic requirement (BMR). The variable component depends on the type and the duration of the tasks being done and consists of two parts: one component that allows for minimum level of physical activity such as sitting, eating, and maintaining personal hygiene (or maintenance requirement), and another that allows for external activities. The maintenance requirement (m) is taken to be approximately 1.4 times the basal metabolic rate (Dasgupta, 1993). In some of the literature, the BMR and m are combined to form a fixed energy requirements (m^*) which is a minimum threshold that must be achieved before one can undertake any external work (Dasgupta, 1997).

Because of this fixed requirement (m^*), individuals with low resources could be trapped at a low equilibrium point where they are unable to work and therefore stay poor with little chance of getting out of poverty. While the better-off with access to non-labour income can finance the minimal requirement for physical activity, the poor with few assets require paid employment in order to be able to finance the same level of consumption. From the employer's perspective, hiring the poor is therefore expensive, because the poor require a wage high enough to be able to consume what is required for m^*, plus additional amounts needed to undertake productive activities. Hence, a wage level below what is required by the poor would enable those with assets to supply the quality of labour that the poor cannot offer. A poor person is unable to get employment because he or she is poor and remains poor because he or she cannot get employment. This is at the core of the relationship between persistent poverty and the nutrition–productivity link. In fact, for a poor household where

labour is the major if not the only source of income, poverty may be the consequence of failure to maintain and invest in human capital. Whereas a well-fed and healthy labourer is attractive for employers, an overly weak person is less likely to find employment in a competitive environment. The same applies to subsistence farmers who cannot produce enough to provide themselves with adequate nutrition; in turn, poor nutrition keeps their productivity low.

The existence of low-health–low-productivity traps or convexity, may have important intra-household distributional consequences (Pitt *et al.*, 1990). One way an intra-household health trap can arise is the following: Given the minimum health threshold described above, consider a poor household whose income is so low that it will always be insufficient to allow everyone to consume at this threshold level, even when all consumption is devoted to health inputs. Even if everyone in the household has the same health endowment at the starting period, and the household members are averse to within-household inequality, it would be favourable to have unequal allocations among members in order for at least one person to be able to earn an income. This may produce a divergence in health status in the short run. Besides this consumption–productivity linkage, the within-household distribution of health inputs may also be influenced by other factors, such as: weights associated with the well-being of each individual member (Behrman, 1988); and degree of influence in decision making (Dercon and Krishnan, 2000a).

The above argument assumes that the direction of causality is from health to income. But income, too, may affect health outcomes. A higher income allows individuals and households to command more health goods. However, circumstances may exist that may mask these relationships, and might partly explain why Case and Deaton (2005) observe the link between health and income to be far from universally strong. For instance, from the health side, where unemployment rates are high either due to a low land–labour ratio or a paucity of options for employment, the household's tasks of an individual who may be unable to work can easily be done by another, and therefore no loss in income occurs. But given that even basic activities can be strenuous – for instance fetching the water for bathing and toileting (use of pit latrines) – physical health is critical for day-to-day life in these households. On the income side, we illustrate this by using an example on HIV patients' access to health care. It is possible that access to health care may be hampered by the stigma associated with HIV/AIDS and/or self-denial. This may result in an episode of poor health persisting equally for those with and without resources. However, in-depth discussions with HIV patients showed that those with

more resources can circumvent this stigma by going to distant clinics where they are not known.

The subsequent analysis therefore takes the simultaneity between health and income as given. That is, it is assumed that households will seek to improve everyone's health to similar status but when allocating resources will also consider productivity of individuals. Greater desire for health equality may mean lower income in the short run, while a predominance of concerns about productivity in the current period can impede the recovery of the persons in poor health. This chapter makes an effort to answer the question of which is the dominating incentive for the households. Empirically, this is difficult to pin down (Smith, 1999). Apart from problems arising from the possibility of the mutually reinforcing interactions between income and health, data on individual consumption are difficult to obtain. The lack of such data makes it difficult to estimate the consumption–productivity relationship. The analysis in this chapter uses a health measure related to an individual's capacity to do work and thus avoids the need for data on individual consumption.

Whichever incentive dominates for the households, there is an implication for policy. A predominance of equality incentive implies that, since the household is already concerned with equality of health outcomes of its members, public concern should be on enhancing income generation activities. The household will redistribute the income. On the other hand, evidence of convexity implies priority should be on health interventions. This is because households in such circumstances can neither optimise output nor invest fully in the recovery of the less healthy, unless the health traps are removed.

An index is calculated as a ratio of health differences in a pair of working age-adults within one household in two consecutive periods. The index is used to test whether households endeavour to reduce health disparities between its members over time as opposed to a preference for productivity concerns. The latter would see health differences increase. Preferences for equality are tested through a null hypothesis of a positive relationship between initial health status and the index. A finding that the initial health is negatively related to the index at some range of health status would suggest that productivity incentives may also be important. The presence of concerns about productivity indicates that households' buffer stock in health and that convexity may exist in the health–productivity relationship.

The chapter is organised as follows: the next section describes the theoretical model, which is followed in section 5.3 by some empirical issues in the measurement of health status and the empirical strategy. Section 5.4 provides the results and section 5.5 concludes.

5.2 Theoretical model

The household is assumed to derive utility from the health status h, of each of the members i, at each moment in time *t*. The allocation of health-augmenting goods and other goods across *N* working individuals within a household *H*, can be determined from the solution to the following optimisation problem[10]:

$$\max_{c_t^i, g_t^i} E_t \sum_{t=0}^{\infty} \delta \sum_{i=0}^{N_H} \omega^i u(c_t^i, g_t^i, h_t^i), \text{ for all } i \qquad (5.1)$$

where *E* is the expectation operator, ω^i represents individual $i's$ Pareto weight in household resource allocation and $\sum_{i=H} \omega^i = 1$, δ represents the rate of time preference. The variable *g* represents health-augmenting goods and *c* represents consumption of other goods not affecting health directly. This distinction is, however, not critical in the analysis because consumption data is not used directly.

This intertemporal utility is maximised within a budget constraint linking asset levels in period *t+1* (A_{t+1}), with assets in period *t* (A_t), income y_t, consumption of health goods g_t and other items c_t. If *r* is the return on a safe liquid asset in period *t*, the asset evolution equation can be written as:

$$A_{t+1}^H = A_t^H (1+r) + y_{t+1}^H (h_t^{N_i}) - \sum_{i=1}^{N_H} g_{t+1}^i - \sum_{i=1}^{N_H} c_{t+1}^i \qquad (5.2)$$

Since the body is a store of energy, a person's health status is considered a stock. Just like any other asset then, the health stock evolves over time. Health at any one time t is a function of past levels of health, while taking into account depreciation of the health stock and current consumption. A health evolution equation can be expressed as:

$$h_{i\,t+1} = h_t^i (1-\alpha) + f(g_{t+1}^i | h_t) + \varepsilon_{t+1}^i \qquad (5.3)$$

[10] The presentation of these theoretical and empirical specifications draws heavily on Osborne (2004).

where h_t denotes the health status of individual i in period t, g represents consumption of health-augmenting goods and services as in equation (5.1); α, is the depreciation, both from energy expenditure and from the natural process. ε is that endowed component of health of an individual that is not influenced by either consumption nor individual behaviour. For poor populations with relatively poor health, the function f is expected to be increasing in consumption at all ranges, i.e. $f'(g) > 0$. This can be illustrated graphically as:

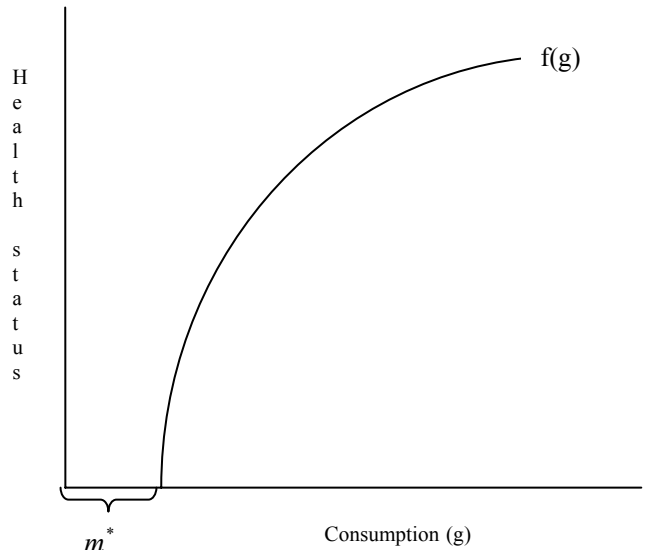

Figure 5.1 Health status as a function of consumption of health goods (a)

The $f(g)$ function may not always be increasing since it is not always possible to improve the health of some people. For instance, for physiological reasons, many more resources may be required to bring a person in very poor health up to a level of health at which they can be productive. Bliss and Stern (1978) and Dasgupta (1993) show that $f(g)$ would then contain a stationary section and $f(g)$ would only start increasing after a threshold has been reached. Hence, $f(g)$ does not start from the origin. Barret (2002) depicts this kink denoted m^* as the subsistence or non-impairment constraint. In the literature, another possible visualisation of Figure 5.1 depicts increasing and later diminishing returns to consumption once the minimum limit (m^*) has been achieved (Bliss and Stern, 1978). This is shown in Figure 5.2.

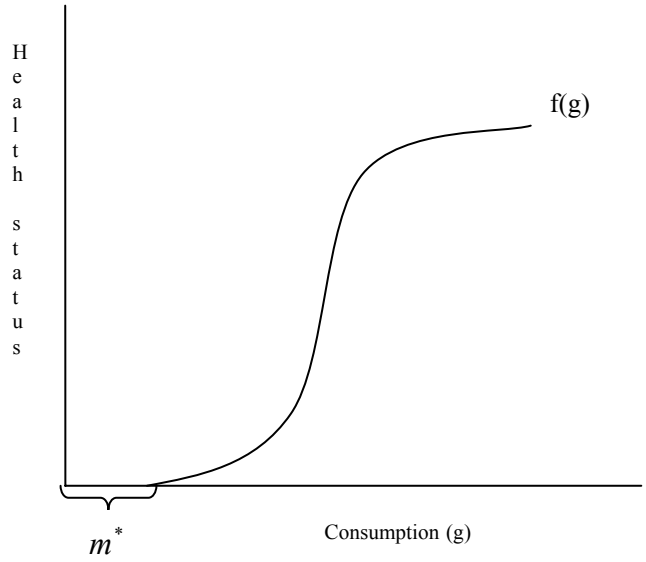

Figure 5.2 Health status as a function of consumption of health goods (b)

The health status in period t also enters in the budget constraint through the household income generation process as:

$$y_{t+1}^{H} = y^{j}(h_t^1, h_t^2, ...h_t^N; K, X) + \eta_{t+1}^{H} \qquad (5.4)$$

Where K denotes fixed household inputs and X other intermediate inputs. η_{t+1}^{i} represents a random shock to income which is not related to the lagged health status h_t. For an individual, equation (5.4) can be written as (5.5) given other people's health (h_t^j):

$$y_{t+1}^{i} = y^{i}(h_t^i \left| h_t^j \right.; K, X) + \eta_{t+1}^{i} \qquad (5.5)$$

where j represents all other household members. As in (5.3), the shape of (5.5) is assumed to be concave (Dasgupta and Ray, 1986). If a convexity exists in (5.3) or (5.5), or in both, then more resources would be required to bring an individual in very poor health to the point where he or she can perform physical tasks. A graph of y_{t+1}^{i} against h_t^i would therefore show the kink as given in Figure 5.1 or yield an S-shaped curve as shown in Figure 5.2.

Assuming the utility function is concave in all its arguments, then

$$u_k > 0 \quad \forall \quad k = g, c, h$$
$$u_{kk} < 0; \qquad (5.6)$$

and that households are averse to catastrophic health or death of the members such that $u_g(g,c,h) \to \infty \quad as \quad h \to 0$ i.e. some level of consumption is guaranteed to secure survival (Dasgupta, 1993).

The problem for the household is to find optimal consumption, asset and allocation of health goods in each period. The solution can be found by solving the optimisation problem (5.1) subject to (5.2), (5.3) and (5.4) using Bellman's principle of optimality. The value function for successive periods satisfies the recursive equation:

$$V(A_t,h_t) = \max_{c_t^i, g_t^i} \sum_{i=1}^{N_H} \omega^i u(g_t^i, c_t^i, h_t^i) + \delta E_t V(A_{t+1}, h_t) \tag{5.7}$$

where $h_t = (h_t^1, h_t^2, ..h_t^{N_H})$

The value of assets and health stock at time t is the best that can be obtained by trading-off current and future consumption by choosing how much to spend on health goods, other goods and a portfolio of assets. The expectation operator E reflects uncertainty in future yields of assets and health. Substituting equations (5.2), (5.3) and (5.4) into the value function (5.7)

$$V(A_t,h_t) = \max_{c_t^i, g_t^i} \sum_{i=1}^{N_j} \omega^i u(g_t^i, c_t^i, h_t^i) + \delta E_t V \begin{bmatrix} \left(A_t(1+r) + y_{t+1}^H(h_t^{ij}) - \sum_{i=1}^{N_H} g_t^i - \sum_{i=1}^{N_H} c_t^i \right), \\ \left(h_t^i(1-\alpha) + f(g_{t+1}|h_t) + \varepsilon_{t+1}^{ij} \right) \end{bmatrix} \tag{5.8}$$

The first order conditions (FOC):

(1) $$\omega^i \frac{\partial u}{\partial c_t^i} = \delta(1+r) E_t \left[\frac{\partial V_{t+1}}{\partial A_{t+1}} \right] \text{ for } i$$

(2) $$\omega^i \frac{\partial u}{\partial g_t^i} = \delta(1+r) E_t \left[\frac{\partial V_{t+1}}{\partial A_{t+1}} \right] - \delta \frac{\partial f}{\partial g_{t+1}^i} E_t \frac{\partial V_{t+1}}{\partial h_{t+1}^i} \text{ for all } i$$

The FOC (1) is the intertemporal optimisation equation for consumption of goods c_i, that do not contribute to health directly. FOC (2) states that the Pareto-weighted instantaneous marginal utility of g consumption equals the discounted expected value of lost resources (A) from the purchase of g minus the discounted expected marginal value of future health

multiplied by marginal health gain from consumption of health goods, *g*. Rearranging and equating these conditions for all individuals ($i \neq j$) in the household results in:

$$\omega^i \frac{\partial u}{\partial g_t^i} + \delta \frac{\partial f^i}{\partial g_{t+1}^i} E_t \left[\frac{\partial V_{t+1}}{\partial h_{t+1}^i} \right] = \omega^j \frac{\partial u}{\partial g_t^j} + \delta E_t \frac{\partial f^j}{\partial g_{t+1}^j} \left[\frac{\partial V_{t+1}}{\partial h_{t+1}^j} \right] \tag{5.9}$$

The current Pareto-weighted marginal utility of health goods *g*, plus the discounted expected future marginal value of health status multiplied by marginal health gain from consumption of health goods in period $t+1$, will be equal across individuals in the household.

By using the envelop theorem, it is possible to differentiate through the right-hand side of (5.8) with respect to h_t ignoring the effects of changes in h_t on the optimal values of expenditure on investment on health (Deaton, 1992: pg. 24). This yields:

$$\frac{\partial V_t}{\partial h_t^i} = \omega^i \frac{\partial u}{\partial h_t^i} + \delta E_t \left[\frac{\partial V_{t+1}}{\partial A_{t+1}} \frac{\partial y_{t+1}}{\partial h_t^i} \right] + \delta E_t \left[\frac{\partial V_{t+1}}{\partial h_{t+1}} \right] \left[(1-\alpha) + \frac{\partial f(g_{t+1} | h_t^i)}{\partial h_{t+1}^i} \right] \tag{5.10}$$

The marginal value of individual $i's$ health is positively related to his or her marginal utility of health $\left(\frac{\partial u}{\partial h_t^i} \right)$ and to the expected productivity of his/her health $\left(\frac{\partial y_{t+1}}{\partial h_t^i} \right)$. That is, an all-increasing health production function (f) and/or income generation function (y). This marginal return to health is weighted with the expected value of future resources $\left(\frac{\partial V_{t+1}}{\partial A_{t+1}^i} \right)$, which is higher when resources are scarce. In times of low resources then, households may have an incentive to invest more on those whose health is considered more productive and health outcomes of household members may subsequently diverge.

To test the implications of the above theory, the analysis first makes a strong assumption: that only concerns about equality and productivity affect health outcomes. For the moment, equal Pareto weights are assumed. Given that health evolves over time, health outcomes between two individuals can be compared between two time periods. Taking the differences between their health status in the two periods, an index of their health differences *R*, is constructed as follows:

$$R_{t+1}^i = \frac{h_{t+1}^i - h_{t+1}^{i-1}}{h_t^i - h_t^{i-1}} \tag{5.11}$$

where i is the individual with higher health status at period t, h_t^{i-1} is the health status of the person in individual $i's$ household whose health was the next worse in period t. h_{t+1}^{i} and h_{t+1}^{i-1} is period's $t+1$ health status of members i and $i-1$.

If households prefer more equality of health status among members, *R* would be expected to be less than 1. Equalisation incentives in the later period will be greater when the health status of the two individuals in the initial period are relatively far apart (i.e. the higher the h_t^i - h_t^{i-1}), since higher utility would be derived from that.

Using *R*, the theoretical argument expounded above can be expressed as:

If $f(g)$ and $y(h)$ are strictly increasing and concave and $\omega^i = \omega^{i-1}$ for all $i, i-1$, and given that $h_t^i > h_t^{i-1}$, households will seek greater equality at $t+1$ in h_{t+1}^i and h_{t+1}^{i-1} such that:

$$E\left[\frac{h_{t+1}^i - h_{t+1}^{i-1}}{h_t^i - h_t^{i-1}}\right] \equiv E_t R_{t+1} < 1 \qquad \textit{Proposition 1}$$

as health status improves, given preposition 1 and the initial health dispersion $(h_t^i - h_t^{i-1})$, the incentive to equalise health outcomes declines. *R* is thus expected to increase as h_t^i rises: *Proposition 2* . The proof for the propositions 1 and 2 is shown in appendix 5.1.

To control for impacts of individual Pareto weights on within-household allocation, the gender and education of the pair are incorporated into the model. The assumption of equal Pareto weights is a strong one and can lead to bias. If individuals have unequal weights, the household may tend to want the health status of the person with higher weight increase at all times.

If the assumptions of the propositions are not true and there is a convexity in $f(g)$ or $y(h)$, there could be less incentive to equalise health outcomes. Productivity incentives may dominate and a negative relationship between *R* and h_t^i results. Under such circumstances, households may to some extent allocate less to individual $i-1$ and more to i. Then it would be expected that the health status of these two individuals would diverge and $E(R_{t+1})>1$. Testing for the null hypothesis of an all-increasing $f(g)$ and $y(h)$ then entails detecting a predominance of *R>1*.

A graphical presentation of earned income in period $t+1$ against health status of each household member in period t would also show which shape characterises the households. A finding of a concave function with a kink as in Figure 5.1 or an S-shaped curve shown in Figure 5.2 would be evidence of potential productivity incentives and possible health-induced poverty.

5.3 Empirical issues

5.3.1 Measurement of health status

Several measures of health status have been used in the empirical literature. They include self-reported general health status, measures of physical functioning, and nutrient-based indicators (anthropometrics and nutrient intakes). Most household surveys rely on interviews with respondents who provide an assessment of their own health status. This is because comprehensive clinical evaluations of health status are too expensive for large samples. According to Schultz and Tansel (1997), epidemiological measurement of morbidity has two objectives. First, which self-reported questions on health status reliably replicate the distribution of clinically confirmed indicators of health status? Second, which self-reported indicators of health status have the greatest 'power' to statistically test hypothesis about relationships of health status and outcomes? A third question on adjudication arises when the two requirements come into conflict. An added problem for low-income countries is that most of the established health measures have been founded on studies of the aged in developed countries. The problem of measurement of acute spells of morbidity among the prime-age adults in an agriculture-based low-income country may differ from that of the elderly in higher income countries.

Within the class of self-evaluation measures, the general health status (GHS) has mostly been used. Respondents rate their health on a scale ranging from excellent to poor. However, this self-evaluation may reflect perceptions. While important, perceptions are likely to be related to values and can be conditioned by background, beliefs and information, all of which are systematically related to socio-economic characteristics. Information about the respondent's own health is likely to be correlated with the extent of use of health facilities. Since people assume they are in better health unless informed to the contrary, those who have little exposure to health facilities are likely to report themselves to be in better health. Hence such a

measure may not be useful for poor people with little access to good health facilities. Nutrient-based indicators such as the body mass index (BMI) have the advantage of having a high probability of replicating clinically proven conditions. However, such indices may not be appropriate for assessing illnesses related to HIV/AIDS. Heightened levels of weight loss in HIV patients render nutritional status and illness non-separable. Such non-separability can affect return to nutrition as measured by the BMI.

Self-reported functional activity limitations are also reliable indicators of clinically confirmed health status. This is especially so when they relate to more specific functional activity limitations (Stewert *et al.*, 1987 in Schultz and Tansel, 1997). Given the above shortcomings of other measures, a measure of difficulties in physical functioning was used in this study: a measure that by comparison with the BMI was also easier to get information on. The limitations in physical functioning considered refer to normal activities important to the daily lives of the people. While the notion of difficulty is subjective, questions about specific activities of daily living (ADLs) are precisely defined, and may be less subject to systematic errors as described above for self-reported health. In South East Asia and the United States, the ADLs have been found to be reliable and valid self-assessments with a high degree of internal consistency. They have routinely been used in studies of labour supply (Gertler and Gruber, 2002). One of the cited drawbacks of ADLs is that limitations in physical activities they capture are frequently due to physical health problems such as shortness of breath, joint or back problems. Such problems may not be common among prime-age adults (Strauss and Thomas, 1998). However, HIV/AIDS mostly affects prime-age adults thus making the ADLs very relevant. One of the earliest and most persistent symptoms of HIV infection is fatigue. Fatigue has been observed to be one of the most common and distressing symptoms in patients with HIV/AIDS (Bormann *et al.*, 2001), even for those otherwise healthy. It has an adverse impact on the activities of day-to-day living and overall quality of life (Rose *et al.*, 1998). Fatigue is bound to have an even greater impact on the lives of rural people where strength may be highly valued as much of the work is manual and requires stamina.

Studies that have used the ADLs in developing economies include Gertler and Gruber, (2002) and Osborne (2004). Gertler and Gruber, (2002) use the ADLs and self-reported illnesses to assess the extent to which families in Indonesia are able to insure consumption against major illness. Osborne (2004) tests for the presence of a convex relationship between individual's consumption and productivity in rural Ethiopia. Osborne notes that as ADLs are a broad

measure of health, compared with nutritional measures such as BMI, they are better able to reveal possible dynamics between preferences for productivity and equality.

To derive the health measure, this survey followed a similar procedure as that for the Ethiopian panel surveys carried out by Oxford University and the University of Addis Ababa. An informed household member, mainly the female and/or the male head, was asked how easily each member over 18 years of age could perform the following tasks: dig a field for a morning (9.00 to 13.00 hours), lift a 20-litre container of water, carry a load of firewood/ banana stems, stand from a sitting position, chop wood, walk for 3 km. Focus group and field testing was done to ensure that the question asked suited the local cultural context. For example, men do not carry firewood but will fetch and carry the banana stems for fodder. The ability to perform each task was ranked from 1– 4 as follows: 1= can perform the task very well; 2= well; 3=with difficulty; and 4=cannot.

Figure 5.3 presents the scores by sex for various tasks. Only scores for prime-age males (N = 236) and females (N = 242) are reported, to avoid age-related morbidity. Pregnant women and women with babies less than six months old are excluded. As would be expected, the more difficulty encountered in performing the task, the higher the score. The women's scores are also higher than the men's, showing that they generally have more difficulty performing tasks. The score also varied by season, with the second round representing the main cropping season showing the worst scores (Figure 5.4). This was a lean season due to failure of the long rains – an indication that a rainfall shock can affect people's ability to perform tasks even within a short time. To examine whether such a shock impacts on health outcomes equally for all household members, the index *R* was computed using health differences for periods one before the shock and period three after the shock.

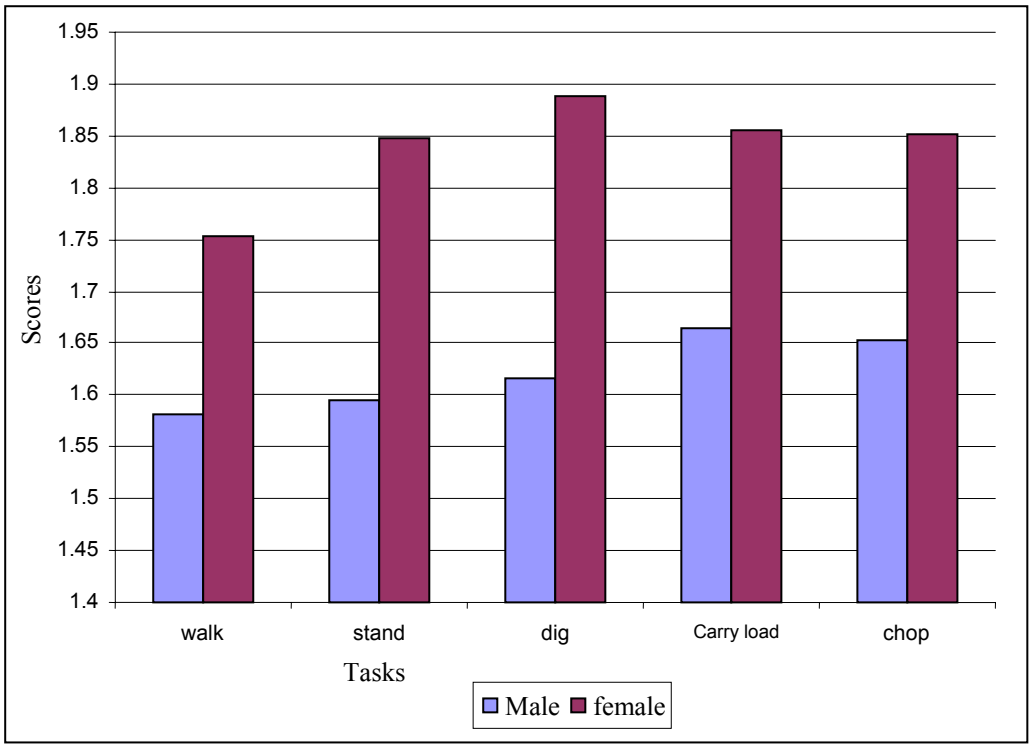

Figure 5.3 Task scores by sex (18-64 years)

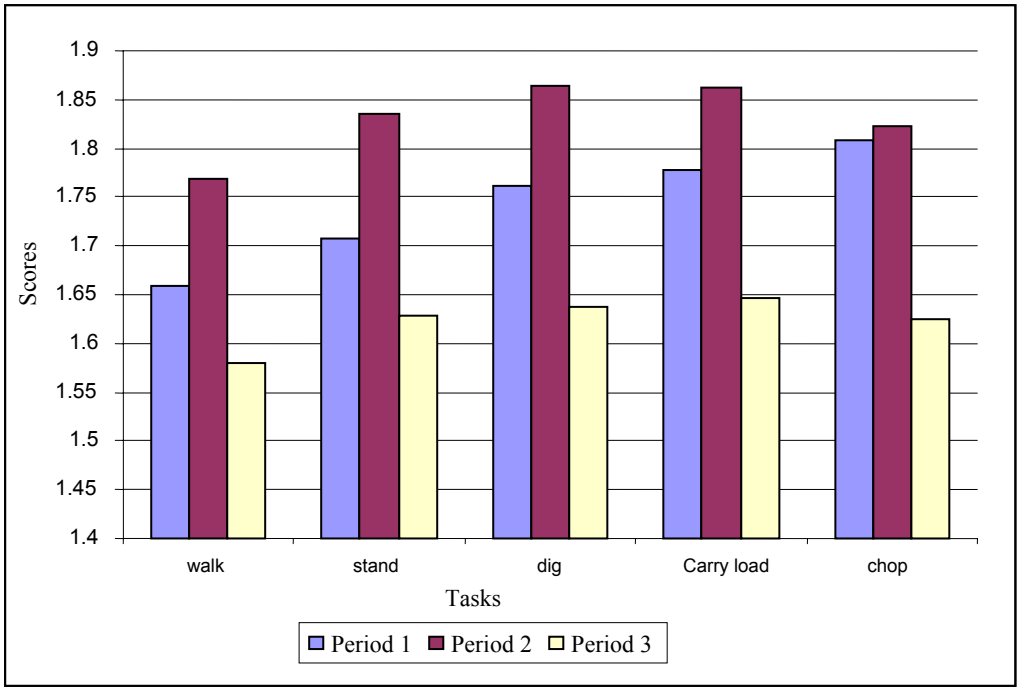

Figure 5.4 Scores of tasks by season

Since the interest in this analysis is in a pair-wise comparison over time, the fact that more than one individual in the household can have the same score in the three periods poses a problem. This is especially so for people who scored 1. Also, more than one individual can be matched to the same person. This would render observations not independent. In addition, households where individuals show no health difference would have to be excluded from the analysis, raising a selectivity problem. An additional problem is that since the scores are categorical, they fail to provide a cardinal health scale that can be used to measure inequality. For instance, it is not possible to compare the difference between a score of 1 and 2 and that between 3 and 4. The proposed measure *R* (and indeed other measures like the health concentration index and the related slope of inequality), require information on health in the form of either a continuous variable or a dichotomous variable (Doorslaer and Jones, 2003; Wagstaff and Doorslaer, 1994).

One of the methods adopted to scale the scores is to assume an underlying latent unobserved health status, h^* (Wagstaff and Doorslaer, 1994). The latent health variable is assumed to be related to some individual and household characteristics in the following way:

$$h_t^{i^*} = \beta_t^i X' + u_t^i \tag{5.12}$$

where X' is a vector of determinants of health status and β is a vector of coefficients to be estimated. u_t^i is a normally distributed error term, i for individuals and *t* the survey round. This method has been validated by Doorslaer and Jones (2003). The observed health status, i.e. the task score, is a categorical ordered response variable and can be mapped to the latent variable as follows:

$$\begin{aligned} h^i &= 0 \quad if \quad h^* \le c_1 \\ h^i &= 1 \quad if \quad c_1 < h^{i*} \le c_2 \\ &.. \quad .. \\ h^i &= 3 \quad if \quad c_3 < h^{i*} \end{aligned} \tag{5.13}$$

Where c_{1-3}, are the threshold levels. For a normally distributed error term, the probability of observing a particular value of *h* is:

$$P = \phi(c_m - \beta X) - \phi(c_m - \beta X), \tag{5.14}$$

where ϕ(.) is the standard normal distribution function. With independent observations, the likelihood for the ordered probit model is maximised to give estimates of β and the unknown threshold values c_m, where $m = 0 - 3$ in equation (5.14). Predictions of the linear index, $x\beta$, once rescaled to the [0,1] interval can then be used as a measure of individual health for each task. A mean score is then obtained from the prediction of the six tasks as the measure of health (*h*). The results of this estimation are shown in appendix 5.2.

5.3.2 The estimation approach for measuring changes in health inequality

In order to test whether current health status affects the implicit allocation of health goods (g) all else being equal, and whether there is a convexity in $f(g)$, the health difference ratio *R*, defined in equation (5.11) is used:

$$R_{t+1}^{i} = \frac{h_{t+1}^{i} - h_{t+1}^{i-1}}{h_{t}^{i} - h_{t}^{i-1}}$$

The average realisation of *R* is a measure of the intensity of the household's desire to equalise target health status of i and $i-1$ between two time periods. This target ratio can be viewed as a factor of a set of conditioning variables *X*, which may determine health and productivity. The household's expectation of *R* expressed as a function of *X* is:

$$R_{t+1}^{i} = ER_{t+1}^{i}(X_{t}^{i}) + e_{t+1}^{i} \qquad (5.15)$$

where e_{t+1}^{i} is a random error term centred at zero. From propositions 1 and 2, *R* is expected to increase as h_t^i rises, given the initial health difference ($h_t^i - h_t^{i-1}$). The incentives to equalise health status therefore depends on both h_t^i and $h_t^i - h_t^{i-1}$, and are hence included among the conditioning variables *X*. If the prime goal of households is equalisation, the coefficient for h_t^i is expected to be positive. A negative slope would indicate that productivity effects are present. Testing for a decreasing slope would be testing for the null hypothesis of a health–productivity relationship that is concave everywhere. The estimating equation is expressed as:

$$R_{t+1}^{i} = \gamma_1 h_t^i + \gamma_2 (h_t^i - h_t^{i-1}) + \gamma_3 x_t^i + \gamma_4 x_t^{i-1} + \gamma_5 x_t^H + e_{t+1}^i \qquad (5.16)$$

Where x^i and x^{i-1} are vectors of individual characteristics of member i and $i-1$ and x^H are the household characteristics. The variables h_t^i and $h_t^i - h_t^{i-1}$ may impact on *R* in a non-linear

manner. The forms of $\gamma_1\left(h_t^i\right)$ and $\gamma_2(h_t^i - h_t^{i-1})$ are investigated through non-parametric estimations.

Equation (5.16) exhibits obvious endogeneity. This is because of the existence of simultaneity between h_t^i, $h_t^i - h_t^{i-1}$, and R. Two stage least square regression is therefore adopted for the estimation of equation (5.16).

Variables considered appropriate as regressors are those that capture household exogenous events prior to the first period e.g. whether the household is identified as AIDS-afflicted, variables controlling for the asset position such as amount of land owned per labour force, livestock wealth in 2003, and value of assets acquired more than three years before the survey. The asset variables are expected to be positively related to health and probably negatively related to inequality in health outcome. But if productivity considerations are important, the coefficient for land per labour force can be positive. Also included is distance to the market and distance to the market interacted with the asset value. Market centres are regarded as the points from which HIV spreads to the rest of the population. A higher prevalence of HIV/AIDS would thus be expected closer to the market centres and therefore, lower health. But given that health facilities are normally located near market centres, this could mean a negative relationship between distance to the market and health status; and probably the health difference ($h_t^i - h_t^{i-1}$). The effect on R cannot therefore be determined a *priori*. People with more assets are expected to interact more with the market. Distance interacted with assets would therefore be expected to have the same sign as the HIV/AIDS dummy. Another variable related to health is having an ill member within a household and if either of the members had a chronic condition. Conditions considered chronic included asthma and other physical disabilities. While people with chronic illnesses are expected to be less healthy, a positive effect on R would exist if productivity concerns are important as household may invest less in such people.

Other variables include the measures of rainfall and crop shocks which are represented by the percent rainfall shortfall for the long rains season and the qualitative measure of a household-specific crop loss shock. Also included is the age and age squared of both members, and their years of education. To examine whether gender differences in health outcomes exist, a dummy variable for the person in better health i, being male is added. Given Figure 5.3, maleness is expected to be positively related to health. To examine whether sex matters for

health inequality, we include a variable if i is male interacted with i^{-1} being female. If work demanding physical strength is important, a dummy variable if main activity involves manual work is added. For identification, variables used as instruments are mainly identified through hypothesis testing. The identifying variables include the value of livestock, the member with better health being male and whether *i* had a chronic condition, being an AIDS-afflicted household and at the same time having ill member; and age of the less healthy member.

5.4 Results

The result of the non-parametric regression for the health index *R,* against initial health status is presented in Figure 5.5. An inverted U-shaped relationship is observed. The index first increases with initial health, as would be the case under the null hypothesis of an all increasing $f(g)$ and $y(h)$. However, a substantial declining range is observed suggesting that at some health levels, equalisation objectives may come into conflict with concerns about productivity. Due to the inverted U-shaped relationship, we add a quadratic term for h in estimating equation 5.16. Figure 5.6 shows the relationship between the health difference in period 1 and the health index. The incentives to equalise health at $t+1$ would be greater when the difference between the two members in the initial period *t,* is large. This supports a hypothesis of an all increasing $f(g)$ and $y(h)$ functions. To examine whether these univariate relationships still hold once other factors are controlled for, we turn to the results of the multivariate analysis.

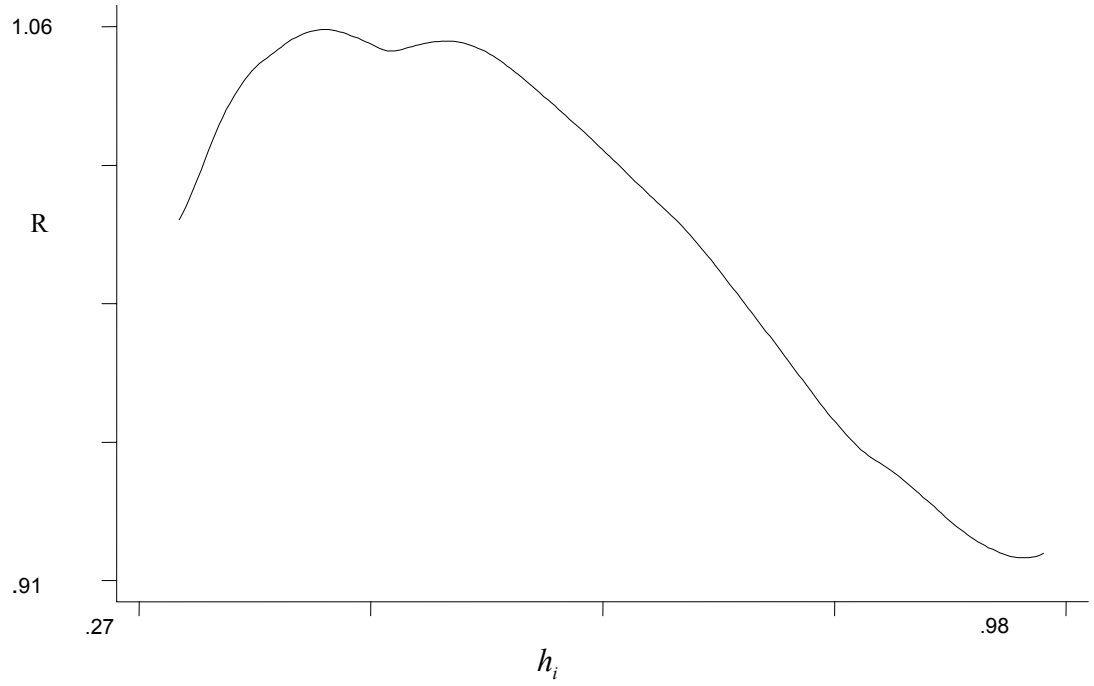

Figure 5.5 Health difference ratio (R) versus initial health

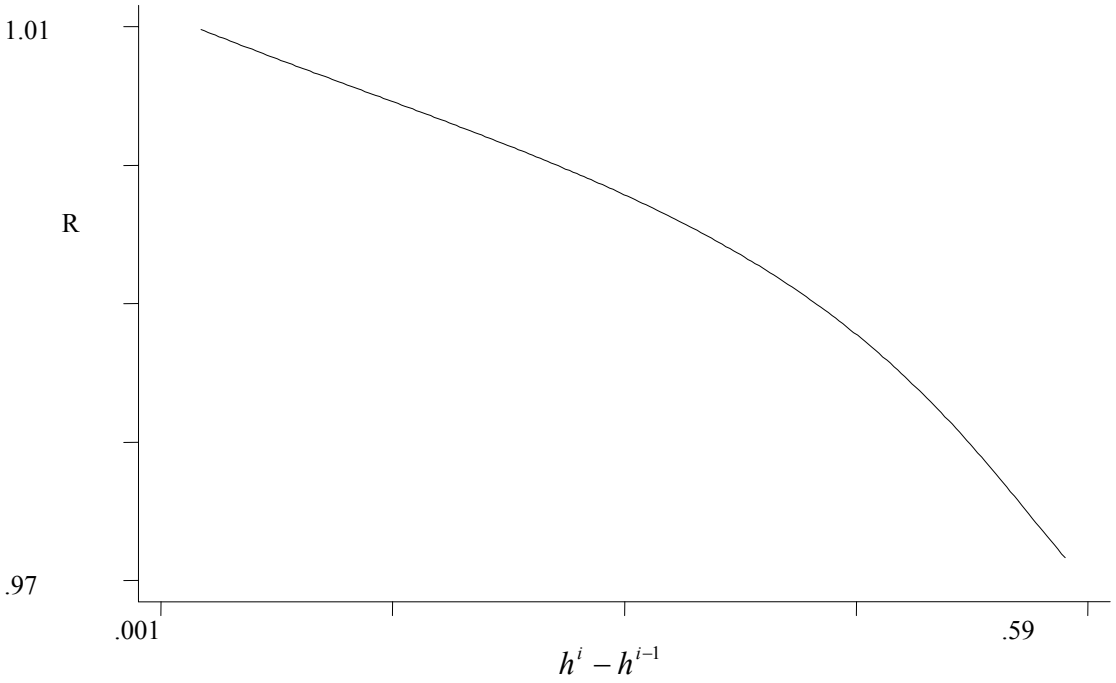

Figure 5.6 Health difference ratio (R) versus initial health difference

Table 5.1 Determinants for the health difference ratio (R)
(Two Stage Least Square regression).

	Coefficient (z-value)
$h^i - h^{i-1}$	-.42
	(-2.03)**
h^i	7.38
	(3.17)***
$(h^i)^2$	-5.05
	(-3.11)***
Education of member i	-.007
	(-1.12)
Education of member $i-1$	-.018
	(-2.02)**
Age of i	.003
	(1.49)
Significant crop loss (dummy=1)	.062
	(1.23)
% rainfall shortfall	0.16
	(1.67)*
HIV dummy	.06
	(1.64)*
Ill member dummy	0.09
	(2.28)**
If i is male & $i-1$ is female	.12
	(2.13)**
If i is male& does manual work	-.011
	(-0.29)
If $i-1$ has chronic condition	.124
	(1.58)
Log land/labour force	.03
	(1.74)*
Log assets value	-0.19
	(-1.70)*
Distance to market	-1.01
	(-1.78)*
Log assets *log distance	.21
	(1.89)*
Constant	-1.70
	(-2.04)**
N	236
R^2	0.06
F	0.01
	Coefficient (P-value)
Anderson canon. corr. LR statistic	58.55 (0.000)
Hansen J statistics	3.15 (0.68)

*** Significant at 1%, ** significant at 5%,* significant at 10%.
Instruments: Livestock value, age of $i-1$ and age of $i-1$ squared, household size, If member *i* has chronic condition and if i is male.

The instrumental variable estimates are shown in Table 5.1. The variables representing stressful conditions have a positive effect on the health index. Low precipitation, presence of an ill member and being AIDS-afflicted all increase the health disparity.

In line with the literature on human capital, education has the expected sign in that it reduces health disparity. The coefficient for the member with lower health $(i-1)$ is significant. More educated people are expected to make higher investments in their health. The coefficient for land per labour force is positively related to the health index. Although the coefficient is only significant at 10 percent, a positive sign is contrary to what one would expect if households desire to equalise health among members. However, a positive relationship would be expected if households with more land invest more in the relatively healthier person as productivity concerns may be important. Such households may be poor in the labour resource relative to land and given equation (5.10), productivity concerns may then be important. As expected, assets are negatively related to the health index, suggesting that poverty could be a cause for health inequality. The effect of distance from the market centre and distance interacted with assets are as expected in relation to the HIV/AIDS dummy. While distance has the opposite effect to the HIV/AIDS in that it reduces the index, when interacted with the value of assets, it increases it, suggesting that those with assets may interact more with the market centres thereby increasing their chances of encountering the virus.

On gender variables, the results show that having the person with better health being male and the next in rank being female, increases the health inequality. This would be the case if higher investments are made on men's health. However, this need not necessarily be due to gender discrimination. Pitt *et al*. (1990) observed that it is also likely that even when households are averse to inequality, within-household disparities in the allocation of the health good can still occur, if such allocations reflect greater participation by men in activities that are more sensitive to health status. To establish whether this is the case, the dummy for member i being male is interacted with the dummy for whether the person is in manual work. The influence of this variable on the health index is not significantly different from zero. This may suggests that either there are real gender inequalities in health or there is a systematic sensitivity to health conditions in women. Higher sensitivity would mean higher reporting of poor health conditions by women than would be the legitimate representation of their health status. If excess sensitivity to health conditions were the case, we would expect women to also report more days of work lost due to illness. However, during the survey period, more

households (91) reported more work days (3.2) lost by men due to illness. This is compared to 66 households reporting an average of 1.9 days not worked by women due to their own illness.

Research in other countries has shown that gender differences in adult health do indeed exist, even after controlling for selection by gender and socio-demographic factors. In Jamaica (Rahman *et al.*, 1994) and Bangladesh (Kuhn *et al.*, 2004), while women may have similar mortality rates as men or sometimes less, women spend most of their adult life in poor health, with the burden of ill health starting early in life. Our study lacks a measure to capture early life development such as height. If height is an important explanatory factor for health disparity for the households, its omission from the estimates would lead to an omitted variable bias.

Turning to the variables of interest, the initial health status h^i and the initial health difference $h^i - h^{i-1}$: both are statistically significant. The health difference is negatively associated with the health index, which agrees with Figure 5.6. The larger the initial health difference between pairs of individuals, the greater the desire to equalise health in the subsequent period. Hence, the lower would be the health disparity. However, the relationship between initial health status and the health index exhibits an inverted U-shape. The signs of h^i and h^i squared agree with Figure 5.5. Nevertheless, the estimated turning point for h^i of about 0.73 (95% CI= 0.68, 0.77) is much higher than that depicted in Figure 5.5.

While the null hypothesis of an all increasing health production function cannot be rejected because the sign h^i is positive, productivity incentives may also exist for these households. At some ranges of health, the health index is negatively related to initial health status, indicating that at such ranges households may attach greater weight to concerns about productivity than to equality. Indeed, about 46 percent of the households had *R* greater or equal to 1. Therefore, convexities may exist under certain circumstances. Nevertheless, given the sign of $h^i - h^{i-1}$ and the high turning point for h^i, the desire to equalise health status dominate. This finding is strengthened by the shape of Figure 5.7.

Figure 5.7 below presents a kernel regression of total income earned in period 3 against the health score of each person in period 1. The curve is concave for most of its range suggesting that equality considerations dominate. However, at very low health levels we observe the kink as described in Bliss and Stern (1978) and Barrett (2002) for individuals whose health status

is very near the minimum threshold for physical activity (m^*). A stationary section is also observed at higher levels of health. It is likely that other constraints may come into play at high levels of health. The two stationary levels may point to possible existence of more than one equilibriums holding other factors like technology constant. The higher stationery level probably explains the turning point of h at a relatively high level of health status.

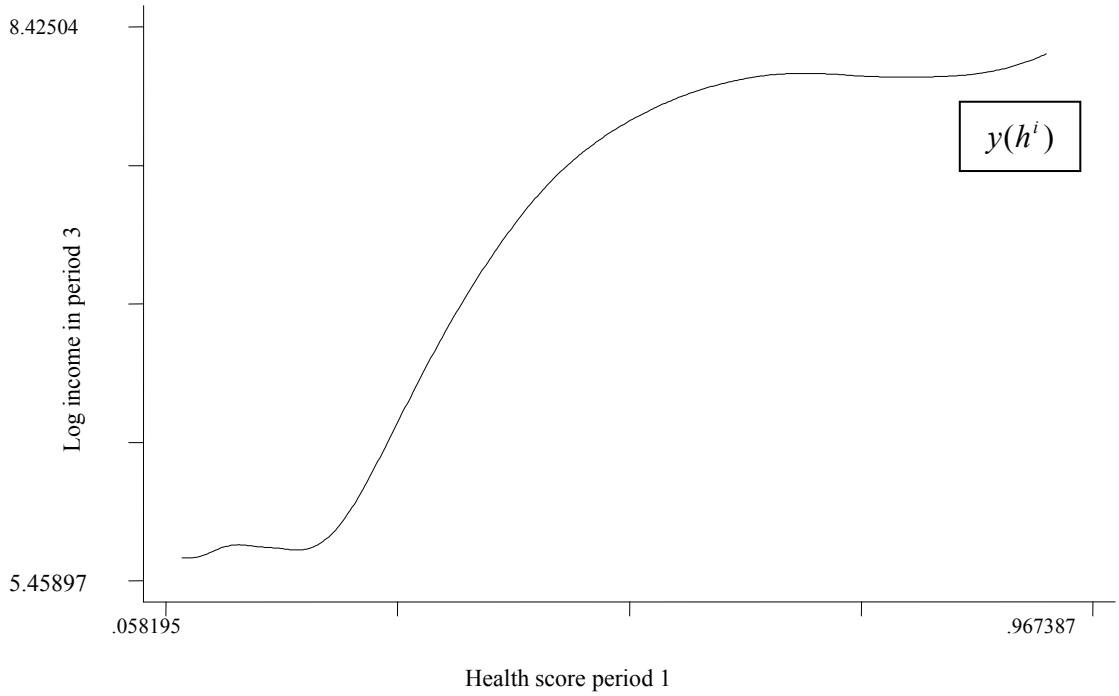

Figure 5.7 Income in period 3 versus health score in period 1

5.5 Conclusions

Using a ratio of health differences between working-age adult members of the same household in two periods, this chapter attempts to examine the dominating incentive for allocation of health goods within a household. Households can be driven by either a desire to equalise health status of its members or by productivity concerns while dealing with health outcomes. When concerns about equality dominate, sacrifices are likely to be made in generation of current income. Whereas if considerations about productivity dominate, household may buffer stock in health and it is likely that less will be invested in the less healthy individuals. The results suggest that while equality incentives dominate, productivity considerations may also be important at some health levels. Even when households seem better-off, for example, having more land per working age adult, the incentive to buffer stock in health would lead to individuals in poor initial health seeing their health status worsen over time. A possibility of a health poverty trap then arises.

The evidence of productivity incentives is similar to findings reported by Dercon and Krishnan (2000a) and Osborne (2004) for rural Ethiopia. Using the same Ethiopian data set, Croppenstedt and Muller (2000) provide evidence for a link between health, nutritional status and agricultural productivity. They show that elasticities of labour productivity with respect to nutritional status are strong especially in the context where separability between consumption and production decision is rejected. The findings presented in this chapter add to this prior evidence on the link between health and productivity. In addition, the results indicate that the relationship between health and income generation may have implication for within-household gender inequality. There exist gender disparities in health in favour of men.

Not surprisingly, the presence of HIV/AIDS is found to increase health disparities within a household. Where public resources are limited, greater return to investment would be derived by targeting the most vulnerable groups within the households. One possible avenue is through investments in education as we find education, especially for those with lower health, significantly reduces health disparity. However, such a policy would undoubtedly have implications on political economy. The same gender or other biases driving the within-household inequalities may exist in the decision-making arena. In her examination of the relationship between public action and the family relations, Agarwal's (1991) observes that, the greater the "external" vulnerability of particular household members to deprivation, the

greater is their "internal" vulnerability to inequitable treatment. But given that we find equality considerations dominate households' motives for allocating the health goods, the broader public policy should be increased investments in income generating activities. The finding of dominance of equality considerations is consistent with the positive compensated wage effects in Chapter 4 which is partly supportive of family utility maximisation.

Availability of a longer panel would assist in revealing the long-term implications of these short-term changes in health outcomes. Nevertheless, even with the limited data, we have been able to show empirically the possible existence of two equilibriums, one of which may hinge on initial health condition. According to Barrett (2005), while establishing the existence of endogenously increasing rates of return to assets is one research challenge, the more difficult task is to identify the thresholds at which welfare dynamics appear to bifurcate. These are the points where one can usefully distinguish between those who remain above the threshold and can therefore recover on their own, and those below the threshold who need "cargo nets" to literally pull them out of the poverty traps (Barrett, 2005; Barrett and McPeak, 2005). In this study, the data points to two possible steady states: one at a lower level, signalling low health and therefore necessity for health interventions, and another higher up, which may signal other constraints to production (for example, financial or technological constraints). According to Barrett (2005) the proper positioning of a health safety net would therefore be just above the lower threshold.

6 Effects of ill-health and weather variability on savings

6.1 Introduction

This chapter discusses the effects of household shocks on saving behaviour. As observed in Chapter 3, a variety of coping mechanisms may exists for dealing with shocks after they occur. Households may also foresee shocks and take measures *ex ante*. *Ex ante* mechanisms mainly entail asset and livelihood diversification. Examination of the asset and livelihood portfolio is in itself of importance, since the effects of income volatility on a household's savings decisions forms the underlying link between the income generation process and poverty. This was partly demonstrated in Chapter 5, where it was shown that the possibility of buffer-stocking in health can result in those with low initial health being trapped in low health status.

The goal in this chapter is to determine whether households are also forward looking in their savings behaviour; that is, whether they are able to manage risks by saving *ex ante* to buffer consumption against shocks. A number of studies have shown that households in developing economies exhibit prudence in that savings decisions reflect expectations of future income (Deaton, 1991; Ersado *et al.*, 2003; Kochar, 2004; Kong *et al.*, 2005; Paxson, 1992). Lundberg *et al*. (2003) and Kong *et al*. (2005) examine health uncertainty and empirically test for precautionary behaviour. Kong *et al.* (2005) show that health uncertainty among the Korean elderly motivates precautionary behaviour by holding down overall consumption and building up medical savings. Lundberg *et al*. (2003) examine whether death predicts savings. They find that death reduces the likelihood that households will save and increases the likelihood of dissaving among the poor. Although other studies have documented that health affects total wealth accumulation (Kong *et al.*, 2005; Rosen and Wu, 2004; Smith, 1999), much less research has been done on how health influences the allocation of that wealth to various assets and livelihood strategies. Rosen and Wu (2004) analyse the role of health status on the portfolio choice of the elderly in the United States. They find that health significantly predicts both ownership and share of financial wealth in each asset category.

Examining the role of health on wealth accumulation and allocation is not only relevant for the elderly within a population. In a country with high levels of HIV infection, there is likely to be great uncertainty about future health. Furthermore, the uninsurable nature of the illnesses may induce households to hold more liquid assets or engage in more flexible livelihood activities that allow them to meet their medical needs as they arise. Several studies providing

evidence on the impacts of HIV/AIDS have shown that households may change their sources of livelihoods in response to the impacts of prime age deaths: less of the farm may be cultivated, crop and off-farm enterprises may change (Haddad and Gillespie, 2001; Yamano and Jayne, 2004). Lundberg *et al*. (2003) describe the savings behaviour preceding death, irrespective of the status of the deceased member within the household. The analysis in this chapter differs from Lundberg *et al*. (2003) in that it focuses on the illness of both the male and female heads and compares how the saving behaviour relates to health-induced uncertainty while controlling for weather uncertainties. The main objective is to estimate the marginal propensity to save out of transitory income (MPS_T). A high MPS_T is suggestive of high prudence. The magnitude of MPS_T can also be used as a measure of the completeness of credit and insurance markets (Morduch, 1991).

Although it is difficult to differentiate between the continuum of *ex ante* behaviour and *ex post* mechanisms within the short period covered in this study, when assessing forward-looking behaviour we use a methodology previously adopted for cross-sectional data (Paxson, 1992). The study recognises that household members are not passive to shocks and that people adapt to their new outcomes. The adaptation to current outcomes may entail reorganisation of their assets and livelihoods, with an eye to the possibility of recurring episodes of negative events. Detecting an effect of current illness or rainfall shortage on past savings can provide information on the extent to which income variability may impact on short-term well-being. The short-run effects may have long-term consequences for poverty (Dercon, 2005). Such effects also provide information on what kinds of households are most sensitive to shocks. If adaptation results in more liquid assets being held, then poverty for such households is likely to increase with time as wealth growth declines.

This chapter is organised in the following way. Section 6.2 presents the theoretical framework for savings behaviour. Section 63 develops the empirical model of savings in the presence of fluctuations in transitory income and describes the savings measures used in the analysis. Section 6.4 presents the results and section 6.5 concludes.

6.2 Theoretical framework

The basic essence of the saving behaviour is the allocation of resources over time. So, an intertemporal choice model is developed. The model draws from Deaton (1997: pg. 357-363). Consider maximisation of the following intertemporal expected utility:

$$u = E_t \sum_{t=0}^{T} \delta^t U(c_t) \tag{6.1}$$

where δ controls the rate at which future utility is discounted relative to current utility. Subject to information available at time zero and a budget constraint:

$$A_{t+1} = (1+r_t)A_t + y_{t+1} - c_{t+1} \tag{6.2}$$

with T large enough and assets zero or non-negative, the maximisation problem yields the standard Euler equation: that the marginal utility of current consumption is equal to the discounted expected marginal utility of future consumption.

$$u'(c_{it}) = \delta(1+r)Eu'(c_{it+1}) \tag{6.3}$$

This specification ignores the inseparability of labour income and asset income, which is a plausible scenario for livelihood strategies in developing economies. It also assumes no borrowing constraints and that lending is at the same interest rate. However, Deaton notes that this basic model elucidates the savings behaviour where households rely on incomes largely determined by weather factors and where capital accumulation is not an integral part of livelihoods (pg. 358).

Under certain assumptions, equation (6.3) is consistent with the permanent income hypothesis (PIH) and the simplest form of life-cycle model (LC). To see these, suppose that each period's sub-utility is identical up to a discounting factor, so that

$$v(c_t) = (1+\delta)^{-t} v(c_t) \tag{6.4}$$

where δ controls the rate at which sub-utility tomorrow is discounted relative to sub-utility today. Suppose the interest rate (r) is constant, so that if $\lambda(c)$ is the derivative of $v(c)$

$$\lambda(c_t) = \frac{(1+\delta}{(1+r)} E_t \lambda(c_{t+1}) \tag{6.5}$$

and if $\delta = r$, for quadratic utility function, (6.3) takes the special form:

$$c_t = E_t c_{t+1} \tag{6.6}$$

This equation says that consumption is a "martingale", a stochastic process whose expected future value is its current value. The transition from (6.3) to (6.6) rules out variations in real interest rates and imposes unreasonable homogeneity in the household's structure. Also, the transition from (6.4) to (6.6) rules out precautionary behaviour which is likely for people living in an uncertain environment. The implication for the presence of uncertainty is examined below in section 6.2.1.

The inference from (6.6) for the optimal path is such that consumption is expected to be constant over the remainder of the decision period. In a life-cycle interpretation, this martingale property is the constant consumption and savings property of the simplest of the "stripped-down" versions of the life cycle model. While the PIH does not assume constant consumption, it is essentially the same. It states that consumption is equal to permanent income, which is defined as the annuity value of the sum of current assets and the discounted present value of expected future earnings. With the absence of uncertainty, permanent income will be constant, and so will be consumption. With stochastic earnings, permanent income is revised as expectations about income are revised, but since permanent income is itself an expected value, its expected change is zero, and it is itself a martingale. The strong assumptions used to derive the constant consumption/constant expected consumption implied by the PIH and LC models are unlikely to hold for poor countries, where precautionary motives are likely to be important (Deaton, 1997: pg. 360).

6.2.1 Precautionary saving

Another problem with both PIH and LC models is that they fail to address situations when there are uncertainties and when the marginal utility is nonlinear. If the marginal utility of the consumption function $\lambda(c)$ can be thought of determining a "shadow price" of consumption, because there is diminishing marginal utility of consumption, this price is higher when consumption is low than when it is high. It is also possible for marginal utility of consumption to rise more rapidly when consumption is low than when it is high: for example, if there is a subsistence level of consumption, as consumption falls to that level the marginal value of consumption might tend to infinity. In this way, the marginal utility of consumption function is convex. This convexity has implications for equation 6.5.

If the marginal utility of consumption function is convex, increases in the uncertainty of future consumption increases its expected future value. Therefore, the current marginal utility of consumption must also increase to preserve the equality in 6.5. Since marginal utility is diminishing, this means that current consumption will fall and saving will increase. Since (6.5) also implies that the marginal utility of current consumption is the appropriately discounted expectation of the marginal utility of consumption in any future period, the same argument shows that an increase in uncertainty in consumption will increase current savings. Such saving can be thought of as precautionary saving.

The subsequent analysis incorporates uncertainty due to ill health and rainfall variability and tests for the implications of the PIH and LC models. While the effect of illness on savings is expected to be positive since the households lack medical insurance, the effect of AIDS-related or other terminal illnesses may be different. While anticipation of ill health may increase savings, as the illnesses progress, increased demand for medical expenditure may reduce savings. However, given that we are dealing with multiple member households, the need to leave bequests may confound a *priori* judgement of behaviour. Bequest motives provide an incentive to smooth the consumption of the survivors. This brings in the issue of portfolio composition. We may expect an increase in durable assets if a motive for smoothing future consumption is strong. Since illness and the presence of HIV/AIDS are expected to contain information about future incomes and therefore consumption, we examine whether they exert any significant influence on saving and the composition of assets.

6.3 Empirical approach

Several methods have been used in the literature to investigate whether individuals make provision for the future. Deaton (1991), Udry (1995), Guiso *et al*. (1996) and Kochar (2004), all following Campbell (1987), tests whether savings predict future changes in income. The empirical approach we follow is adopted from Paxson (1992) and Alderman (1996). Savings are taken as linear functions of permanent income (Y_{it}^{P}), transitory income (Y_{it}^{T}), income variability (VAR_{it}) and a set of variables that measure the life-cycle stage of a household (LC_{it}). This is expressed as:

$$S_{it} = \alpha_{ot} + \alpha_1 Y_{it}^{P} + \alpha_2 Y_{it}^{T} + \alpha_3 VAR_{it} + \alpha_4 LC_{it} + \varepsilon_{it} \qquad (6.7)$$

where S_{it} is per capita saving for household i in period t, and ε_{it} is an error term. Permanent income is defined over a short time horizon as expected income for period t conditional on the resources and information available at the beginning of the period. This concept of permanent income is different from the definition in life-cycle models in which permanent income is defined as the annuity value of lifetime wealth. Empirical tests of the effect of α_3 on savings would show whether people with more uncertain income save more on average than those with more stable income streams. However, without long panel data, it is difficult to compute measures of income variability suitable for this analysis. For this reason, we follow Paxson (1992), who combines cross-sectional household information and a set of variables that measure the variability of regional rainfall as the proxy for VAR. For livelihoods which are largely dependent on agriculture, more variable rainfall is likely to yield more variable incomes. Also included in the VAR is a dummy for affliction with HIV/AIDS. Following Rosenzweig and Binswanger (1993), we interact the VAR variables with wealth.

The life-cycle factors in LC_{it} consist of variables that measure the number of household members in a number of age-sex categories. Included are number of household members in the following age classes: 5 years or less, 6–14, 15–17, 18–64, and above 65. The life-cycle models suggest that households with greater numbers of young children and older members can be expected to save less, since their current labour income is less than the annuity value of their lifetime wealth. Furthermore, if parents rely on their children for support in old age, then expenditure on children may serve as a substitute for savings, implying that households with more children may save even less. However, the presence of HIV/AIDS implies shorter lifespan for parents. How this impacts on savings behaviour is an empirical issue. For instance, while the need to meet immediate medical expenses may mean liquidation of assets, the need to leave stable income streams for children may lead to an increase in desire to maintain or acquire productive or more durable assets.

6.3.1 Estimation of permanent and transitory incomes

To estimate the permanent component of income, the following equation is specified:

$$Y_{it}^{P} = \beta_t^{P} + \beta_1 VD + \beta_P X_{it}^{P} + u_{it}^{P} \qquad (6.8)$$

where X_{it}^{P} represents a vector of household-fixed variables that are determinants of permanent income. This includes education and sex of household members; and ownership of physical assets. More education is expected to make people less myopic and hence save more. Households with more females are expected to have a different saving behaviour than households with more males. Some intra-household studies indicate that women tend to spend more of their income on food, child health and education. (Jianakoplos and Barnasek, 1998; Quisumbing and Maluccio, 2000). VD are village dummies, β_t^{P} is a seasons effect common to all households and u_{it}^{P} is a random error term with zero mean.

The transitory income is expressed as:

$$Y_{it}^{T} = \beta_t^{T} + \beta^{T} X_{it}^{T} + u_{it}^{T} \qquad (6.9)$$

where X_{it}^{T} is a set of variables that affect transitory income. We include the percent rainfall shortage, a qualitative index of crop loss measuring the farmer's perception of loss experienced due to the severity of drought in each cropping season; the number of work days lost by male and female spouses due to ill health and the latter interacted with the HIV/AIDS dummy. Interaction of ill days with the HIV/AIDS dummy helps differentiate effects of illnesses due to HIV from other illnesses. Paxson (1992) did not have information on household-specific variables of transitory income. The effect of household-specific shocks on savings was therefore included in the error term u_{it}^{T}. β_t^{T} is a season's effect common to all households. For the rainfall shock, the precipitation in the two critical periods in the crop cycle is considered: the planting season and the weeding season (which also captures the growth phase).

Equations (6.8) and (6.9) are combined to form an equation for total income as:

$$Y_{it} = \beta_{0t} + \beta_1 VD + \beta^{P} X_{it}^{P} + \beta^{T} X_{it}^{T} + \mu_{it} \qquad (6.10)$$

where $\beta_{0t} = \beta_t^{P} + \beta_t^{T}$. Equations (6.8) and (6.9) can also be substituted into the structural savings equation (6.7):

$$S_{it} = \alpha_{ot} + \alpha_1\left[\beta_t^P + \beta_1 VD + \beta^P X_{it}^P\right] + \alpha_2\left[\beta_t^T + \beta^T X_{it}^T\right] + \alpha_3 VAR_{it} + \alpha_4 LC_{it} + \varepsilon_{it}$$

$$S_{it} = \rho_{0t} + \rho_1 VD + \rho_P X_{it}^P + \rho_T X_{it}^T + \alpha_3 VAR_{it} + \alpha_4 LC_{it} + \varepsilon_{it} \qquad (6.11)$$

where $\rho_1 = \alpha_1\beta_1$ $\quad \rho_{0t} = \alpha_{ot} + \alpha_1\beta_t^P + \alpha_2\beta_t^T$; $\rho_P = \alpha_1\beta^P$; $\rho_T = \alpha_2\beta^T$

Noting that the variables in LC_{it} and VAR_{it} are collinear with X_{it}^P, a reduced form of the savings equation can be written as a function of the X's :

$$S_{it} = \gamma_{it} + \gamma_0 VD + \gamma_P X_{it}^P + \gamma_T X_{it}^T + \eta_{it} \qquad (6.12)$$

The variable η_{it} in (6.12) is a vector of error terms, γ_P reflects the impact of X_{it}^P on savings through its effect on permanent income, and γ_T measures the impact of transitory variables on savings. γ_o captures the village effects. The key restriction derived from the PIH is that $\gamma_T = \beta^T$. The more complete are the financial markets, the closer γ_T is to one. Therefore, we expect γ_T not to be significantly different from 1. This also implies that the effects of the elements of X_{it}^T on savings should be identical to their effect on income. In other words, transitory shocks should affect income and savings in an identical manner and that X_{it}^T variables should have no effect on consumption. Positive and significant γ_T or a finding in favour of the PIH would indicate that households save in anticipation to future changes in income. Similarly, the hypothesis that the propensity to save out of permanent income should not be significantly different from zero (i.e. $\gamma_P = 0$) implies that all variables in X_{it}^P should have no effects on savings. Such variables should strictly be only those that are not collinear with LC_{it}. However, it may be difficult to find such variables, especially with only a few cross-sections of about a year and half. For instance, the value of assets is likely to be correlated with age. Indeed, we find age of the household head to be negatively correlated with education and cannot be considered independent (Spearman's rho = -0.30). To avoid simultaneity between current income and assets, only the value of those assets acquired three or more years before the first round survey are used. The analysis was done for changes in savings in each survey period.

Paxson (1992) uses two-step estimation to approximate the marginal propensity to save out of transitory income. She retrieved the predicted values of the transitory and permanent components of income from the reduced form estimates, which are then used in a second-

step savings equation. However this method, as Paxson notes, is inefficient. An alternative approach is to estimate using instrumental variables. The instrumental variables for transitory income include percent rainfall shortfall, the crop loss index and days of ill health. The assumption made is that rainfall shortage and crop loss affect transitory income only, not permanent income. This assumption would fail if prolonged drought persists and affects people's ability to generate income in subsequent periods. Given that the drought during the survey year was not sufficiently serious to adversely affect the health of most people in the area, we take this assumption as reasonable. However, the assumption does not hold for ill health. Ill health in the current period can affect permanent income. So, health variables also enter the second-stage estimation. The instrumental variable estimations are also used to check the validity of the reduced form results. However, with this estimation strategy, we only compute the marginal propensity to save out of transitory income and not the marginal propensity to save out of permanent income. But since the interest in this chapter is to test consumption smoothing using savings, the computation of the marginal propensity to save out of transitory income is sufficient.

To examine the effect of uncertainty on asset composition we use the long rains season's income shocks (the second period survey) against the various forms of savings observed during the first period survey. Censored estimations are performed, since most of the households record zero for some forms of savings. This analysis follows a strategy employed by other authors who have examined whether variations in health exert significant effect on the ownership of a particular form of asset (Alderman, 1996; Kochar, 2004; Rosen and Wu, 2004).

6.3.2 Savings and income measures

Total household income was estimated as a sum of household earnings from farming activities, wage, business, transfers and rents. The savings measures are derived from the investment behaviour. Savings was defined as reported purchases minus sales of assets (mainly livestock) and cash savings. We also included expenditure on consumer durables in each survey period. Consumer durables like furniture or clothing provide services over several years or at least several seasons and so allow current income to contribute to future utility. Paxson notes that computing savings in this manner may have serious problems if purchases and sales of farm animals and equipment are not explicitly measured. This problem was minimised in this survey as extra effort was made to record all the household purchases three

months prior to each survey. In the first round of survey, retrospective data was collected for 6 months and one year period. Computing savings as the observed savings has the advantage of being uncorrelated with errors in estimated income. Savings computed as a residue of income and expenditure is likely to be correlated with errors in income. Although the respondents were assured of the confidentiality of the information provided, cash savings may have been underestimated if the savings are in unrecorded form: for example, kept under the mattress.

6.4 Results

Estimates for both the reduced form and structural equations are shown in Tables 6.1 to 6.3. The results are presented for each season. We will first discuss the results of the reduced form income and savings equations (6.10) and (6.12); and later return to the estimates for the structural savings equation (6.11).

6.4.1 Reduced form income and savings estimates

The reduced form equations test for the implications of the PIH on savings behaviour. PIH implies that the effect of transitory variables on income should be equivalent to their effect on savings and that there should be no significant effect on consumption. The test results are presented at the bottom of Table 6.1. The significance of the transitory rainfall variables is first examined and the results are shown as Test 1. The test rejects the hypothesis that the effects of the transitory rainfall variables are jointly equal to zero in both the savings and income equations for all three periods. In particular, rainfall shortage at planting time is significant in all the estimations. During the first survey for example, a 1 percent reduction in rainfall from its mean at planting time results in loss of income of about KSh. 28 and a dissaving of about KSh. 41. This reduction in savings is substantial given the daily wage for hired farm labour is about KSh.90 (US$ 1.20). At the mean rainfall shortfall of 25 percent (Table 2.4), this translates to a dissaving of about KSh. 1050, or close to two weeks' earnings. Test 2(a) tests for the equality of the effect of transitory rainfall shock on income and savings. The tests lead to acceptance of the null hypothesis that the effect of the transitory rainfall variables on income is identical to their effect on savings in all the three periods.

Table 6.1 Reduced form estimates for per capita income and per capita savings equations for the three periods (Seemingly Unrelated Regression)

Variables	Period 1 Minor cropping season		Period 2 Main cropping season		Period 3 Minor cropping season	
	Income	Savings	Income	Savings	Income	Savings
			Coefficient (z-value)			
# aged < 6	-209.02	-425.83	-.426.69	314.67	-542.34	64.84
	(-0.75)	(-1.41)	(-1.05)	(1.02)	(-94)	(0.23)
# aged 6–14	-427.49	-399.60	-202.62	-298.60	-228.27	-238.97
	(-2.88)***	(-2.48)***	(-0.87)	(-1.71)*	(-0.78)	(-1.60)
# aged 15–17	-492.81	-728.82	-156.97	-134.51		
	(-1.17)	(-1.59)	(-0.22)	(-0.25)		
# aged > 65	-2030.48	-1561.68	309.04	752.67	-241.77	-127.01
	(-3.45)***	(-2.45)***	(0.36)	(1.16)	(0.21)	(-0.22)
# males aged 18–64	-145.62	-293.58	-276.29	22.91	-338.03	-220.42
	(-0.93)	(-1.73)*	(-1.31)	(0.13)	(-1.01)	(-1.34)
# females aged 18–64	-445.27	580.71	-342.71	-421.70	-338.03	162.47
	(-1.14)	(1.35)	(-0.66)	(-1.09)	(-0.60)	(0.58)
Average education male 18–64	25.91	-41.23	96.44	-84.04	392.93	141.0
	(0.33)	(-0.48)	(1.31)	-(0.90)	(1.78)*	(1.66)*
Average education female 18–64	-108.35	105.75	163.86	44.47	316.48	117.30
	(-1.21)	(1.10)	(1.71)*	(0.47)	(2.37)**	(1.34)
Log Asset	177.35	509.21	488.20	3485.21	545.56	690.12
	(0.84)	(2.24)**	(1.59)	(1.74)*	(1.31)	(3.28)***
Log Land	936.62	606.34	575.14	811.85	1059.47	116.14
	(3.07)***	(1.83)*	(1.71)*	(3.00)***	(1.64)*	(0.34)
Ill days	-3.24	-20.25	8.89	6.68	-20.06	-11.33
	(-0.15)	(-0.87)	(0.96)	(0.95)	(-0.62)	(-0.46)
HIV*ill days	-12.17	-20.76	-48.55	-67.80	-2.97	-11.33
	(-0.04)	(-0.64)	(-1.41)	(-2.58)***	(-0.06)	(0.34)
Crop loss index	-387.94	-454.13	-595.14	-152.62	-1167.71	-574.23
	(-2.49)***	(-2.66)***	(-2.75)***	(-0.94)	(-2.62)***	(-2.54)***
% rainfall shortfall planting	-28.50	-41.35	-48.57	-34.70	- 110.80	-34.57
	(-2.78)***	(-3.05)***	(-3.13)***	(-2.94)***	(-2.00)***	(-2.39)**
% rainfall shortfall weeding	-21.14	-10.15	-23.55	-23.22	-14.45	-18.74
	(-1.14)	(-0.35)	(-1.82)*	(2.15)**	(-0.28)	(-0.85)
N	182	182	166		169	
χ^2	70.61***	87.60***	48.98***	46.61***	43.04***	57.80***
R^2	0.28	0.32	0.23	0.21	0.20	0.25
Hypothesis Tests χ^2 (P-value)						
[1]Test1	7.84(0.02)	10.94(0.01)	9.83(0.01)	10.21(0.01)	5.29(0.07)	5.71(0.06)
[2]Test2						
(a)	0.94(0.62)		1.26(0.53)		3.57(0.17)	
(b)	0.19(0.66)		5.06 (0.02		2.23(0.14)	
[3]Test3		8.40(0.02)		9.18(0.01)		11.68(.003)

[1]Test 1: The rainfall variables are jointly equal to zero

[2]Test 2: ($\gamma_T = \beta_T$)

a) The effect of the rainfall variables on income is the same as the effect on saving:

b) The effect of crop-loss index on income is the same as the effect on saving

[3]Test 3: The joint effect of assets and land on savings is equal to zero ($\gamma_P = 0$).

Table 6.2 Log per capita food consumption

Variables	Period 1	Period 2	Period 3
	Coefficient (z-value)		
# aged <6	-0.06	-0.05	-0.08
	(-1.01)	(-0.83)	(-1.24)
# aged 6–14	-0.10	-0.08	-0.20
	(-3.10)***	(-2.26)**	(-5.27)***
# aged 15–17	-0.20	-0.20	-0.15
	(-2.11)**	(-1.76)*	(-2.05)**
# aged > 65	-0.29	-0.12	-0.30
	(-2.14)**	(-0.89)	(-2.42)**
# males aged 18–64	-0.06	-0.10	-0.28
	(-2.00)**	(-2.83)***	(-7.07)***
# females aged 18–64	-0.11	-0.08	-0.20
	(-1.26)	(-0.99)	(-2.82)***
Average education male aged 18-64	-0.02	0.01	
	(-1.25)	(0.30)	
Average education female aged 18–64	-0.02	0.01	
	(-1.25)	(0.31)	
Log Asset	0.21	0.16	0.05
	(4.52)***	(3.53)***	(0.99)
Log Land	0.05	0.04	0.03
	(0.70)	(0.73)	(0.31)
Ill days	-0.01	-0.0003	-0.01
	(-2.74)***	(-0.22)	(-2.58)***
HIV*ill days	0.02	0.01	0.01
	(2.49)**	(1.05)	(2.30)**
Crop loss index	-0.08	-0.01	-0.16
	(-2.39)**	(-0.15)	(-2.85)***
% rainfall shortfall planting	-0.01	-0.53	-0.84
	(-3.15)***	(-2.19)**	(-2.27)**
% rainfall shortfall weeding	0.0003	-0.17	0.19
	(0.10)	(-0.95)	(0.33)
No. of observations	182	166	169
χ^2	112.16***	64.40***	144.60***
R^2	0.38	0.29	0.46
[1]Test χ^2 (P-value)	10.67 (0.005)	4.84 (0.09)	6.77 (0.03)

*** Significant at 1%, ** significant at 5%,* significant at 10%.

[1]The rainfall variables are jointly equal to zero

Although equality of coefficients of the rainfall variables in the savings and income equations cannot be rejected, the PIH effect may be a weak one, given the significant adverse effect of low precipitation at planting time on consumption in all the three periods (Table 6.2). Even though households show some prudence, the significant effect on consumption suggests that households are still unable to completely buffer consumption against income shortfalls resulting from low precipitation.

Test 2(b) shows that the equality of the coefficients of the household-specific crop loss index on savings and income cannot be rejected for first and third rounds. This hypothesis would be expected to hold since households observe the crops grow and would therefore be expected to make better judgment on crop outcome and prepare accordingly. However, the second period seems inconsistent with this argument. Crop loss has no significant effect on saving leading to rejection of the PIH for this season. It could also be that having been a much more stressful period, people's prudence may have been adversely affected. We also note that the acceptance of the null of the PIH in the third period is at the margin (*p-value = 0.14*), compared to the first period (*p-value=0.66*), showing that seasonality does impact on people's precautionary behaviour. From Test 2(a), the level at which we accept the PIH for the rainfall variables also declines as we move from period 1 to 3.

Another implication of the PIH is that savings are unrelated to permanent income. This relationship implies that after controlling for life-cycle effects, the permanent income variables such as land ownership and other assets should have zero impact on savings. The results presented as Test 3 do not support such an assertion for any of the seasons. Asset ownership variables are jointly significant for the three periods. Land size and assets are positively related to savings, suggesting that households with more assets save more.

The effect of family composition does not show a strong and consistent pattern between savings and age structure. The signs of the coefficients are mixed across the equations. However, where significant in the first period, they are consistent with the theory. Households with more elderly members and young children save less.

Turning to the health variables, although the effects of ill days and being an AIDS-afflicted household are generally negative, they are not significant apart from the second period savings equation. From Table 6.2, we find being AIDS-afflicted and ill is positively associated with per capita food expenditure. The positive effect can be explained by the fact that there is greater need to maintain good nutritional status for HIV patients. The need to meet immediate consumption needs may hamper the desire/ability to smooth future consumption. This argument however, may not apply to illness in general. Ill days without the interaction with the HIV/AIDS dummy reduce food consumption.

6.4.2 Results of the structural equation: marginal propensity to save out of transitory income

The instrumental variable results for equation 6.7 fail to agree with the reduced form estimates in that they lead to a rejection of the PIH (Table 6.3). The results, however, agree with the observation made earlier that the PIH effect is weak in the sense that consumption is affected (Table 6.2). Households do not save as much of their transitory income as the PIH would predict. The average marginal propensity to save out of transitory income is about 0.33. The hypothesis that the coefficient in each period is equal to unity is rejected at 1 percent level of significance. These findings are close to Ersado *et al*. (2003), who estimated a marginal propensity to save out of transitory income of 0.36 for rural Zimbabwe, but differ from Paxson (1992) who showed households to save a large proportion of their transitory income (0.78–0.83). The Thai households examined by Paxson were much wealthier (middle-income category) than those examined here and in Zimbabwe. In much poorer households, budgeting of transitory income can be expected to deviate substantially from the theoretical prediction that all transitory income is saved. The ability to use savings to smooth consumption is much lower during the second period, possibly in response to the dry spell, which agrees with Test 2 in Table 6.1.

The coefficients for planting season rainfall variability (CV) are all positive. The third period is significant. The positive effect implies high rainfall variability at planting time leads to more savings indicating prudence. When rainfall variation interacts with wealth, the first period shows that farmers' precautionary balances may decline as the sign is negative and significant. Reduction of precautionary balances with wealth would suggest that poorer farmers face a higher premium for risk since they may hold more of their wealth in liquid form compared to wealthier ones. But as the season deteriorates, the effect of CV interacting with wealth becomes insignificant, which may point to a vulnerable asset base even for the better-off.

Table 6.3 Estimates for the structural equation for savings
(Two-stage least squares regression)

Variables	Period 1	Period 2	Period 3
	Coefficient (z-value)		
Log per capita Income	0.35	0.29	0.34
	(2.16)**	(1.91)*	(2.55)***
# aged < 6	-1308.73	463.09	
	(-1.88)*	(1.60)	
# aged 6–14	-682.62	-156.88	-86.69
	(-1.57)	(-0.79)	(-0.70)
# aged 15–17	1572.34	-204.0	353.46
	(1.08)	(-0.43)	(1.54)
# aged > 65	-872.29	1002.71	
	(-0.49)	(1.81)*	
# males aged 18–64	-280.30	136.60	-234.84
	(-.71)	(0.51)	(-2.14)**
# females aged 18–64	3490.94	-171.69	
	(3.17)***	(-0.51)	
Education head	269.61	-118.71	68.14
	(1.13)	(1.20)	(0.72)
Log asset	1584.69	-445.37	771.86
	(2.56)***	(-2.11)**	(3.16)***
Log land	1900.32	634.04	266.34
	(1.81)*	(2.40)**	(1.20)
Ill days	1953.31	-54.26	-17.14
	(1.53)	(-2.62)***	(-0.96)
HIV/AIDS dummy	-2281.12	-86.54	633.09
	(-1.71)*	(-0.19)	(1.42)
HIV/AIDS dummy*wealth	-203.68	-497.27	-556.28
	(-0.97)	(-0.82)	(-1.04)
CV planting	6204.74	2130.87	3144.89
	(1.04)	(1.03)	(2.50)**
CV planting*wealth	-6516.79	70.79	-220.43
	(-2.18)**	(0.10)	(-0.56)
Constant	-1886.12	3516	-10369.36
	(-2.27)**	(1.18)	(-3.60)***
N	177	166	169
F	5.18***	2.85***	8.11***
R^2	0.26	0.38	0.31
	Coefficient (P-value)		
Anderson canon. LR statistics	95.78 (0.00)	12.95 (0.01)	8.55 (0.04)
Hansen J statistic	0.04 (0.85)	0.005 (0.94)	0.38(0.82)

*** Significant at 1%, ** significant at 5%,* significant at 10%.

While farmers may exhibit some caution regarding rainfall variability, prudence is not obvious for stress posed by poor health. The signs of the coefficients of the illness variables are mixed across the seasons. However, during the drier second period, illness within a household significantly reduces savings. Apart from the first period where the HIV/AIDS dummy has a negative significant effect at 10 percent, the HIV/AIDS variables are mainly insignificant even when interacted with wealth. We note that the HIV/AIDS dummy in the third period, which was a better cropping season, has a positive effect. Although still not

significant, it may point to a change in behaviour and it could be possible that households may exhibit some prudence towards the presence of HIV/AIDS if not faced with other negative shocks. A longer period of observation would reveal better the dynamics in household savings behaviour under different kinds of stressful conditions. Elsewhere, Gertler and Gruber (2002) point that while farmers have sufficient experience to at least have subjective probabilities of rainfall shocks, major illness is difficult to anticipate through savings.

Apart from households' inability to accurately predict the extent to which income may fall following an illness, Gertler and Gruber (2002) note that naive optimism may also play a role since being optimistic has a payoff. Taylor *et al*. (1992) observe that unrealistic optimism about the likely future consequences of HIV is associated with better psychological adjustment[11]. While the relationship between psychological and adaptive behaviour is beyond the scope of this study, such optimism can have an impact on savings, with unrealistic optimism likely to predict less saving. But even with realistic optimism, we may still observe less saving if households do not have access to saving instruments or if the existing savings that hold value are risky under the prevailing environment or are lumpy and inaccessible to poor households. In the next section, we examine the effects of uncertainty on ownership of the various types of savings.

6.4.3 Effects of income variability on composition of savings

The goal for this section is to determine whether variations in weather and health exert a significant influence on the value of a particular type of asset owned by the household. The forms of savings are differentiated by the level of liquidity. The types of savings considered are savings in cattle, small ruminants and chicken (local breeds); cash held in informal community groups and all cash savings observed during the first survey period. These are regressed on rainfall variability and illness in the second survey and the HIV/AIDS dummy. The results are shown in Table 6.4.

[11] The sample examined by Taylor *et al*. (1992) was composed of men who had not been diagnosed with HIV but only symptomatic. If HIV/AIDS is diagnosed, a more realistic optimism may be adapted because the household is faced with actual illnesses and increased possibility of death. So, savings behaviour may differ for the two scenarios.

Table 6.4 Effect on income variability on saving composition (IV Tobit estimates)

Variables	Cattle	Other livestock	Informal group savings	Cash savings
	Coefficient (z-value)			
Log per capita income	-0.33	0.44	0.07	0.37
	(-.75)	(2.04)**	(1.89)*	(1.14)
# aged < 15	-413.23	114.57	-49.91	-66.85
	(-1.08)	(0.62)	(-1.36)	(-0.24)
# aged 15–17			-106.33	-1705.68
			(-0.65)	(-1.24)
# aged > 65		107.68	-1333.58	-2960.84
		(2.00)**	(-4.10)***	(-1.71)*
# males aged 18–64	-574.28	-277.61	-73.14	36.42
	(-1.11)	(-1.02)	(-1.35)	(0.11)
# females aged 18–64	-805.82	120.60	-64.04	772.95
	(-1.03)	(0.26)	(-0.66)	(1.50)
Age Head	153.34	360.43	-67.37	-496.82
	(1.67)*	(1.75)*	(-1.68)*	(2.08)**
Age squared		-3.19	.89	6.563
		(-1.46)	(2.06)**	(2.58)***
Education head	150.85	-201.12	-23.38	
	(0.46)	(-1.26)	(-0.73)	
Log asset	2998.84	235.50	57.46	936.94
	(2.76)***	(0.54)	(0.69)	(1.41)
Log land	561.29			282.64
	(0.62)			(0.42)
Ill member	1368.51	589.63	-201.15	3259.37
	(0.85)	(0.78)	(-1.38)	(2.53)***
AIDS dummy	-2675.94	919.18	-29.79	-2278.12
	(-1.71)*	(1.23)	(-0.21)	(-2.09)**
AIDS dummy*	2033.78	1325.60	313.10	-282.64
Wealth	(1.41)	(1.78)*	(2.11)**	(-0.23)
CV planting	-34548.20	1324.05	992.13	6754.15
	(-1.98)**	(0.34)	(1.99)**	(1.94)*
CV planting * wealth	-4920.55	-2225.32	-116.20	-995.88
	(-1.99)**	(-1.91)*	(-0.60)	(-0.76)
Constant	-16730.92	-16314.53	-269.81	-14101.63
	(-.63)	(-2.04)**	(0.18)	(-1.40)
N =172				
Wald χ^2	46.47***	28.09*	44.84***	27.65**
Log likelihood	-2429.72	-2963.72	-2531.05	-1979.59
Wald test of exogeneity χ^2 (P-value)	0.40 (0.53)	1.76 (0.18)	1.93 (0.16)	2.58 (0.11)

*** Significant at 1%, ** significant at 5%,* significant at 10%.

Rainfall variability and being AIDS-afflicted reduce the value of cattle holding. Wealth is unlikely to attenuate the negative effect of rainfall variability as the coefficient for the rainfall variability interacted with wealth is still negative and significant. In contrast to the value of cattle, rainfall variability has a positive effect on other forms of savings and the effect is significant on both informal group savings and cash held. Illnesses in general are also

associated with a significantly higher level of cash savings. However, cash savings significantly decline in response to the presence of HIV/AIDS. Unlike uncertainty posed by weather, wealth may be an important factor for the HIV-induced uncertainty in some forms of savings. The HIV dummy interacted with wealth is significant in positively influencing the amount saved in informal groups and the value of small ruminants. Group savings and small ruminants are both relatively safe but also easier to liquidate compared to cattle in case of need. The increase in informal savings with wealth may point to a positive relationship between social capital and wealth, reinforcing the findings of Chapter 3 that self-interest motives may be important for informal networks.

The general observation from Table 6.4 is that the propensity to save in liquid but save forms is higher as shown by the significant effect of transitory income on saving in small livestock. Rainfall variability increases the liquid assets held with the clearest distinction seen in the value of cattle and the two forms of cash savings. Cash savings increase with rainfall volatility, which is consistent with the theory that people facing greater uncertainty are expected to hold more liquid wealth. However, being afflicted reduces significantly the amount of cash held, which would be the case if households have to meet medical and other consumption expenditure. This finding partly shows the means by which HIV and AIDS may impact on poverty by changing and reducing the portfolio of a household's wealth.

6.5 Conclusions

This chapter investigates the possibility that households save *ex ante* to buffer future consumption against shocks. It entailed examining seasonal changes in saving behaviour and testing the notion of the permanent income hypothesis that households save most of their transitory income. The results show that while people may exhibit some level of prudence, the marginal propensity to save out of transitory income deviates from unity as the theory postulates. About 33 percent of the transitory income is saved. Since the marginal propensity to save out of transitory income is a measure of completeness of financial markets, the implication is that households are not able to use savings and credit to smooth consumption.

The results show seasonality to influence level of prudence with stressful seasons likely to depress substantially the level of precautionary saving. Wealth too seems to matter, with wealthier households less likely to hold higher precautionary cash balances. This would be in line with Rosenzweig and Binswanger (1993) results in rural India that show wealthier

farmers to be less risk-averse. However, for the farmers in this study, the asset base seems quite vulnerable as the wealth effect becomes insignificant as the seasons become worse.

The presence of HIV/AIDS increases per capita consumption which would imply depressed savings. We find the value of cattle holding and cash savings decline in response to HIV/AIDS. While a decline in savings would jeopardise future investments, the rise in consumption when the human asset is threatened is in accordance with the behaviour of forward-looking agents when future income is endogenous to current asset shock (Barrett and McPeak, 2005). When income shocks arise in part due to asset shocks, then forward-looking agents will try to balance the desire to equalise the discounted expected utility of consumption across periods – taking income as given – with the desire to smooth the asset in order to smooth expected income across periods. For the survey households, the desire to smooth the asset (improve health) may outweigh the desire (or the ability) to smooth future consumption through increased savings. As a consequence, consumption would tend to be relatively volatile. This would therefore explain the higher consumption variability observed in Table 2.2, and the greater mobility between consumption quartiles for AIDS-afflicted households shown in Chapter 3.

On portfolio composition, while both high rainfall variability and being AIDS-afflicted reduce the value of cattle holding, the two forms of uncertainty differ with regard to holding of cash savings. Rainfall uncertainty increases holding of cash savings while AIDS-affliction reduces it. The rise in cash savings and decline in cattle holding with rainfall variability points to an increase in risk avoidance.

While these findings are in agreement with a buffer stock model where people use savings in bad times, they go against previous predictions that "…AIDS medical costs will be met by reducing both consumption and savings in a balanced manner, and not necessarily be drawn disproportionately from own savings" (Bloom and Mahal, 1997: pg. 109). The rise in consumption and the negative effect on savings may be a signal that the relationship is likely to be disproportionate.

7 Discussion and conclusions

7.1 Introduction

People who live in the rural areas of poor countries often have to cope not only with severe poverty, but also with extremely variable incomes. The implications of this income variability on consumption has been a central theme of much research in developing countries since the early 1990s (Deaton, 1991; Paxson, 1993). However, income variability implies consumption variability only if households do not use mechanisms to insulate consumption from income fluctuations. The bulk of the work providing most of the insights on consumption smoothing use weather as the major source of income variability (Czukas *et al.*, 1998; Dercon and Krishnan, 2000b; Kinsey *et al.*, 1998; Paxson, 1993; Udry, 1994). While weather is an important source of risk in rain-fed agriculture, with the spread of HIV/AIDS in low-income countries especially in Sub-Saharan Africa, health uncertainties have increasingly become important.

Poor people's portfolio is highly favoured towards human capital and a threat to this capital is a threat to their livelihoods. In the absence of formal insurance mechanisms and limited public health expenditure, it becomes important to investigate how households deal with the consequences of ill-health and the implications of buffers that households may build against future uncertainty on welfare. The ability of the household to deal with the effects of HIV/AIDS may be complicated by several factors: the associated stigma, the possibility of multi-infections within a household and the certainty of death. Stigmatisation may weaken network-based coping mechanisms such as transfers from kin and friends as well as group loans and savings arrangements. The presence of multiple infections implies that the effects of stress caused by HIV/AIDS last longer than other forms of stress. This may mean a reduction in household's resilience to other shocks and therefore an increase in vulnerability. In addition, the risk of mortality may alter the discount rate, which in turn can affect a household's buffer stocking strategies.

This study therefore, presents an analysis of households' responses to shocks with an emphasis on response to HIV/AIDS. To the extent that the study analyses household response to weather and to HIV/AIDS related illnesses, it partly responds to Gillespie's (2006) call for more knowledge on how the increasing number of households and communities are struggling to respond to multiple overlapping vulnerabilities (Gillespie, 2006: p.14).

Most previous studies on household responses to shocks have examined the extent to which a household smoothes consumption. Much less research has been done on the mechanisms by which consumption is smoothed. Using a framework that represents the interaction of a household's portfolio with risk, this thesis begins by exploring households' reliance on collective opportunities such as informal loans and gifts and individual household mechanisms such as assets and labour sales following illness and weather shocks. The possibility that a household insulates consumption by building buffers before shocks occur is then examined. Building buffers can be costly for households and often means sacrificing current consumption to secure future consumption. The sacrifice can be in form of holding less risky but low-yielding assets, or can mean securing consumption for some members of the household at the expense of others. The analysis therefore examines the intra-household differences in responses to shocks.

The remainder of this concluding chapter provides a discussion of the findings. The next section briefly discuses the set-up for the study. Section 7.3 provides the main findings and their place in the vulnerability literature. The findings are presented in two levels based on the main objective stated in section 1.3. First, household responses to shocks are presented in sub-section 7.3.1, and secondly, the intra-household and gender aspects of the findings are presented in sub-section 7.3.2. In each of the sub-sections, answers to the research questions are presented and the policy implication of each finding is concurrently provided. Section 7.4 summarises the relevance of the study for the country's health policy, while section 7.5 presents the limitations of this study and areas of further research.

7.2 Data

This study was done in Thika and Maragua districts in the central highlands of Kenya, about an hour's drive from the capital city, Nairobi. Although Thika district is widely considered a peri-urban area, the livelihoods are characteristically rural and largely agrarian. Large commercial farms dominate much of the lower zones of Thika district and over the years have provided hubs for both migrant workers and local inhabitants. The commercial farms, in combination with an industrial site in Thika town have been nodes from which HIV has spread to the interior. A data set from three surveys in three consecutive seasons covering 196 households was used for this analysis. The data set was designed to collect information on risk and risk-coping behaviour over an 18-month period. Qualitative information obtained before

the initial survey and in between the other two surveys was used to confirm or elaborate on issues that emerged from the quantitative analysis.

At this point it is important to mention some challenges encountered in data collection. Ethical issues and stigma associated with HIV/AIDS posed critical challenges for the fieldwork. Unlike other terminal illnesses such as cancer, stigma has made quantitative studies on HIV patients difficult. Studies with sufficient numbers of correctly identified HIV patients necessary for quantitative analysis are rare (Booysen and Bachmann, 2002). Ethically, it was necessary that the fieldwork did not compromise the privacy of the afflicted members or increase their vulnerability to more social stigmatisation. To minimise these problems, AIDS-afflicted and non-afflicted households were included in the study. Even so, the possibility of stigmatisation became apparent by the third round of the survey, so to avoid problems, the visits were stopped. Identification of HIV/AIDS afflicted households was done with the help of community health workers working with people living with HIV/AIDS (PLWH). From 13 community health groups (CHG), a total of 101 afflicted households were visited in the three surveys.

7.3 Synthesis of the findings

7.3.1 Household responses to shocks

7.3.1.1 Consumption vulnerability to ill-health and rainfall shocks

A description of income and consumption variability in Chapter 2 shows income to be more variable than consumption across the three survey periods. This points to availability of some consumption smoothing devices so that not all variability in income is transmitted to consumption. In Chapter 3, an investigation is done on whether there could be differences in consumption variability across households in spite of this fairly stable average consumption. Consumption transition matrices are used to examine the extent to which households' consumption is vulnerable to shocks, and therefore answer the first part of research question (i); how vulnerable is a household's consumption to different types of shocks?

The expectation is that AIDS-afflicted households would have more variable consumption in line with the permanent income hypothesis for households experiencing permanent shocks. The results reveal this to be the case. AIDS-afflicted households have a higher mobility index for their consumption than the non-afflicted ones. The difference in consumption mobility

among the households can partly be attributed to differential access to *ex post* mechanisms for dealing with different types of shocks. Chapter 3 proceeds to examine the question of which institutions and markets are available to deal with the consequences of weather and health related stress. To answer this question, the effect of shocks on informal loans, informal transfers/gifts and livestock transactions is examined. The shocks or sources of stress considered are rainfall shortage, crop loss due to drought, number of work-days lost due to illness, and whether a household was AIDS-afflicted.

The results show that crop loss as a result of rain failure reduces the sum of the receipts of informal transfers and loans. A common rainfall shock also reduces such receipts, suggesting that transfer and loan exchanges mainly take place within close communities. This negative effect also points to the importance of the community as a risk-sharing mechanism for the households. Even for those with assets, the community may matter for risk-pooling since livestock transactions also decline in response to low rainfall. The decline in livestock transactions in response to rainfall shortage is consistent with Christiansen and Subbarao's (2005) finding that possession of cattle and sheep/goats appears to be ineffective in protecting consumption against covariant shocks. With regard to AIDS-afflicted households, while both transfers and loans rise for households with an ill member, the loans rise slightly more than transfers. This suggests that household resort more to own resources. The overall effect of AIDS related illnesses is a reduction of the total transactions in transfers, loans and assets. The implication for the decline in these transactions is that neither the community nor the household is able to insure consumption against ill-health related to HIV/AIDS through informal loans, transfers or livestock sales.

Using descriptive statistics, the results indicate that the usage of the various mechanisms may differ by wealth. The asset-poor AIDS-afflicted households have significantly higher loans than the non-afflicted while the better-off afflicted have higher transfers with no statistical difference in loans. A positive relationship between wealth and gifts points to a dominance of self-interest motives over altruism in giving. The two competing motives have different implications for efficacy of public transfers. Where altruism dominates, Becker (1974) observes that changes in private transfers could render ineffective public social security transfers. On the other hand, if households are motivated by self-interest in gift exchange, such crowding out may not happen. The question is how to target assistance where it is most needed. Since the results indicate that gift giving is likely to be localised, community-based health groups could play an important role in facilitating outreach to the afflicted households.

At the same time, existence of self-interest in giving points to networks which group-based financial institutions could exploit. Of course such group-based financial arrangements must consider a re-insurance arrangement due to the covariance nature of rainfall and HIV/AIDS shocks.

7.3.1.2 Labour response to ill-health and weather variability under credit constraints

For families who cannot insure through credit and asset markets, sale of labour can be an alternative. Chapter 4 documents the use of household labour as a consumption-smoothing device. Using a model that accommodates persistence and transitory shocks, *ex ante* and *ex post* effects of weather and health stress on labour supply are analysed. The hypothesis that credit constraints drive the labour responses is tested. The findings show liquidity constraints to be an important factor in labour supply. Unlike the results in Chapter 3 which show loans to play a limited role in assisting households deal with shocks, the findings in Chapter 4 lead to a conclusion that credit can be an important consumption-smoothing device but may work through the labour market for some household members. Lack of credit inhibits the ability of households to use the labour market as a coping mechanism. This is especially so for males. The findings conforms to other studies that find off-farm labour supply to depend on both incentive and capacity to participate (Reardon, 1997; Woldenhanna and Oskam, 2001). The shock to farm income provides the incentive for participation, but the capacity to participate is limited by the lack of finance, especially if off-farm work requires initial capital.

Further analysis of labour response to shocks reveals that households respond more to the more persistent source of weather stress, as hypothesised by the permanent income hypothesis. This finding of an *ex ante* response to weather risk is similar to Rose(2001) who shows households facing greater risk are more likely to participate in the labour market. A significant effect of labour response to rainfall variability is evidence of risk avoidance. Such behaviour prevents farmers from achieving the output potential they would otherwise be capable of (Kurosaki and Fafchamps, 2002). Provision of efficient insurance mechanisms thus becomes important in poverty reduction policies. The fact that wealth significantly modifies the effect of rainfall variability, especially towards off-farm work, suggests that policies towards wealth creation should be emphasised. This finding is supportive of the current Kenyan policy for wealth and employment creation (Kenya, 2003).

The results also show that households respond to transient rainfall and crop shocks. But unlike the "added-worker effect" hypothesis would suggest, labour supply generally declines in

response to a covariant rainfall shock. There is only limited evidence of positive adjustment in labour supply, and this is only during the planting season for some household members. In general, the findings of this chapter lead to the conclusion that the labour markets are unable to insure households against a rainfall shock and crop failure. This finding is in agreement with Townsend's (1994) who shows that Indian villagers found it difficult to insure against covariant risk. The decline in labour supply with a rainfall shock can be described as 'a discouraged worker effect' (Maloney 1987; Lundberg 1985; Prieto and Rodriguez 2000). The same factors affecting males' unemployment (dry spell) affect the females' unemployment. However, there are indications that the male labour supply contracts more than that of the females'. The gender differences in labour supply response are discussed below.

7.3.1.3 Seasonal changes in intra-household health inequality

Having observed in Chapter 4 that households respond *ex ante* to uncertainty through labour adjustments, Chapters 5 and 6 provide further analyses on alternative ways by which households can protect consumption before shocks occur. Households may self-insure to mitigate risk by accumulating buffer stocks. For people whose main occupations demand physical strength, good physical health is an important asset. Dercon and Krishnan (2000b) find seasonal returns to labour to be important in rural Ethiopia. Higher returns to labour would encourage households to boost consumption to cash in on the higher returns. Chapter 5 explores this possibility by examining seasonal changes in health inequality, but without the direct use of consumption data.

Data on individual consumption can be difficult to obtain and has partly been responsible for a dearth of empirical work on intra-household allocation of consumption goods. In the allocation of health goods within a household, households can be driven by either a desire to equalise health among members, or by the need to generate income. The latter motive is likely to be high for poorer households. Such households may be subsistent constrained and may therefore have a higher incentive to smooth consumption more for those whose future household income is more dependent (Zimmerman and Carter, 2003). Empirically, it is difficult to show the dominating incentive in household allocation of health goods. In addition to lack of consumption data at the individual level, the possibility of mutually reinforcing interactions between income and health make conclusions about the relationship between income and health difficult to pin-down (Smith, 1999). Our analysis uses a health measure

related to capacity of an individual to do work and thus avoids the need for individual consumption data.

The results show that while households largely seek to equalise health outcomes among its members, the concern for productivity still matters at some health levels. People with low health status are likely to remain unhealthy or become worse off because they cannot generate sufficient income. This finding is what the theory would predict for the relationship between persistent poverty and nutrition-productivity link (Barrett, 2002; Bliss and Stern, 1978; Dasgupta, 1993; Dasgupta and Ray, 1986). The data reveals two possible thresholds: a low equilibrium that is likely to hinge on low initial health, and another at a higher health level which may point to other production constraints.

In the analysis of poverty traps, there are two research challenges: one is the identification of endogenously increasing rates of return to assets, and the other, and the more difficult one, is the identification of points where one can distinguish between the transient poor who can recover from a shock on their own, and those who face chronic poverty (Barrett, 2005; Barrett and McPeak, 2005). The two possible thresholds suggested by these data are likely to represent different forms of poverty and therefore have different policy implications. The lower-level threshold may signal a low health trap and calls for public transfers in health, while the higher one shows the possibility of other constraints to production such as financial or technological constraints that would argument good health in income generation.

However, given that the results show equality considerations dominate the relationship between health and income, the policy implication is that more emphasis should be on investments that aim at alleviating constraints to income generation. In other words, polices that aim at raising income should be an important component of the country's health strategy. Nevertheless, the evidence of productivity concerns at some health range shows the need for health transfers that should target the vulnerable individuals.

7.3.1.4 Effects of ill health and weather variability on savings

Chapter 6 examines the use of physical and financial assets as a buffer stock. It answers the fourth question on whether households exhibit any precautionary behaviour towards AIDS-related illnesses and weather variability. Deaton (1997: pg.367) shows that in the complete absence of financial markets, prudent households may accumulate and draw down on stocks of physical or financial assets to maintain consumption levels that vary slightly from time to

time. The more variable the future income, the higher would be the incentive to save for a "rainy (dry) day"(Campbell, 1987).

Using the methodology proposed by Paxson (1992) for cross-sectional data, regression of savings against transitory income yield low marginal propensity to save out of transitory income. We find that about 33 percent of the transitory income is saved. This figure also provides a measure of the completeness of the credit and insurance markets in the study area. The results are, however, consistent with expectations for very poor households since budgeting of transitory income would be expected to deviate from the theoretical predictions that all transitory income is saved. People are likely to actually be consuming from transitory income—hand-to-mouth. Ersado *et al*. (2003), also estimates a marginal propensity to save out transitory income of 0.36 for rural Zimbabwe, which is almost half (0.78–0.83) of that estimated by Paxson (1992). The Thai households examined by Paxson are much wealthier and are categorised as middle-income group.

Despite the low levels of precautionary saving, there is evidence to suggest that the households exhibit behaviour of forward-looking agents. Results in Chapter 5 indicate that at some health levels, households are likely to buffer stock in health. In Chapter 6 we find that the presence of HIV/AIDS, while depressing savings as observed for cattle holding and cash savings, is positively related to per capita food consumption, possibly as households try to smooth the health (asset) stock. HIV/AIDS being an asset shock presents an income risk to households. Prudent households facing an asset shock, given income, will try to balance the desire to equalise the discounted expected utility of consumption across periods with the inevitable desire to smooth the asset stock in order to smooth expected income across periods. The desire to smooth the asset stock, however, seems to outweigh the ability or the desire to smooth future consumption through increased savings. This would mean higher volatility in consumption over time for households where asset risk is greater. Consequently, Chapter 2 finds consumption levels for AIDS-afflicted households to be more variable. Results of Chapter 3 also show greater mobility between consumption quantiles for the afflicted households over the survey period.

Other evidence of precautionary behaviour is shown by the results of portfolio composition. Households have a higher propensity to save in more liquid but save forms. The marginal propensity to save in small livestock is higher (0.44) than the average of 0.33. Also, while we find lower levels of cattle holding in response to rainfall variability and affliction with AIDS,

cash savings increase with rainfall variability. The reduction in cattle value in response to rainfall variability and HIV/AIDS may mean increased vulnerability for AIDS-afflicted households in areas with high rainfall variability, since livestock form a major buffer for rural households (Moll, 2005). This result has implications for approaches for addressing vulnerability to both HIV/AIDS and food insecurity: for example, how to design sustainable interventions that would handle effectively the continuous nature of the HIV stress and the intermittent rainfall shocks.

7.3.2 Intra-household aspects of the findings

In the above section, we have discussed how the households seek to cope with the stress associated with the seasonal decline in farm production due to rain failure and ill-health mainly associated with HIV/AIDS. In this section, we examine whether the burden of coping and managing risk *ex ante* falls equally on men and women within a household. The first three empirical chapters examine gender differences in response to shocks.

7.3.2.1 Does the availability of the institutions that enable households to deal with stress differ by ill-health of men and women?

This question has been addressed in Chapter 3. In particular, the analysis focuses on how the informal loans, transfers and livestock transactions are impacted on by male and female head illness. The results indicate that households may result to different coping mechanisms depending on whose health is at risk: the male or the female spouse. Female spouse illness significantly reduces the probability that households receive informal transfers, while male spouse illness has no effect. If gift-giving networks operate through the female spouse and reciprocity is anticipated, an ill female head may not guarantee such reciprocity and so the transfer receipts decline. The results suggest that households having a sick female head are likely to hold higher cash balances. Just as in Hoddinott and Kinsey (2000), who find livestock wealth to protect women's health against the effects of drought, it is an *ex ante* private mechanism that is likely to protect the household against the effects of female's head illness. The consequence for holding very liquid assets could be a rise in poverty levels.

7.3.2.2 Male and female labour response to ill-health and weather variability under credit constraint

Chapter 4 explores the effect of weather and health stress on labour supply of adult men and women. As mentioned earlier, there is limited positive labour adjustment towards rainfall

shocks. However, females may work more at planting time in response to rainfall shortage. While responses towards transient rainfall shock are somewhat similar for men and women, response to the persistent rainfall and health stress differ. Males' off-farm labour supply rise in response to rainfall variability while female's decline. This difference in *ex ante* response to weather stress may point to a labour market differentiated by gender. An examination of labour responses towards various types of off-farm work or tasks may shed more light as to what markets are important for each sex and therefore, what matters for income diversification and hence insurance.

On health related stress, we find that males in AIDS-afflicted households retract from off-farm activities towards own-farm work. In line with Desmond *et al.* (2000), off-farm work may be less flexible for males than farm work. Desmond *et al.* (2000) observes that one of the first phase responses to HIV/AIDS infections is a re-allocation of work to more flexible jobs or from formal to informal jobs. Female labour supply to the family farm declines in AIDS-afflicted households probably as their time constraint becomes more binding given their care giving role. However, in AIDS-afflicted households that also have an ill member, females may work more off-farm. This may either be in line with the "added-worker effect" hypothesis or that off-farm activities are more flexible for females than farm work in times of AIDS related illness. Probably the need for cash to meet immediate medical expenditure can partly explain this positive response.

Apart from examining labour response to shocks by sex, we also examine whether the household labour allocation decisions among its members corresponds to maximisation of a family utility function. This is done by testing the restriction imposed by utility maximisation theory that the compensated wage effects are non-negative. Our findings are in support of the theory. However, without the test for a second restriction of symmetry of compensated cross-wage effects, the results are limited in concluding whether the unitary model holds for the examined households. Using plot level data for men and women, Udry (1996) rejects the unitary model for Ghanaian rural households. Nevertheless, based on the findings of positive compensated wage effects, the results in this study suggest that the family can serve as an intermediary between public policy and individual household members. This conclusion is consistent with the evidence that equality incentives dominate household motives in allocation of health goods as observed in Chapter 5.

7.3.2.3 Are there intra-household gender inequalities in health outcomes?

In Chapter 4 we find that labour response to seasonal shocks may differ by gender. Where seasonal returns to physical strength are important, households may have an incentive to boost consumption to cash in on the higher returns. Chapter 5 asks the question whether such an incentive exists, and if it exists, whether there are gender inequalities in health outcomes. The results show evidence of intra-household gender disparities in health outcomes which is in favour of men. This finding points to an inefficient intra-household sharing of risk. Other studies that have shown inefficiencies in intra-household risk-sharing include Dercon and Krishnan (2000a) for rural households in Ethiopia, Doss (1996) and Goldstein (2004) for Ghana. While the results suggest that education of the less healthy member reduces inequality, and therefore points to the importance of investments in education, the political economy implication of gender targeted policies is noted. In her examination of the relationship between public action and family relations, Agarwal's (1991) observes that, the greater the "external" vulnerability of particular household members to deprivation, the greater is their "internal" vulnerability to inequitable treatment within the household. The insight from Agarwal is that public action to support more vulnerable members, may in some way strengthen the support such members may get from the family.

7.4 Relevance of the findings

Kenya, like many other nations, is confronted with the grim reality that the suffering and death from HIV/AIDS is impacting upon the ability to meet other development goals. The country has to deal with erosion of its human resources, with HIV accounting in large part for a 15-year drop in life expectancy: from 62 years in 1990 to 47 years in 2001 (Kenya, 2005b). Kenya's health care expenditure per capita is about KSh. 1,506 (US$ 19), with 51 percent being borne by the households. Given that more than half of the population is below the poverty line, this proportion is worrying. According to available statistics, more than a third of the poorer households seek no treatment (Kenya, 2005a). The findings of our study corroborate this fact, as it shows that poorer afflicted members of the society may also face larger costs in accessing community resources. This raises equity issues that the country needs to address. The importance of this study lies in helping identify some of the most vulnerable groups that policy should target as the country struggles to develop a comprehensive health insurance policy. The attempt to uncover underlying household behaviour in coping

mechanisms goes some way to identifying sustainable ways by which help can be channelled where most needed. For a redistribution policy to be effective, it is important it takes into consideration the existing household and community systems, building on the existing strengths while relieving the burdens on households.

7.5 Limitations of the study and future research

Within the given research period, it has been possible to observe households during three consecutive seasons and analyse their behaviour towards shocks. The results lead to interesting insights, but part of these insights would require a substantially longer period of observation to be able to distinguish with a greater level of confidence between risk factors (health and weather uncertainties) and subsequent outcomes.

A second limitation of the study is the chance that AIDS might be confounded with other illnesses if HIV has not been diagnosed. While we believe using clients of community-based health groups minimised this problem, the error of treating households as non-afflicted when they may be afflicted still remains large. Prevalence rates in the population are relatively high. Official statistics for the area at the time of the survey was about 8 percent (Kenya, 2004), implying that close to 1 in every 12 people were infected. The comparisons between afflicted and non-afflicted households would therefore underestimate the true differences attributable to HIV/AIDS if there were errors in identification of the non-afflicted households.

As mentioned earlier, stigma is a major limitation to HIV/AIDS research. There is need for research into understanding why stigmatisation is greater in certain communities than in others. Such an understanding may help in the design of HIV/AIDS impact studies and therefore, in the development of intervention strategies. For instance, where myths shroud the understanding behind the spread of HIV, sociological solution or education related interventions are more likely to have higher payoff than just focusing on change in attitude towards HIV/AIDS patients. This would be different where AIDS is viewed as punishment for poor morals and is therefore seen as an ‘own fault’ problem. Blatant stigmatisation is likely to be high where AIDS is judged on moral values. Quantitative research in such an area is likely to be difficult, as was the case for some of the sites covered in this study. In such circumstances, interventions targeting both behaviour and altitude change are likely to bring higher returns. Ethnographic studies may provide more insights and would provide direction for future quantitative work.

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Appendices

Appendix 3.1

Table A3.1 Consumption transition matrix for the AIDS-afflicted and non-afflicted households in the three survey periods

		Period 2 Quartiles			
		1	2	3	4
Period 1 Quartile	1	0.63	0.17	0.13	0.08
	2	0.29	0.42	0.19	0.10
	3	0.08	0.31	0.39	0.22
	4	0.02	0.08	0.29	0.60
		Period 3 Quartiles			
		1	2	3	4
Period 1 Quartile	1	0.56	0.24	0.18	0.02
	2	0.28	0.32	0.26	0.15
	3	0.11	0.33	0.37	0.20
	4	0.06	0.13	0.21	0.60
		Period 3 Quartiles			
		1	2	3	4
Period 2 Quartile	1	0.45	0.29	0.20	0.06
	2	0.34	0.24	0.30	0.12
	3	0.16	0.31	0.29	0.24
	4	0.04	0.15	0.22	0.59

Appendix 3.2

Table A3. 2 Probit estimates of shocks on casual labour and savings

	Column 1	Column 2
	Earnings from casual labour	Cash savings
Household Characteristics		
Education head	-0.06	0.03
	(-1.24)	(0.64)
Age of head	.02	-0.08
	(.46)	(-1.97)**
Age squared	-.0001	0.001
	(-0.44)	(1.51)
# male adults	.04	0.16
	(0.45)	(1.70)*
# female adults	-.12	0.25
	(-1.08)	(2.13)**
Dependency ratio	-0.19	
	(-1.53)	
Log assets	-0.42	0.23
	(-4.42)***	(2.48)***
Log livestock value	-0.07	0.12
	(-2.06)**	(3.58)***
Shocks		
AIDS dummy	0.43	-0.16
	(1.75)*	(-0.72)
AIDS dummy* ill days	-0.02	0.02
	(-1.04)	(1.07)
Ill days husband	0.02	-.03
	(1.02)	(-1.58)
Ill days wife	-.02	.04
	(-0.89)	(1.88)*
Crop loss index	0.04	.02
	(0.65)	(.14)
% rainfall shortfall planting	0.15	-0.31
	(0.51)	(-1.11)
% rainfall shortfall weeding	-1.01	-.35
	(-2.02)**	(-0.62)
Constant	4.91	-2.13
	(3.64)***	(-1.47)
Log likelihood	-182.64	-180.99
Wald χ^2	48.81***	74.12***
Pseudo R^2	.22	.17
Correctly specified	71.10	72.5

[1] Robust standard errors estimates

*** significant 1%, ** significant 5%, * significant 10%

Appendix 4.1

Table A4.1 Prediction of shadow wage and income

	Shadow wage	Shadow income
	Coefficient (z-value)	
Log owned land	0.41	0.31
	(1.64)*	(4.24)***
# of males 18-64 years	-0.25	-0.05
	(-1.58)	(-0.91)
# of females 18-64 years	-0.09	0.11
	(-0.42)	(1.78)*
Log livestock value	0.11	0.05
	(1.66)*	(3.02)***
Age head	-0.08	0.72
	(-0.79)	(2.39)**
Age squared	0.24	-0.001
	(1.11)	(2.80)***
Education head	0.30	0.04
	(3.14)***	(1.39)
Hired wages	0.24	0.06
	(2.10)**	(2.23)**
HIV dummy (if AIDS-afflicted=1)	0.30	-07
	(1.80)*	(-0.51)
% rainfall shortage planting	-1.68	0.86
	(-1.68)	(2.72)***
% rainfall shortage weeding	2.59	--0.64
	(2.95)***	(-1.79)**
Distance to market	-0.40	-0.12
	(-1.20)	(-1.13)
Constant	-5.15	6.57
	(-0.61)	(7.72)***
R^2	0.33	0.35
F	3.31***	7.76***
N	189	186

Robust standard error estimates

*** significant 1%, ** significant 5%, * significant 10%

Appendix 5.1

Given the assumptions on the utility function in equation 5.6:

$$u_k > 0 \quad \forall \quad k = g, c, h$$
$$u_{kk} < 0;$$

And that a household is averse to catastrophic health or death of its member i.e. $u_g(g, c, h) \to \infty \quad as \quad h \to 0$. Marginal value of individual i health will be declining in h i.e. $\frac{\partial V}{\partial h} < 0$,

From equation (5.10), $\frac{\partial V}{\partial h_t^i}$ is positively related to the expected productivity of health $\frac{\partial y_{t+1}}{\partial h_t^i}$.

For two household members such that $h_t^{i-1} < h_t^i$, for a concave income generation function, it is expected that $\frac{\partial y_{t+1}}{\partial h_t^{i-1}} > \frac{\partial y_{t+1}}{\partial h_t^i}$. Since $E_t\left[\frac{\partial V_{t+1}}{\partial h_{t+1}}\right]$ is monotonically decreasing in $E_t h_{t+1}$, there are two possible outcomes:

either, $E_t h_{t+1}^{i-1} > E_t h_{t+1}^i$, which implies more investments of g in the member with lower health status i.e. $g_t^{i-1} > g_t^i$;

or $E_t h_{t+1}^{i-1} < E_t h_{t+1}^i$. This outcome also has two possibilities: $\frac{\partial f}{\partial g_{t+1}^{i-1}} < \frac{\partial f}{\partial g_{t+1}^i}$ or $\frac{\partial f}{\partial g_{t+1}^{i-1}} \geq \frac{\partial f}{\partial g_{t+1}^i}$.

If $\frac{\partial f}{\partial g_{t+1}^{i-1}} < \frac{\partial f}{\partial g_{t+1}^i}$ from equation (5.9):

$$\omega^i \frac{\partial u}{\partial g_t^i} + \delta \frac{\partial f}{\partial g_{t+1}^i} E_t\left[\frac{\partial V_{t+1}}{\partial h_{t+1}^i}\right] = \omega^{i-1} \frac{\partial u}{\partial g_t^{i-1}} + \delta \frac{\partial f}{\partial g_{t+1}^{i-1}} E_t\left[\frac{\partial V_{t+1}}{\partial h_{t+1}^{i-1}}\right],$$

assuming equal Pareto weights ($\omega^i = \omega^{i-1}$), the concavity of the utility function imply that $u'(g_t^{i-1}) > u'(g_t^i)$, it must be the case that $g_t^{i-1} > g_t^i$ for the equality to hold. Alternatively, $\frac{\partial f}{\partial g_{t+1}^{i-1}} \geq \frac{\partial f}{\partial g_{t+1}^i}$, then $g_t^{i-1} > g_t^i$ is directly implied.

From the concavity of the *f(g)* function and $g_t^{i-1} > g_t^i$, it can be expected that the health difference in period *t+1* $(h_{t+1}^i - h_{t+1}^{i-1})$, will be lower than $h_t^i - h_t^{i-1}$, so that $E\left[\frac{h_{t+1}^i - h_{t+1}^{i-1}}{h_t^i - h_t^{i-1}}\right] = ER_{t+1}^i < 1$ — **Proposition 1**.

Now suppose that there are two individuals *i* and *j* such that $h_t^i > h_t^j$. Let their nearest neighbours in the health distribution be $i-1$ and $j-1$ such that $i > i-1 > j > j-1$. Let $h_t^i - h_t^{i-1} = h_t^j - h_t^{j-1}$.

Suppose the household wishes to set: $ER_{t+1}^i < ER_{t+1}^j$. This would imply that the health difference in pair *i* decrease more than that of the pair *j* between *t* and *t+1*.

From proposition 1, this would mean that $g^i > g^{i-1} > g^j > g^{j-1}$ and also $g_t^{i-1} - g^i > g_t^{j-1} - g^j$. From the concavity of the utility function, it can then be implied that:

$u'(g_t^{i-1}) - u'(g^i) < u'(g_t^{j-1}) - u'(g^j)$.

From equation 5.9, assuming $\omega^i = \omega^{i-1}$ for all household members, this would imply:

$$\frac{\partial f}{\partial g_t^{i-1}} E_t \frac{\partial V_{t+1}}{\partial h_{t+1}^{i-1}} - \frac{\partial f}{\partial g_t^i} \frac{\partial V_{t+1}}{\partial h_{t+1}^i} > \frac{\partial f}{\partial g_t^{j-1}} E_t \frac{\partial V_{t+1}}{\partial h_{t+1}^{j-1}} - \frac{\partial f}{\partial g_t^j} E \frac{\partial V_{t+1}}{\partial h_{t+1}^j}.$$

Now, this would only be the case if the household wants to change the ordering of the health rankings among its members. However, if this happens, the strictly increasing and concavity condition of $f(g)$ would be violated as well the condition for a decreasing $E_t\left[\frac{\partial V_{t+1}}{\partial h_{t+1}}\right]$ in $E_t h_{t+1}$. With this outcome, households will not always have a greater preference for equality of health outcomes. To prevent this contradiction, a household would therefore wish to set $ER_{t+1}^i > ER_{t+1}^j$. Since $h_t^i > h_t^j$, then R would be expected to increase with h_t^i given the initial health dispersion if equality consideration dominate — **Proposition 2**.

Appendix 5.2

Table A5. 1 Parameter estimates for the ordered probit model

Variable	Walk	Stand	Water	Hoe	Wood	Chop
	Coefficient (z-value)					
Period 3	-0.30	-0.30	-0.37	-0.38	-0.39	-0.50
	(2.08)*	(2.29)**	(-2.62)**	(-2.77)**	(-2.80)**	(-3.63)**
Period 2	0.37	0.35	0.32	0.33	0.28	0.13
	(2.85)***	(2.74)**	(2.48)***	(2.57)***	(2.22)**	(1.01)
HIV dummy	0.53	0.51	0.59	0.57	0.62	0.60
	(4.10)***	(4.42)***	(5.13)***	(4.97)***	(5.46)***	(5.21)***
Household	-0.07	-0.08	-0.08	-0.08	-0.08	-0.09
size	(-2.17)*	(-2.53)**	(-2.66)**	(-2.60)**	(-2.60)**	(-2.89)**
# below5	0.19	0.21	0.23	0.18	0.176	0.19
	(2.86)***	(3.34)***	(3.65)***	(2.77)***	(2.77)**	(2.89)***
Distance to	-0.09	-0.04	-0.08	-0.04	-0.04	-0.07
market	(-1.87)	(-0.75)	(-1.55)	(-0.79)	(-0.79)	(-1.48)
If female	0.53	0.73	0.61	0.72	0.56	0.56
	(4.57)***	(6.20)***	(5.17)***	(6.32)***	(4.72)***	(4.82)***
If husband ill	0.52	0.60	0.69	0.64	0.60	0.62
	(4.34)***	(5.11)***	(5.70)***	(5.41)***	(5.51)***	(5.24)***
If wife ill	0.40	0.65	0.59	0.59	0.60	0.50
	(2.67)**	(4.56)***	(4.12)***	(4.07)***	(4.19)***	(3.44)***
If chronic	1.99	1.74	2.39	2.35	2.30	2.02
	(6.58)***	(6.88)***	(7.96)***	(8.30)***	(7.67)***	(6.35)***
Years of	-0.04	-0.03	-0.02	-0.03	-0.03	-0.04
education	(-2.07)*	(-1.37)	(-1.07)	(-1.59)	(-1.5)	(-2.10)*
Age	0.14	0.18	0.12	0.14	0.13	0.13
	(4.98)***	(6.14)***	(4.26)***	(4.81)***	(4.70)***	(4.45)***
Age squared	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-2.59)**	(-3.68)**	(-1.70)	(-2.58)**	(-2.27)*	(-2.09)*
_cut1	4.12	5.22	3.96	4.14	4.12	3.66
	(6.49)	(7.74)	(6.11)	(6.51)	(6.31)	(5.70)
_cut 2	5.89	7.00	5.79	5.86	5.85	5.36
	(9.14)	(10.21)	(8.77)	(9.01)	(8.80)	(8.21)
_cut 3	8.44	8.61	7.27	7.49	7.28	7.01
	(12.60)	(12.38)	(110.82)	(11.23)	(10.86)	(10.58)
$\chi 2$	356.96	386.92	397.52	386.61	387.28	380.28
Pseudo R	0.14	0.15	0.16	0.15	0.15	0.15
Correctly predicted	0.59	0.58	0.579	0.578	0.574	0.58
N	1431					

*** Significant at 1%, ** significant at 5%,* significant at 10%.
Robust standard errors.
_cut1, _cut2 _cut3 significant at 1%

As the subjective health measure runs from very well to cannot, a positive sign of the coefficient indicates that the variable lowers the health status. A negative coefficient indicates that an increase in that variable will improve health. All the objective health conditions lower the health score significantly. Presence of HIV/AIDS, illnesses, and having a chronic condition all lower the score. Years of education improve health in line with the human capital interpretation of health. Higher educated people are able to invest more in their health.

The positive coefficient of women is in line with Figure 5.3. The age effect is expected. Younger people are expected to perform physical tasks better that older ones. Period 3 is associated with better health, while health is lower in period 2 as expected given Figure 5.4.

The predictions from these regressions are rescaled into the range [0,1]. The mean of the six tasks for each individual is used as the health score (h). Based on this predicted score, household members were then ranked from best health to worst. Health score of rank 2 in period 1 is subtracted from that of rank 1 in period 1 to create the health difference $h_1^1 - h_1^2$. This pair is then traced to the next period to obtain $h_2^1 - h_2^2$. R is given by $\frac{h_2^1 - h_2^2}{h_1^1 - h_1^2}$. Similarly, R is computed for members rank 2 and 3, 3 and 4 and for all other possible pairs in each household.

Summary

The subject of risk and risk coping mechanisms is at the core of the debate on vulnerability and poverty. The discussion on human deprivation has shifted in emphasis from who are the poor or vulnerable to what causes vulnerability to poverty. Questions as to what strategies households use to deal with the causes of vulnerability have been at the forefront of this discussion. The reason being, a subset of strategies adopted by households may be the cause of poverty many households find themselves in. Identification of strategies that keep households out of poverty and those that perpetuate poverty is among the first line of interventions for governments and development partners in enhancing risk management capacity of households. This thesis provides insights as to how farm households in Central Kenya respond to two of the major causes of vulnerability: weather and HIV/AIDS.

From the first case of diagnosis in Kenya in 1984, HIV prevalence rate rose steadily to a peak of about 14 percent in 1999. Although the prevalence rate has since dropped to about 6 percent in 2005, this proportion and the maturing infections pose substantial health uncertainties for many Kenyan households. The health uncertainties compound an already existing problem faced by rural households whose livelihoods are dependent on rain-fed agriculture. Vulnerability of rain-fed agriculture to adequacy, reliability and timeliness of rainfall imply food insecurity. When food insecurity interacts with health problems, it translates into nutrition insecurity especially if health care provision is inadequate. The lack of formal insurance mechanisms for agriculture and limited public health expenditure makes it necessary to investigate how households deal with the consequences of weather shocks and illnesses, and the implications of the household's risk management strategies on their welfare.

The study uses a framework that represents interaction of a household's asset portfolio with risk to analyse the effect of sources of stress on consumption. The analysis is applied to data collected in three survey rounds from 196 households in Central Kenya. The households were sampled from the national sampling frame which consists of segments or clusters of households. HIV/AIDS afflicted households within the clusters were identified with the assistance of community health workers. One hundred and one households (101) were AIDS-afflicted or experienced illnesses related to HIV/AIDS. The study sites are introduced in Chapter 2.

Chapter 3 starts by examining the extent to which household consumption is vulnerable to shocks using consumption transition matrices. The results show that AIDS-afflicted households face greater mobility in their consumption than the non-afflicted ones, a finding that is consistent with the permanent income hypothesis. The hypothesis postulates that consumption is more sensitive to permanent income shocks. Differences in consumption mobility may also occur if households have differential access to consumption-smoothing devices. Chapter 3 also examines available coping mechanisms for different types of shocks. The analysis starts with an assessment of households' reliance on collective opportunities such as informal loans and gifts as well as individual household mechanisms such as assets and labour sales. In general, we find AIDS-related illnesses to have the characteristic of a covariant shock such as rainfall shortage. This is in the sense that neither the community nor the household based mechanisms seem able to protect consumption against ill-health related to HIV/AIDS. On specific mechanisms, the results show that gifts play an important role in assisting households to deal with shocks. While loans seem to play a minimal role, there are indications that they could be important for AIDS-afflicted households. The findings indicate that wealth is an important factor in gift exchange pointing to an environment where self-interest motives are important. In such an environment, the literature shows that public transfers would be beneficial as they are unlikely to displace community mechanisms. The existence of self-interest also points to presence of networks which group-based financial institutions can exploit.

Recognising that the most important asset for the low income people is their labour, Chapter 4 continues the discussion on coping mechanisms by examining how the male and female labour responds to shocks. A labour supply model that accommodates analysis of *ex ante* and *ex post* responses to shocks is used to explore the effects of persistent and transitory shocks. The role of credit constraint in driving labour responses is examined.

We find evidence of both *ex ante* and *ex post* labour responses to shocks. An *ex ante* response is indicative of risk avoidance. Since such behaviour may prevent farmers from achieving their potential output, provision of efficient insurance for farm households becomes an important poverty reduction strategy.

While results in Chapter 3 lead to a conclusion that loans play a minimal role in consumption smoothing, the analysis in Chapter 4 reveal liquidity constraint to be an important factor which may operate through the labour market. Lack of liquidity especially constrains the use

of male labour as a coping mechanism. Not surprisingly, a common rainfall shock also reduces the use of rural labour market for consumption smoothing. With regard to response to the presence of HIV/AIDS, males labour supply to off-farm work decline while on-farm work rise. While female's on-farm work decline, the female-head may work more off-farm in response to illness in an AIDS-afflicted household.

Having observed in Chapter 4 that labour responds *ex ante* to shocks, Chapter 5 and 6 explore other means by which households insulate consumption from shocks. Where physical strength is an important asset for daily livelihoods of a people, or where returns to labour input may vary between seasons, households may have an incentive to boost consumption to cash in on higher returns. This means that households buffer stock in health. Results of Chapter 4 show that labour response to shocks may differ by sex. Chapter 5 proceeds to examine whether there could also be differences in allocation of consumption goods by sex, if at all households buffer stock in health. To test for possibility of use of health as a buffer stock, the motives for allocating health goods within a household are examined. Allocation motives could be driven by either a desire for equality of health status among members or a concern for income generation. Predominance of incentive for income generation has implication for persistence poverty since it implies allocation of more health goods to those who can guarantee future income, and less to those whose health status may not enable them to work. While the findings indicate equality incentives dominate, productivity concerns are also important at some health ranges. The results show evidence of possible equilibriums, suggesting existence of poverty trap. We find sex disparities in health outcomes in favour of men, a result that is unlikely to be explained by involvement of men in more strenuous tasks.

Chapter 6 extends the analysis of *ex ante* responses to shocks by examining households' precautionary behaviour regarding use of physical and financial savings. The proportion saved out of transitory income (marginal propensity to save out of transitory income) was used as it provides a measure of the extent to which households use savings and credit markets to buffer consumption against income shortfalls. Households save about a third of what theoretical prediction suggests. According to the permanent income hypothesis, or in well functioning credit and insurance markets, households should save almost all of their transitory income. The proportion thus saved is a measure of completeness of credit and insurance markets. The results show seasonality to impact on prudence behaviour, with more stressful events adversely affecting the ability of households to save for the future.

Further examination of portfolio composition reveals the marginal propensity to save out of transitory income to be higher for more liquid but save forms of assets such as small livestock. Higher uncertainty, whether due to weather or HIV/AIDS, reduces the level of high value assets like cattle. While cash savings may rise with rainfall uncertainty, it declines in response to the presence of HIV/AIDS. Although the decline in savings with HIV/AIDS may suggest lower prudence, the fact that we find food consumption to be higher in AIDS-afflicted households that also have a sick spouse is evidence of precautionary behaviour. Higher food consumption would be expected given the need to maintain good nutrition to protect against opportunistic infections. Such behaviour is consistent with forward-looking agents, since such agents would try to protect the asset (health) on which their future income depends.

In Chapter 7, the findings of the different chapters are combined and their place in the vulnerability literature provided. The chapter shows how the results of one chapter motivate the analysis in the next and, on the whole, provide an indication of how households respond to different sources of stress, before and after shocks occur. This chapter also provides the policy implication regarding each finding.

The main policy relevance of the study is in the identification of some of the more vulnerable groups that policy should target especially as Kenya struggles to develop a comprehensive health insurance policy and also implement its policy for wealth and employment creation. The attempt to uncover underlying household behaviour in coping mechanisms goes some way in identification of sustainable ways by which help can be channelled where most needed. An effective redistribution policy needs to take into consideration existing household and community systems, building on the existing strengths while relieving the burdens to the households.

The findings of this study would be strengthened by availability of longitudinal data. Availability of only three observations per households within a span of 18 months limits the confidence at which we can provide causal effects between risk factors and subsequent outcomes. To reveal dynamics, a longer period of observation would be necessary.

Samenvatting (Summary in Dutch)

Risico's en het hanteren van risico's staan centraal in het debat over armoede en kwetsbaarheid. De discussie is verschoven van de identificatie van armen of kwetsbaren naar de oorzaken van armoede en kwetsbaarheid. Met name de vragen over de strategieën die huishoudens hanteren met betrekking tot de oorzaken van kwetsbaarheid komen aan de orde. De reden is dat een deel van de door huishoudens gevolgde strategieën mogelijk bijdragen aan hun armoede. Identificatie van strategieën die huishoudens vrijwaren van armoede en van strategieën die armoede laten voortduren, behoort dan ook tot de eerste taak van overheden en ontwikkelingsorganisaties als ondersteuning van het risico management van huishoudens. Dit proefschrift geeft inzicht in de reactie van huishoudens in Centraal Kenia op twee belangrijke oorzaken van kwetsbaarheid: het weer en HIV/AIDS.

Vanaf de eerste vaststelling van HIV in Kenia in 1984 steeg de infectiegraad geleidelijk tot een piek van 14 procent in 1999. Hoewel de infectiegraad is gedaald tot ongeveer 6 procent in 2005, leidt deze mate van infectie met een toenemende individuele intensiteit tot substantiële gezondheidsrisico's voor veel Keniase huishoudens. Deze gezondheidsrisico's verergeren de bestaande problemen die rurale huishoudens ondervinden door regen afhankelijke landbouw. De onzekerheid van regen met betrekking tot de hoeveelheid, de betrouwbaarheid en de tijdigheid resulteert in voedselonzekerheid. Indien voedselonzekerheid samenvalt met gezondheidsproblemen komt de voedingstoestand in gevaar, met name bij een onvoldoende gezondheidszorg. Het ontbreken van formele verzekeringsmogelijkheden in de landbouw en een beperkte gezondheidszorg door de overheid maakt onderzoek noodzakelijk naar het gedrag van huishoudens ten aanzien van de gevolgen van weer en ziekte.

Deze studie maakt gebruik van een model dat de interactie weergeeft tussen de samenstelling van de bezittingen van een huishouden en de risico's voor de analyse van de effecten van schokken op de consumptie. De analyse is toegepast op gegevens van 196 huishoudens in Centraal Kenia die in drie ronden verzameld zijn. De huishoudens werden geselecteerd uit de nationale steekproef die bestaat uit huishoudens ingedeeld in groepen. Door HIV/AIDS getroffen huishoudens werden geïdentificeerd met behulp van medewerkers uit de gezondheidszorg. Een totaal van 101 huishoudens was door HIV/AIDS getroffen of ondervond ziekten gerelateerd aan HIV/AIDS. In hoofdstuk twee wordt een overzicht gegeven van de onderzoeksgebieden.

Hoofdstuk 3 begint met een analyse van de kwetsbaarheid van de consumptie door schokken met behulp van matrices die consumptieveranderingen weergeven. De resultaten laten zien dat

door AIDS getroffen huishoudens grotere consumptieveranderingen ondervinden dan niet door AIDS getroffen huishoudens. Deze bevinding spoort met de permanente-inkomens hypothese, die stelt dat consumptie afhankelijk is van permanente inkomensveranderingen. Verschillen in consumptieveranderingen kunnen ook voorkomen als huishoudens ongelijke toegang hebben tot buffermechanismen die consumptie gelijkmatig kunnen houden. In hoofdstuk 3 worden vervolgens de verschillende buffermechanismen onderzocht in samenhang met de verschillende typen van schokken. De analyse begint met een beoordeling van de mogelijkheden die huishoudens hebben om een beroep te doen op collectieve voorzieningen zoals informele leningen en giften en individuele mogelijkheden als de verkoop van bezittingen en het leveren van arbeid. De conclusie is dat AIDS gerelateerde ziekten de karakteristieken hebben van algemene schokken, zoals droogte, omdat zowel collectieve als individuele buffermechanismen niet in staat zijn de consumptie te beschermen. Betreffende individuele mechanismen tonen de bevindingen aan dat giften belangrijk zijn als mechanisme om met schokken om te gaan terwijl leningen een geringe rol spelen, mogelijk met uitzondering van door AIDS getroffen huishoudens. De resultaten suggereren dat rijkdom een belangrijke factor is in het uitwisselen van giften en dit is een indicatie voor een omgeving waarin eigenbelang een grote rol speelt. In een dergelijke omgeving kan ondersteuning vanuit de overheid effectief zijn omdat het onwaarschijnlijk is dat ze voorzieningen uit de lokale gemeenschap verdringt. De aanwezigheid van eigenbelang in deze situatie duidt ook op het bestaan van netwerken die gebruikt zouden kunnen worden door financiële instituties.

In de wetenschap dat arbeid tot de belangrijkste bezittingen hoort van huishoudens met een laag inkomen wordt de discussie naar risico hantering in hoofdstuk 4 vervolgd met onderzoek naar het aanbod van arbeid door mannen en vrouwen als reactie op schokken. Een arbeidsaanbodmodel wordt gebruikt dat zowel ex ante als ex post de reacties weergeeft van permanente en tijdelijke schokken. De rol van kredietbeperkingen in relatie tot arbeidsaanbod is onderzocht.

We vinden dat het arbeidsaanbod zowel ex ante als ex post reageert op schokken. Een ex ante reactie duidt op het risico mijdend gedrag. Dergelijk gedrag kan boeren belemmeren hun potentiële productie te bereiken en een effectieve verzekering kan in deze situatie bijdragen aan armoedebestrijding.

Hoewel hoofdstuk 3 tot de conclusie leidt dat leningen een geringe rol spelen in het op peil houden van de consumptie laat de analyse in hoofdstuk 4 zien dat liquiditeit beperkingen een

rol kunnen spelen via het arbeidsaanbod. Gebrek aan kontante middelen beperkt met name de arbeidsinzet van mannen als middel tot risico hantering. Een algemene schok als droogte beperkt eveneens de rol van arbeid als middel om schokken op te vangen. De aanwezigheid van HIV/AIDS leidt tot een beperking van het arbeidsaanbod buiten de boerderij terwijl de arbeidsinzet op de eigen boerderij toeneemt. De arbeidsinzet van vrouwen op de boerderij neemt af, maar de inzet buiten het bedrijf kan toenemen in een door AIDS getroffen huishouding.

Na de bevinding in hoofdstuk 4 dat arbeid gebruikt om schokken op te vangen worden in de hoofdstukken vijf en zes andere mogelijkheden onderzocht om de consumptie op peil te houden in geval van schokken. In gevallen waar fysieke kracht belangrijk is voor de dagelijkse werkzaamheden, of waar de beloning van arbeid wisselt per seizoen, kunnen huishoudens gestimuleerd worden de consumptie te verhogen om tot hogere inkomsten te komen. De resultaten van hoofdstuk 4 laten zien dat het arbeidsaanbod bij schokken kan verschillen per sekse. Hoofdstuk 5 vervolgt met de vraag of ook de consumptie per sekse kan verschillen, indien huishoudens investeren in gezondheid. Teneinde te testen of gezondheid gebruikt wordt als buffer worden de verschillende mogelijkheden om de consumptie binnen een huishouden te verdelen onderzocht. Verdelingsmotieven zouden enerzijds kunnen stoelen op de wens voor een gelijke gezondheid binnen de huishouding of op de wens tot het verdienen van inkomen. Nadruk op inkomensvorming leidt tot een voortdurende armoede omdat degenen die verdienen meer consumptie toegewezen krijgen ten koste van degenen die vanwege hun gezondheid niet in staat zijn tot arbeid. De bevindingen tonen een nadruk op gelijkheidsmotieven, maar productiviteitsoverwegingen spelen een rol bij sommige gezondheidsniveaus. De resultaten duiden op evenwichtssituaties, wat het voorkomen van een armoedeval suggereert. Wat betreft de gezondheidsstatus wordt ongelijkheid gevonden tussen de seksen wat niet verklaard kan worden uit de door mannen verrichte zwaardere taken.

Hoofdstuk 6 verbreedt de analyse van ex ante reacties op schokken door een analyse van voorzorgsmaatregelen als fysieke en financiële besparingen. De besparingsquote uit tijdelijk inkomen is gebruikt omdat het een maatstaf geeft voor de mate waarin huishoudens de spaar- en kredietmarkt gebruiken om de consumptie tegen toekomstige schokken te beschermen. Huishoudens sparen ongeveer een derde van wat de theorie voorspelt. Volgens de permanente- inkomens theorie, of in een situatie met goed functionerende spaar- en verzekeringsmarkten, zouden huishoudens bijna het gehele tijdelijke inkomen sparen. De besparingsquote is een maatstaf voor het functioneren van de spaar- en verzekeringsmarkten.

De resultaten laten een seizoenseffect zien op voorzorgsmaatregelen, waarbij grotere schokken de spaarmogelijkheden negatief beïnvloeden.

Een verdere analyse van de samenstelling van de bezittingen vertoont een stijging van de marginale neiging tot sparen uit tijdelijk inkomen in de meer liquide maar toch veilige vormen als kleinvee. Een grotere onzekerheid, toe te schrijven aan het weer of aan HIV/AIDS, verlaagt de aanwezigheid van grotere bezittingen zoals runderen. Het aandeel van besparingen in kontanten kan stijgen bij onzekerheid, maar bij het voorkomen van HIV/AIDS daalt het aandeel van kontanten. Hoewel de lagere besparingen bij HIV/AIDS kunnen wijzen op beperktere voorzorgsmaatregelen betekent de gevonden hogere consumptie in door AIDS getroffen huishoudens met een ziek familielid dat voorzorgsmaatregelen wel genomen worden. De hogere consumptie van voedsel kan verwacht worden gegeven de noodzaak van bescherming tegen infectieziekten. Dergelijk gedrag past bij individuen die vooruit kijken omdat deze zullen proberen de gezondheid te beschermen vanwege het toekomstige inkomen.

In hoofdstuk zeven worden de uitkomsten uit de voorgaande hoofdstukken samengenomen en ingepast in de literatuur. Het hoofdstuk toont hoe de resultaten uit één hoofdstuk de analyse in het volgende hoofdstuk sturen en het geeft een beeld van de reacties van huishoudens op verschillende typen van schokken. Dit hoofdstuk geeft ook de consequenties van de bevindingen voor het beleid.

De belangrijkste bevinding van de studie met betrekking tot het beleid ligt in identificatie van de meer kwetsbare groepen waarop de aandacht gericht kan worden. Dit is van speciaal belang omdat Kenia worstelt met de ontwikkeling van een algemene gezondheidsverzekering naast het uitvoeren van beleid ten aanzien van armoedebestrijding en werk. De poging om huishoudgedrag ten aanzien van risicohantering bloot te leggen draagt bij aan het ontwikkelen van methoden om ondersteuning te richten op degenen die het nodig hebben. Een effectief herverdelingsbeleid dient bestaande systemen op huishoud- en gemeenschapsniveau in beschouwing te nemen, voort te bouwen op deze bestaande systemen, en de lasten van huishoudens te verlichten.

De bevindingen van deze studie zouden sterker gefundeerd zijn door beschikbaarheid van gegevens over een lange periode. De feitelijke beschikbaarheid van slechts drie observaties per huishouden over een periode van 18 maanden beperkt de betrouwbaarheid van de gevonden causale verbanden tussen risico factoren en resultaten. Het onderkennen van de totale dynamiek tussen gedrag en uitkomsten vereist een langere periode van waarnemingen.

TRAINING AND SUPERVISION PLAN

Description	Institute / Department	Year	ECTS
Courses			
Mansholt Introduction course	MGS[1]	2003	1.5
Research methodology	MGS	2003	3
Socio-cultural field research methods	MGS	2003	3
Field research Methods	ISS[2]	2003	6
Gender and economics in rural Africa	ISS	2003	1.5
Gender, food, agriculture and development	CERES[3]/MGS	2003	3
Livelihood analysis and research for poverty reduction	CERES	2003	2
Efficiency and productivity analysis: Parametric methods	MGS	2003	3
Efficiency and productivity analysis: Non-parametric methods	MGS		3
HIV/AIDS and Rural Livelihood in Sub-Sahara Africa	MGS	2003	3
Development of Development theory	ISS	2003	5.6
New Institutional Economics: Property Rights, Contracts and Transaction Costs	MGS	2004	3
Microfinance and marketing in developing countries	Wageningen University	2004	6
Farms, firms and livelihoods	Wageningen University	2004	6
Econometrics II	Wageningen University	2005	6
Presentations at conferences and workshops			
Mansholt multidisciplinary Seminar		2003	1
European/ EAAE PhD Workshop		2005	1
UNU-WIDER Conference on Advancing Health Equity 29-30 September 2006 , Helsinki, Finland		2006	1
Total (minimum 30 ECTS)			**58.6**

*One ECTS is equivalent to 30 hours of coursework
[1]Mansholt Graduate School
[2] Institute of Social Studies
[3]CERES Research School for Resource Studies for Development

CURRICULUM VITAE

Lydia Ndirangu was born on 15th August 1966 in Murang'a district in Central Kenya. She studied agricultural sciences at University of Nairobi, obtaining a Bachelor of Science degree in 1990. After a year of working at Coffee Research Foundation (CRF), with a scholarship from the German Academic Exchange Service (DAAD), she obtained a Master of Science degree in Agricultural Economics in 1995. She wrote her masters thesis on "Socio-economic factors determining efficiency of coffee marketing co-operatives in Kenya". In 1996-1997, she worked as an Intern at the Institute of Policy Analysis and Research (IPAR), Nairobi, where she did her research on impacts of liberalising the cereal sector on food security in Kenya.

Until the year 2000, she continued working with CRF on socio-economic issues on coffee production and marketing. In 2001, she joined the Kenya Institute for Public Policy Research and Analysis (KIPPRA) as a policy analyst. At KIPPRA, she is involved in policy research on issues pertaining to rural development and development of medium and small-scale enterprises. Her research interests are on rural poverty and food security, with a specific focus on rural financial and labour markets, intra-household and HIV/AIDS issues.