PRECAUTIONARY SAVINGS, HEALTH AND WEATHER UNCERTAINTY: EVIDENCE FROM CENTRAL KENYA

By

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Abstract

This paper examines precautionary savings behaviour of households towards weather and health shocks. The marginal propensity to save out of transitory income is used as the measure of the extent to which households use savings to buffer consumption against income shortfalls.

Using a sample of 196 households examined over three consecutive cropping seasons, the results show the marginal propensity to save out of transitory income to be about a third of what the Permanent Income Hypothesis postulates. This proportion saved is an indication of the extent of incompleteness of credit and insurance markets in the study area. Seasonality is found to impact on prudence behaviour, with more stressful seasons adversely affecting savings and consumption. However, while savings decline in response to health stress associated with HIV/AIDS, consumption rise. Thus, the desire to smooth the health (asset) stock outweighs the desire (ability) to smooth future consumption and therefore savings decline.

JEL classification codes: I1, D52, D91.
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1. Introduction

Health uncertainty posed by HIV/AIDS compounds an already existing problem faced by rural households whose livelihoods are dependent on rain-fed agriculture. This study aims at determining whether households are forward looking in their savings behaviour by examining the way that savings respond 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. The fact that HIV/AIDS affects most the younger and more economically active members of the population makes such an analysis very relevant. 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 is used as a measure for the saving response to shocks. A high propensity suggests high prudence. The magnitude is also relevant for financial policy as it shows the degree of 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. 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 households adapt by keeping more (unproductive) liquid assets, their wealth growth declines.

Data used in this paper come from three household surveys fielded in 2004-2005 in Thika and Maragua districts in Central Kenya. The surveys covered two short rains cropping seasons and one long rains season. 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. The paper is organized as follows: 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.

2. 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 (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, 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 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:

$$Y_{it}^P = \beta_t^P + \beta_1 VD + \beta^P X_{it}^P + u_{it}^P \quad (2)$$

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:

$$Y_{it}^T = \beta_t^T + \beta^T X_{it}^T + u_{it}^T \quad (3)$$

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:

$$Y_{it} = \beta_{0t} + \beta_1 VD + \beta^P X_{it}^P + \beta^T X_{it}^T + \mu_{it} \quad (4)$$

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

$$S_{it} = \rho_{0t} + \rho_1 VD + \rho_P X_{it}^P + \rho_T X_{it}^T + \alpha_3 VAR_{it} + \alpha_4 LC_{it} + \varepsilon_{it} \quad (5)$$

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 :

$$S_{it} = \gamma_{it} + \gamma_0 VD + \gamma_P X_{it}^P + \gamma_T X_{it}^T + \eta_{it} \qquad (6)$$

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 the financial markets are, 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 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.

Income, saving and consumption were calculated as follows: 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. Consumption consists of expenditure on food plus expenditure on non-food including health care. Expenditure on food was constructed from purchased foods and imputed values of home production and informal transfers/gifts.

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, especially when associated with HIV/AIDS, 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.

3. Results

This section presents three sets of results. The descriptive statistics are first presented. Estimates for both the reduced form and structural equations are then discussed in sections 3.2 and 3.3. The results are presented for each season. The effect of uncertainty on portfolio composition is lastly examined in sub-section 3.4.

3.1 Descriptive statistics

Table I provide the means and variability of household per capita consumption. A differentiation is made for HIV/AIDS-afflicted and non-afflicted households. 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). Afflicted households have higher food and non-food consumption than non-afflicted, but also face higher volatility. Their income is on average also more volatile. The volatility in food consumption is, however, less than both total expenditure and income throughout the three seasons.

Table I Mean and variability of monthly per capita consumption, income and savings 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)
Income	5085.04 (0.48)	5826.74 (0.55)	5123.75 (0.86)	5226.94 (0.58)	5877.35 (0.80)	5940.18 (0.54)	5362.05 (0.71)	5664.62 (0.55)
Savings	13033.72 (0.59)	13568.57 (0.61)	5100.80 (0.84)	5478.78 (0.80)	6903.06 (0.67)	6300.24 (0.71)	8345.70 (0.65)	8449.20 (0.67)
N	97	95	88	84	88	84		

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

The above variability in consumption can be linked to shocks experienced by the households. Information on shocks is presented in Table II. The table reports the severity of crop and livestock losses reported by the households. Data was collected on events in the past cropping season that could have affected crop and livestock production. An index similar to that of Dercon and Krishnan (2000) 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 also shown is the measure of rainfall shock: the percent rainfall deviation of observed rainfall from the 14-year average. Since the survey period was generally drier than normal, the variable is regarded as percent rainfall shortfall. 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 II 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)
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

3.2 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 III. 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 IV). 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 2 (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 long-rain 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.

Table III 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:* ($\gamma_T = \beta_T$)

(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 IV 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

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 IV, 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.

3.3 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 V). The results, however, agree with the observation made earlier that the PIH effect is weak in the sense that consumption is affected (Table IV). 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 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 suggests 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 V 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	.29	0.34
	(2.16)**	(1.66)*	(2.55)***
# aged < 6	-1308.73	489.04	
	(-1.88)*	(1.75)*	
# aged 6–14	-682.62	-144.97	-86.69
	(-1.57)	(-0.79)	(-0.70)
# aged 15–17	1572.34	-175.85	353.46
	(1.08)	(-0.42)	(1.54)
# aged > 65	-872.29	959.80	
	(-0.49)	(1.79)*	
# males aged 18–64	-280.30	147.32	-234.84
	(-.71)	(0.71)	(-2.14)**
# females aged 18–64	3490.94	-147.32	
	(3.17)***	(-0.44)	
Education head	269.61	-107.67	68.14
	(1.13)	(1.12)	(0.72)
Log asset	1584.69	3114.11	771.86
	(2.56)***	(1.51)	(3.16)***
Log asset squared		-180.44	
		(1.78)*	
Log land	1900.32	699.50	266.34
	(1.81)*	(2.77)***	(1.20)
Ill days	1953.31	-54.48	-17.14
	(1.53)	(-2.78)***	(-0.96)
HIV/AIDS dummy	-2281.12	-304.71	633.09
	(-1.71)*	(0.52)	(1.42)
HIV/AIDS dummy*wealth	-203.68	-416.16	-556.28
	(-0.97)	(-1.11)	(-1.04)
CV planting	6204.74	2897.19	3144.89
	(1.04)	(0.39)	(2.50)**
CV planting*wealth	-6516.79	512.26	-220.43
	(-2.18)**	(0.65)	(-0.56)
Constant	-1886.12	14003.06	-10369.36
	(-2.27)**	(1.22)	(-3.60)***
N	177	166	169
F	5.18***	2.37***	8.11***
R^2	0.26	0.40	0.31
	Coefficient (P-value)		
Anderson canon. LR statistics	95.78 (0.00)		8.55 (0.04)
Hansen J statistic	0.04 (0.85)		0.38(0.82)

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

3.3 Effects of income variability on composition of savings

The goal for this section is to determine whether health and weather uncertainty significantly influence the portfolio of households. Savings in period 1 are regressed on shocks and rainfall variability in period 2. 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 VI.

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

Variables	Cattle	Other livestock	Informal savings	Cash savings)
	Coefficient (z-value)			
Log per capita income	-33	.44	0.07	.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 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 safe 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 less wealth in illiquid from.

4. 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, the implication is that households are not able to 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. The consequence is more volatile consumption.

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). 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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