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Effects of Ill Health and Weather Variability on Savings

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Abstract

This paper examines the effects of households' shocks on saving behaviour. It investigates the possibility that households save *ex ante* to buffer against adverse weather and health shocks. The relatively high prevalence rate of HIV/AIDS in Kenya combined with rain fed agriculture implies great uncertainty for rural livelihoods. Adopting a methodology previously used on cross-sectional data (Paxson, 1992), the paper examines the level of households precautionary behaviour. This is done by estimating the marginal propensity to save out of transitory income over a period of 18 months. The results show that while households may exhibit some level of prudence, the marginal propensity to save out of transitory income is about a third of what the permanent income hypothesis postulates. Seasonality influences prudence behaviour, with stressful seasons likely to depress substantially the level of precautionary saving. The presence of HIV/AIDS illness lowers savings and raises per capita consumption. While reduced savings may seem to jeopardize future investments, the rise in consumption when the human asset is threatened, is in accordance with behaviour of forward-looking agents when future income is endogenous to current asset shock. The desire to smooth the health (asset) stock outweighs the desire (ability) to smooth future consumption and therefore savings decline. As a consequence, consumption for the HIV-afflicted households is relatively more volatile. While these findings are in agreement with a buffer stock model, 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. A rise in consumption and a drop in savings may be a signal that the relationship is likely to be disproportionate.

Keywords: Household, Shocks, Savings, HIV/AIDS

Introduction

This paper examines the effects household shocks on savings behaviour. Specifically, it aims at determining whether households are forward looking in their savings behaviour by examining the extent to which they save to smooth consumption in response to weather and health uncertainty. Such behaviour may 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.

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; Lundberg *et al.*, 2003; Paxson, 1992). 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. 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 (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. This paper 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 marginal propensity to save out of transitory income (MPS_T) is used as the measure for the extent to which households save in response to shocks. A high MPS_T is suggestive of high prudence. The magnitude of MPS_T is also of relevance for policy as it is indicative of the completeness of credit and insurance markets (Morduch, 1991).

Although it is difficult to differentiate between the continuum of *ex ante* and *ex post* behaviour within the short period covered in this study, the study recognizes that household members are not passive to shocks and that people adapt to their new outcomes. The adaptation to current outcomes may entail reorganization of the 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.

Data used in this paper come from three household surveys fielded in 2004-2005. The surveys covered two short rains seasons and one long rain season in Thika and Maragua districts in Central Kenya. For a more detailed account of the sampling framework for HIV/AIDS afflicted households see Ndirangu (2007). In total 196 households were visited in the three surveys rounds of which 101 were AIDS-afflicted and 95 non-afflicted. Of the 194 households with complete data, 178 comprised couples living together.

This paper is organized in the following way. Section 2 presents the empirical model of savings in the presence of fluctuations in transitory income. Section 3 presents the results and section 4 concludes.

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), test whether savings predict future changes in income. This paper adopts Paxson's (1992) approach who computes the marginal propensity to save out of transitory income and combines with that of Alderman's (1996) who examines the portfolio of savings. Savings is taken as a linear function 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:

$$S_{it} = \alpha_{ot} + \alpha_1 Y_{it}^{P} + \alpha_2 Y_{it}^{T} + \alpha_3 VAR_{it} + \alpha_4 LC_{it} + \varepsilon_{it} \quad (1)$$

where S_{it} is per capita saving for household i in period t, and ε_{it} is an error term. 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. In the absence of panel data that would allow computation of income variability suitable for this analysis, Paxson's (1992) 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. In addition, the VAR variables are interacted with wealth as per Rosenzweig and Binswanger (1993) since wealth may influence precautionary behaviour.

The life-cycle factors in LC_{it} consist of variables that measure the number of household members in a number of age-sex categories. This include number 5 years and below, 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.

Estimation of permanent and transitory incomes

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

$$Y_{it}^{P} = \beta_{t}^{P} + \beta_{1} VD + \beta_{P} X_{it}^{P} + u_{it}^{P}$$

where X_{it}^{P} represents a vector of household-fixed variables that are determinants of permanent income. This includes age, 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 (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:

$$Y_{it}^{T} = \beta_{t}^{T} + \beta^{T} X_{it}^{T} + u_{it}^{T} \qquad (3)$$

where X_{it}^{T} is a set of variables that affect transitory income. We include percent rainfall deviation from a 14-year average precipitation, a qualitative index of crop loss measuring the farmer's perception of loss experienced due to 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 deviation, the precipitation in two critical periods in the crop cycle is considered: the planting season and the weeding season (which also captures the growth phase). This variable is hereafter referred to as percent rainfall shortage. The rainfall information was collected from ten weather stations in the study area.

Equations (2) and (3) are combined to form an equation for total income as:

$$Y_{it} = \beta_{0t} + \beta_{1} VD + \beta^{P} X_{it}^{P} + \beta^{T} X_{it}^{T} + \mu_{it} \qquad (4)$$

where $\beta_{0t} = \beta_{t}^{P} + \beta_{t}^{T}$. Equations (2) and (3) can also be substituted into the structural savings equation (1):

$$S_{it} = \rho_{0t} + \rho_{1} VD + \rho_{P} X_{it}^{P} + \rho_{T} X_{it}^{T} + \alpha_{3} VAR_{it} + \alpha_{4} LC_{it} + \varepsilon_{it} \qquad (5)$$

where $\rho_{1} = \alpha_{1}\beta_{1}$ $\quad \rho_{0t} = \alpha_{ot} + \alpha_{1}\beta_{t}^{P} + \alpha_{2}\beta_{t}^{T}$; (2)

$\rho_{P} = \alpha_{1}\beta^{P}$; $\rho_{T} = \alpha_{2}\beta^{T}$

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 :

$$S_{it} = \gamma_{it} + \gamma_{0} VD + \gamma_{P} X_{it}^{P} + \gamma_{T} X_{it}^{T} + \eta_{it} \qquad (6)$$

The variable η_{it} in (6) 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. The effects of the elements of X_{it}^{T} on savings are also expected to be identical to their effect on income. That is, 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) at 1 percent significance level. 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.

An instrumental variable estimation is used to estimate the marginal propensity to save out of transitory income. The instruments 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. 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.

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.

Results

Estimates for both the reduced form and structural equations are shown in Tables 1-3. The results are presented for each season. We will first discuss the results of the reduced form income and savings equations (4) and (6); and later return to the estimates for the structural savings equation (1). The effect of uncertainty on portfolio composition is lastly examined.

Reduced form income and savings estimates

The reduced form equations test for the implications of the PIH on savings behaviour. The test results are presented at the bottom of Table 1. Test 1 shows the significance of the transitory rainfall variables. The test rejects the hypothesis that the effects of rainfall variables are jointly equal to zero in both the savings and income equations for all three seasons. In particular, rainfall shortage at planting time is significant in all the estimations. During the first survey for example, a 1 percent rainfall shortfall 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 a mean rainfall shortfall of 25 percent, 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 seasons.

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 2). Even though households show some prudence, the significant effect on consumption suggests that households are unable to completely buffer consumption against income shortfalls arising from rain failure.

Test II(b) does not reject equality of the effects of household-specific crop loss on savings and income 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 judgments on crop outcome and prepare accordingly. However, the second period is inconsistent with this argument. Crop loss has no significant effect on saving leading to rejection of the PIH for this season. Evidence that seasonality does impact on the precautionary behaviour can also be deduced from the fact that, the level at which the null of the PIH is accepted in the third period is at the margin (p-value=0.14) compared to the first period (P-value=0.66). Similarly, in Test 1(a) the level of acceptance for PIH for the rainfall variables also declines between periods 1 and 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.

The asset ownership variables are jointly significant. Land size and other assets are positively related to savings, suggesting that households with more assets save more.

The demographic variables do not show a strong and consistent pattern between savings and age structure as well as sex. 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 coefficients for being ill and AIDS-afflicted are negative, only the second period's savings are significantly impacted on. From Table II, being AIDS-afflicted and ill is positively related to per capita food expenditure. The positive effect can be explained by the fact that there may be 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.

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

The instrumental variable results for equation 5 fail to agree with the reduced form estimates in that they lead to a rejection of the PIH (Table III). The results, however, agree with the observation made earlier that the PIH effect is weak in the sense that consumption is affected (Table II). Households do not save as much of their transitory income as the PIH would predict. The average 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 finds a propensity to save out transitory income of 0.36 for rural Zimbabwe, but differ from that of Paxson (1992), who finds households 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 would be expected to deviate substantially from the theoretical prediction that all transitory income is saved. The coefficients for planting season rainfall variability (CV) are all positive. The third period is highly significant. The positive effect implies high rainfall variability at planting time leads to more savings, indicating prudent behaviour. 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.

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 period survey. The results are shown in Table 4.

Rainfall variability and being AIDS-afflicted reduce the value of cattle holdings. 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 the two forms of cash savings. Illness in general is 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 general observation from Table IV is that the propensity to save in liquid but save forms is higher than average 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. This 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.

Conclusions

This paper 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 propensity to save out of transitory income is a measure of completeness of financial markets, households cannot use savings and credit to smooth consumption.

The presence of HIV/AIDS increases per capita consumption which would imply depressed savings. The value of cattle holding and cash savings decline in response to HIV/AIDS. 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, forward-looking agents try to balance the desire to equalize 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.

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; pp. 109). The rise in consumption and the negative effect on savings may be a signal that the relationship is likely to be disproportionate.

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Table 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)	(1.31)	(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)
# observations	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 (0.007)	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: ($\gamma_T = \beta_T$); The effect of the rainfall variables on income is the same as the effect on saving; 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 2. Log per capita food consumption

Variables	Period 1	Period 2	Period 3
		Coefficient (z-value)	
# aged <6	-0.06 (-1.01)	-0.05 (-0.83)	-0.08 (-1.24)
# aged 6–14	-0.10 (-3.10)***	-0.08 (-2.26)**	-0.20 (-5.27)***
# aged 15–17	-0.20 (-2.11)**	-0.20 (-1.76)*	-0.15 (-2.05)**
# aged > 65	-0.29 (-2.14)**	-0.12 (-0.89)	-0.30 (-2.42)**
# males aged 18–64	-0.06 (-2.00)**	-0.10 (-2.83)***	-0.28 (-7.07)***
# females aged 18–64	-0.11 (-1.26)	-0.08 (-0.99)	-0.20 (-2.82)***
Average education male aged 18-64	-0.02 (-1.25)	0.01 (0.30)	
Average education female aged 18–64	-0.02 (-1.25)	0.01 (0.31)	
Log Asset	0.21 (4.52)***	0.16 (3.53)***	0.05 (0.99)
Log Land	0.05 (0.70)	0.04 (0.73)	0.03 (0.31)
Ill days	-0.01 (-2.74)***	-0.0003 (-0.22)	-0.01 (-2.58)***
HIV*ill days	0.02 (2.49)**	0.01 (1.05)	0.01 (2.30)**
Crop loss index	-0.08 (-2.39)**	-0.01 (-0.15)	-0.16 (-2.85)***
% rainfall shortfall planting	-0.01 (-3.15)***	-0.53 (-2.19)**	-0.84 (-2.27)**
% rainfall shortfall weeding	0.0003 (0.10)	-0.17 (-0.95)	0.19 (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*

Table 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	.35 (2.16)**	.29 (1.91)*	0.34 (2.55)***
# aged < 6	-1308.73 (-1.88)*	463.09 (1.60)	
# aged 6–14	-682.62 (-1.57)	-156.88 (-0.79)	-86.69 (-0.70)
# aged 15–17	1572.34 (1.08)	-204.0 (-0.43)	353.46 (1.54)
# aged > 65	-872.29 (-0.49)	1002.71 (1.81)*	
# males aged 18–64	-280.30 (-.71)	136.60 (0.51)	-234.84 (-2.14)**
# females aged 18–64	3490.94 (3.17)***	-171.69 (-0.51)	
Education head	269.61 (1.13)	-118.71 (1.20)	68.14 (0.72)
Log asset	1584.69 (2.56)***	-445.37 (-2.11)**	771.86 (3.16)***
Log land	1900.32 (1.81)*	634.04 (2.40)**	266.34 (1.20)
Ill days	1953.31 (1.53)	-54.26 (-2.62)***	-17.14 (-0.96)
HIV/AIDS dummy	-2281.12 (-1.71)*	-86.54 (-0.19)	633.09 (1.42)
HIV/AIDS dummy*wealth	-203.68 (-0.97)	-497.27 (-0.82)	-556.28 (-1.04)
CV planting	6204.74 (1.04)	2130.87 (1.03)	3144.89 (2.50)**
CV planting*wealth	-6516.79 (-2.18)**	70.79 (0.10)	-220.43 (-0.56)
Constant	-1886.12 (-2.27)**	3516 (1.18)	-10369.36 (-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%.

Table 4. Effect on income variability on saving composition (IV Tobit estimates)

Variables	Cattle	Other livestock	Informal savings	Cash savings)
		Coefficient (z-value)		
Log per capita income	-33 (-.75)	.44 (2.04)**	0.07 (1.89)*	.37 (1.14)
# aged < 15	-413.23 (-1.08)	114.57 (0.62)	-49.91 (-1.36)	-66.85 (-0.24)
# aged 15–17			-106.33 (-0.65)	-1705.68(-1.24)
# aged > 65		107.68 (2.00)**	-1333.58 (-4.10)***	-2960.84 (-1.71)*
# males aged 18–64	-574.28 (-1.11)	-277.61 (-1.02)	-73.14 (-1.35)	36.42 (0.11)
# females aged 18–64	-805.82 (-1.03)	120.60 (0.26)	-64.04 (-0.66)	772.95 (1.50)
Age Head	153.34 (1.67)*	360.43 (1.75)*	-67.37 (-1.68)*	-496.82 (2.08)**
Age squared		-3.19 (-1.46)	.89 (2.06)**	6.563 (2.58)***
Education head	150.85 (0.46)	-201.12 (-1.26)	-23.38 (-0.73)	
Log asset	2998.84 (2.76)***	235.50 (0.54)	57.46 (0.69)	936.94 (1.41)
Log land	561.29 (0.62)			282.64 (0.42)
Ill member	1368.51 (0.85)	589.63 (0.78)	-201.15 (-1.38)	3259.37 (2.53)***
AIDS dummy	-2675.94 (-1.71)*	919.18 (1.23)	-29.79 (-0.21)	-2278.12 (-2.09)**
AIDS dummy* Wealth	2033.78 (1.41)	1325.60 (1.78)*	313.10 (2.11)**	-282.64 (-0.23)
CV planting	-34548.20 (-1.98)**	1324.05 (0.34)	992.13 (1.99)**	6754.15 (1.94)*
CV planting * wealth	-4920.55 (-1.99)**	-2225.32 (-1.91)*	-116.20 (-0.60)	-995.88 (-0.76)
Constant	-16730.92 (-.63)	-16314.53 (-2.04)**	-269.81 (0.18)	-14101.63 (-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%.