Do Savings Predict Death?

Precautionary Savings during an Epidemic

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Abstract

Using a four-round panel dataset from Kagera, Tanzania, we examine whether households that suffer a death engage in precautionary savings to smooth consumption over the crisis. Under Deaton's buffer-stock hypothesis, savings equal the present value of future falls in income. In that case, we should see greater accumulation of assets among households which anticipate a death, and liquidation of assets following the death. We construct a sample of households by matching on the probability of suffering a death (the "propensity score"). We control for possible crowding out of own savings by including the receipt of transfers and credit as instrumented variables, and we bootstrap both the first-stage and the second-stage multinomial logits 1000 times. We find that households do not behave according to the buffer-stock model, and that the consequences of the death are more severe among poorer households than wealthier.

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Introduction

Death is among the most severe traumas that can visit a household; yet it appears that many households in Kagera are able to cope with, and recover from, the death of a household member. The success of the household in coping materially with tragedy is a function of the household's physical and social resources. The portfolio of coping mechanisms differs across households, by wealth and opportunity; and these differences determine households' vulnerability to shocks. In this paper, we examine the household's ability to self-insure through own savings.

There is a vast body of literature on the role of savings in smoothing consumption in environments of incomplete markets for insurance and credit. However, there has been little research on the role of savings in smoothing consumption in the AIDS epidemic: "... the prospect of a future AIDS death may result in increased precautionary savings in families of persons living with HIV, although there is very little evidence on this issue (Bloom and Mahal 1997:109)." Barnett and Blaikie (1992) provide anecdotal evidence of large reductions in asset holdings following an adult death. Using panel data from Kenya, Yamano and Jayne (2002) find that an adult man's death decreases the value of the household's farm equipment, and the value of small animals falls after the death of an adult woman.

Aside from the ordeal of loss and mourning, death inflicts a potentially overwhelming economic burden on afflicted households. The death of a productive household member reduces the household's available work force. Other things being equal, fatal illness increases household expenses (for health care, and ultimately funerals) at the same time as it reduces household income (due to diminished labor time). Prior to death, the ill person may be unable to work; and other members of the household may be forced to take time from their productive activities to provide care. The children of ill or dying parents may be withdrawn from school if the family can no longer pay fees or buy supplies, or if the child's labor is needed at home, on the farm, or in the marketplace.

The consequences of HIV and AIDS for the household are not the same as other diseases and other causes of death. Because the virus is mainly sexually transmitted, AIDS usually strikes prime-age adults, at the peak of their productive and income-earning years, who are often heads of families. Yet according to previous research using this dataset, households are at least partly able to compensate for, and in time recover from, the death of a family member (see e.g. Over *et al*. 2000).

How do households manage, and why do some manage more successfully than others? Even without explicit insurance markets, households have recourse to a range of consumption-smoothing mechanisms. Households would rather choose the insurance mechanism that maintained consumption without altering the mix or evolution of production and income; in this case, the mechanism that ensured not only the welfare of household members around the time of the death, but also their well-being in the future.

The plan of the paper is as follows. We first discuss the literature on consumption smoothing and precautionary savings, as it relates to the AIDS epidemic and Kagera. Then, we describe the survey, and present descriptive statistics on savings across wealth classes and death experience. Finally, we attempt to discover whether, and in which form, savings respond to a death in the household.

Consumption smoothing

Rural households are vulnerable to unexpected events in weather, prices, pests, illness, and death. They are unable to insulate themselves completely from the impact of these events. But households and communities have developed diverse methods to maintain living standards in the face of uncertainty and income variability. For the most part, households self-insure: they act both to minimize their exposure to risk, and to minimize the adverse consequences of unexpected shocks. In addition, as Townsend (1994), Udry (1991) and others have shown, there is considerable pooling of risks across households within and outside their immediate community.

The adverse events that households face can be distinguished by ubiquity and recurrence. Some shocks affect only individual households, independently of others. Non-infectious illness, injuries, and (except in epidemics) death are examples of such "idiosyncratic" shocks. Drought, in contrast, usually affects entire regions. Some shocks, such as unemployment, may be related both to individual characteristics and common events such as business cycles. Some shocks may be repeated over time. Deaton (1997) found that the ability of households to maintain consumption diminishes as the "autocorrelation" in shocks rises. Households can draw on assets to smooth consumption over the course of one drought; a succession of droughts is more difficult to overcome. On the other hand, some degree of repetition makes it possible to learn from experience – to apply the lessons learned during one event to future events, thereby lessening their adverse consequences. Gertler and Gruber (1997) found that households in Indonesia are better able to insure consumption against more frequent risks such as illness and idiosyncratic unemployment than against rare shocks such as death.

It may be useful to distinguish the ways of dealing with uncertainty by the timing and purpose of insurance. First, arrangements may be made *ex ante* or *ex post*: that is, in anticipation of or in response to a crisis. Second, arrangements may be made to minimize uncertainty in *income* or *consumption*.[1] Table 1 offers a summary description of some of the tactics households may employ to prevent or compensate for unexpected shortfall. This list is not exhaustive, nor is the taxonomy especially neat: some actions may be taken both *ex ante* and *ex post*.

There are three dimensions in which a household may smooth consumption. The permanent income hypothesis (PIH) refers to smoothing across *time*; that is, maintaining a desired level of consumption over the lifetime of the household. This is not explicitly an insurance mechanism, but the establishment of time-smoothing arrangements may permit the household to smooth consumption across *states of nature*, by allowing a household to spread risks over many periods, including the time of shortfall, for example by borrowing (*ex post*) from future income or saving (*ex ante*) for future expenditure. Finally, insurance across *space* involves risk pooling across households in a village, or between a household and relatives outside the region. Local inter-household risk pooling can effectively compensate for idiosyncratic risks that affect households independently, but not for aggregate risks that affect an entire village, such as regional drought.

Over and Mujinja (1995) make an additional distinction in insurance mechanisms by the structure of the "mediating institution:" that is, whether the insurance is mediated through the market or through extra-market relations. Examples of the latter include migration and marriage, ROSCAs, etc. Similarly, one might distinguish between those types of insurance which are within and outside the family (e.g. savings from own income v. borrowing from neighbors).

These various mechanisms are not completely independent. To the extent that *ex-ante* smoothing is successful, the *ex-post* environment is smoother, and the household will need to engage in less consumption smoothing. This may lead to underestimation of the importance of each one method (e.g. consumption-smoothing is less important if income already smoothed, cf. Morduch).

The household's choice of coping mechanisms is determined by the environment (the existence of markets and other institutions) as well as by the household's own resources and preferences. For example, in peri-urban areas or market towns, there may be more opportunities to engage in wage labor to compensate for idiosyncratic crop failure. In terms of household resources, larger households may be more able to take advantage of labor market opportunities than small households. The Zimbabwean farm households surveyed by Kinsey, Burger and Gunning (1998) report that households with nonagricultural income and those with livestock assets were by far less vulnerable during the 1991-92 drought. Kinsey *et al*. argue that poor

[1] It can be argued that all insurance activities are ultimately intended to ensure consumption, and this can be accomplished by protecting income or by protecting consumption following a decline in income.

households are relatively constrained in their choice of coping mechanisms: "the relatively poor tend to smooth income more than consumption while the relatively wealthy tend to smooth consumption alone (p.90)." The choice of response may reflect limited opportunities among poor households, rather than differences in preferences.

One can imagine a hierarchy of insurance mechanisms, which can be ranked, for example, by reversibility. According to this criterion, re-allocating labour is preferable to disposing assets. Similarly, if the household is forced to sell assets, it may prefer to sell consumer durables before productive assets, or selling livestock before land. In this paper, we examine changes in different types of assets in response to a death. There is some evidence that households do order preferences in response to drought and famine. On the income side, households diversify income sources, and productive assets are sold only at last resort. On the consumption side, households change the variety and composition of diets, and skip meals (see e.g. Reardon, Delgado, and Matlon 1992, Webb and Reardon 1992, Corbett 1988).

All households are not equally successful at minimizing risks. Jalan and Ravallion (1997) find that while all households in their sample from southern China are partially insured against income shocks, the effectiveness of consumption insurance increases with wealth. The poorest ten percent are the least well insured, with 40 percent of an income shock being passed on to consumption. The consumption of the richest one-third of households is protected from almost 90 percent of an income shock.

Around an income shock, consumption can evolve in one of a few stylized paths. The household may fully insured, and individuals within the household experience no change in consumption. This may be because the household has ensured the stability of income, or the stability of consumption in spite of a drop in income. If the shock alters income permanently, the Permanent Income (or more precisely, the Certainty-Equivalent) hypothesis suggests that the household adjusts consumption accordingly, to reflect the new level of permanent income. The household may adjust its behavior (for example by changing its asset stocks) to slow the change in consumption, until it reaches a new permanent level. If the shock is anticipated, the household can also adapt gradually to the new level. This can happen in the case of a fatal illness prior to death, through loss of income or increased expenses for health care. If the shock is temporary, the PIH-CEQ hypothesis suggests that consumption does not change. The household borrows, or adjusts its asset stocks, to smooth consumption. If the household has no access to consumption-smoothing mechanisms, changes in consumption exactly reflect changes in income.

Other things equal, the relative effectiveness of households' income- and consumption-smoothing mechanisms can be roughly measured by the size of the drop in consumption. Coping mechanisms might then be ranked inversely according to the associated drop in consumption: a smaller drop in consumption equals more successful coping.

But not all coping mechanisms are equal, even if they support the same level of consumption for the duration of the crisis. First, there are adjustment costs, and even “full” insurance may not enable the household to return to the previous consumption levels. Second, while the consumption profile of a household that sells assets to maintain consumption may be the same in the short run as that of a household with more effective insurance arrangements, the consequences for household welfare are quite different. Selling assets to maintain short-run consumption is likely to have adverse consequences for household income and welfare in the long run, especially if the household is forced to dispose of productive capital.

Third, insurance arrangements may maintain aggregate consumption levels while forcing adjustment of the distribution of consumption within the household. This will happen if the household does not distribute according to an equal sharing rule; or does not pool income and control over income changes, for example if children enter the labor market following the death of a parent and they are permitted to keep some share of the income they earn.

Pecautionary savings and HIV/AIDS

Precautionary savings are usually modelled as a response to income variance. According to the PIH-CEQ model, positive transitory income is saved and consumed during temporary shortfalls. On average, over time, savings are zero. The “buffer stock” model allows for precautionary savings that are motivated by anticipated fluctuations in income. All households form expectations of the evolution of their assets and permanent income over time. If they anticipate changes, they may save in order to equate consumption today with consumption in the future (more precisely, they equate the marginal utility of consumption today with the discounted expected marginal utility of future consumption). Households with access to credit markets need not worry about transitory fluctuations – they can borrow to make up temporary shortfalls and repay when income is higher than expected. For credit-constrained households, on the other hand, precautionary savings are driven by transitory shocks.

Deaton’s (1992) specification of the precautionary motive first expresses consumption as the annuity value of assets and expected labor income (i.e. permanent income):

$$c_t = \frac{r}{1+r} A_t + \left(\frac{r}{1+r}\right) \sum_{i=0}^{\infty} (1+r)^{-i} E\left(y_{t+1} \middle| \Omega_t\right), \quad (1)$$

where c is consumption, y is real labor income, A is the real value of assets, r is the constant interest rate, and Ω_t is the information available to the agent at time t. Savings are then defined as the difference between real income and consumption:

$$s_t = \frac{r}{1+r} A_t + y_t - c_t \,. \tag{2}$$

Substituting (2) into (1) yields

$$s_t = -\sum_{i=1}^{\infty} (1+r)^{-i} E(\Delta y_{t+1} | \Omega_t) \,, \tag{3}$$

where Δ denotes the (*t+1* to *t*) first difference. Precautionary savings are thus the discounted present value of all expected future falls in income.

Deaton (1992) suggests that the information available to the econometrician is a subset of the information available to the agent ($H_t \subseteq \Omega_t$), where H_t includes at least current income and savings. Then we can use the available information (on savings) to predict changes in income. Changes in savings reflect the agent's private information about expected changes in income. Future income is the realized outcome of some current process that affects expectations about income. If more information is available, expected income can be replaced in the savings equation by the factors that drive income expectations. In our case, we have more information than the household has: while the family of someone with AIDS is presumably aware of the impending death, we have information on the month in which that person dies. We can therefore examine savings as a function of the months remaining until (or following) death.

On the individual level, if serious illness were a reliable predictor of mortality, consumption should increase and savings decline (absent bequest motives). There are three motives for increasing savings by individuals: (i) uninsurable medical and funeral expenses (and uncertain life expectancy); (ii) bequests to family members *outside* the household; and (iii) ensuring the consumption of the multiple-member or multiple-generation household. Atomistic households (consisting of only of one person) have no reason to smooth consumption after their death. If households live longer than the individuals within it, there are arguably incentives for the dying individual to be concerned about household consumption. More plausibly, the household is not a collection of individuals with individual objective functions, but a group that maximizes (weighted) collective utility. Precautionary savings are a way for the *household* to smooth consumption around the death.

Households are motivated to save by a desire to raise consumption above income in case of a negative (permanent or transitory) income shock. In addition, to the extent that households are "prudent," (that is, display convex marginal utility [$U'''>0$]), they are motivated by an aversion to volatility. To the household, illness and death both increase the variance of income and shift the expectation to the left. In the absence of other insurance mechanisms, income is expected to fall. The drop in expected future income (given declining marginal utility) raises the expected marginal utility of future income.

How does AIDS increase uncertainty? Death has a binary distribution: one is either alive or not alive. Any increase in the probability of death to less than 50 percent increases the variance (as any increase in probability above 50 percent decreases the variance). If survival with AIDS is randomly distributed over 14 months, the expected probability of dying in any month is 1/14, or about seven percent. More plausibly, the probability of dying with AIDS increases over the course of the illness; but it is arguable that the naive expected probability of dying never exceeds 50 percent, except in the final, acute phase of the illness.[2] Thus both the likelihood of death and the uncertainty of death increase over the course of the illness.

AIDS is an avoidable risk: an individual can change his or her behavior to minimize the likelihood of exposure to HIV. But as there is yet neither vaccine nor cure for AIDS. Once an individual is infected with the HIV virus, death is likely but not certain: while the disease is so far always fatal, the virus does not always lead to the disease. It is also random, in the sense that the timing of the onset of symptoms and of death are unknown.

In industrial countries, median survival time prior to the use of highly active anti-retroviral therapy (HAART) was around 12 years.[3] Survival following the onset of AIDS symptoms ranges from 14 to 25 months in industrial countries. Both the time from HIV infection to AIDS, and the time from AIDS to death are believed to be much shorter (World Bank 1997b). Using data from the Kagera region, Killewo *et al*. (1993) estimate an average duration of infection of seven years. One study in Uganda estimated the median survival time from infection as just over five years for people infected under age 55, and three years for those infected at later ages (Nunn *et al.* 1997). Among 101 HIV-infected hospital workers studied in Kinshasa, 31 percent had developed AIDS symptoms or had died of AIDS within two years (N'Galy *et al*. 1988). Pallangyo and Laing (1990) estimate that the typical adult AIDS patient in Tanzania lives for a year and a half; and the World Bank (1992) estimate that 80 percent of adults with AIDS die

[2] We are an innately optimistic race: Gatti (1997) finds that in the U.S. Health and Retirement Survey, the experience of a major illness (heart attack, cancer, stroke) reduces the self-assessed expected probability of surviving to the age of 75 by a mere 6 to 11 percent (holding age and other covariates constant). There is some evidence that optimism pays off: survival with AIDS may increase with the patient's denial of mortality (Reed *et al.* 1997).

[3] HAART consists of daily doses of Zidovudine (AZT), Didanosine (ddI), and either Ritonavir (RTV) or Indinavir (IDV). The cost of this therapy has come down dramatically in recent years, but still exceeds the value of annual GDP per capita in many countries.

within one year, and all are dead within two years. Boerma *et al.* (1997) estimate that the mean survival time following the onset of disease is a mere ten months in the Mwanza region of Tanzania. In the Kagera sample, the average adult (15-50) survival with AIDS is 14.4 months (15.3 for women, 12.7 for men), and 15.7 months for those who died form other causes (13.4 and 17.9, respectively). The average duration of acute, debilitating illness for those who subsequently die is 29 days.

In any event, fatal illness provides two motives for savings: it increases the expected variance of income, and it decreases the expected mean of income. Holding current income constant, households are prompted to save by aversion to expected variance (Kimball's "prudence") and by higher expected marginal utility.

AIDS also adds one time dimension to the consumption-smoothing decisions of the household: decisions are now divided into (a) the period prior to the manifestation of the illness; (b) following the onset of illness and before death; and (c) following death. This has complications for the empirical estimation of savings around a death. One can imagine that savings evolve in response to the illness as depicted in Figure 1. Abstracting from other precautionary motives, awareness of illness (or perhaps awareness of increased prevalence and increased subjective *probability* of illness, prior to actual infection) leads the household to save in anticipation of future difficulty. As the illness progresses, and the household both loses income and requires greater expenditure for health care, net flows of savings may turn negative – that is, the household begins to consume its prior savings.

Previous studies of precautionary savings (Paxson 1992, Udry 1995, Alderman 1996) have examined changes in savings in response to strictly exogenous income shocks. In this case, not only is the illness endogenous (more precisely, it is a function of unobserved household characteristics), but the income shock is anticipated. Similarly, previous tests of precautionary savings have been based on the PIH-CEQ model, in which permanent income is consumed, and only transitory income is saved. In the case where death is unanticipated, and the household shifts to a new, constant, but lower consumption path, there is no change in savings. Where death is unexpected, it only affects savings to the extent that it is temporary. Is death a permanent or transitory shock? This is not so absurd as it sounds: Over *et al*. (2000) find that consumption declines following a death (for some households), but then recovers within a year. On the other hand, if death is expected, precautionary savings should increase with anticipated declines in permanent income as well as transitory income.

Why might HIV and AIDS *NOT* increase precautionary savings?

Gertler and Gruber (1997) point out that while farmers have sufficient experience to understand or at least have subjective probabilities of rainfall shocks, major illness is difficult to anticipate through savings. Death is even more so – it is hard to imagine that a household can develop a great deal of experience smoothing consumption over the death of prime-age household members. But the question being asked here is whether the household changes its behavior once it becomes aware of impending death; not whether the household can use the experience of one death to ease the burden of the next. In fact, the anticipation of death is key to the model: the deepening illness and decline contain information about future income and expenditure to which the household responds.

As emphasized by Morduch (1995), consumption-smoothing is needed to compensate for variability in income. If income is already smoothed, Deaton's model overstates the importance of the household's ability to ensure consumption through the use of explicitly consumption-smoothing arrangements. The household spreads some risk *ex ante* (by smoothing income), and some *ex post* (by smoothing consumption). Income is the result of some household production process, and risk-averse households, or those who expect changes in available labor, will adjust their sources of income. Finally, the household may have access to alternative insurance mechanisms. Lundberg, Over and Mujinja (2000) describe that remittances and assistance can account for XXX percent of total consumption among households that experience a death. In addition, there is some evidence, primarily from developed countries, that assistance "crowds out" own savings. Hubbard, Skinner and Zeldes (1995) and Engen and Gruber (1995) find that unemployment insurance reduces wealth accumulation, although the latter find no evidence of crowding out of non-financial assets. Conversely, Foster and Rosenzweig (1996) show that the presence of formal financial intermediaries diminishes (but does not eliminate) inter-household transfers.

Survey and descriptive statistics

The data come from a four-round panel survey in the Kagera region of northwestern Tanzania, conducted between 1990 and 1994. The region is west of Lake Victoria and borders the Rakai district of Uganda to the north, and Rwanda and Burundi to the west. More than 80 percent of the population lives in the rural areas, most of them in agriculture. The farming system consists of tree crops in the north (bananas and coffee) and annual crops (maize, sorghum and cotton) and livestock in the south.

Adult mortality is relatively high in Kagera, partly due to the early spread of HIV and AIDS. The first recorded case of AIDS in the region was in 1983, but the virus was probably present at least a decade earlier. The region is a crossroads for goods traffic, and was affected by the war between Tanzania and Uganda in the late 1970s. More recently, it has provided a haven for refugees fleeing Rwanda and Burundi. A population-based seroprevalence survey in Bukoba, the regional capital, in 1987, found that roughly a quarter of the prime-aged (15-50) adults were infected with HIV, as were up to 10 percent in the surrounding areas.

Although AIDS has severely affected parts of central and southern Africa, and is widely prevalent in the survey region, it is not the largest cause of death in the sample. The survey was conducted over a three-year period from 1990 to 1994, during which some 9.6 percent of sample individuals died (compared to a crude death rate in Tanzania of 1.4 percent in 1995 [World Bank 1997]). About 40 percent of sample deaths can be directly attributed to AIDS. Including deaths in the year prior to the survey period, 44 percent of household-wave observations have experienced a death at some point in the past.

The province was stratified by cluster and village, and all households within selected villages were given an initial enumeration survey. From that enumeration, 838 households were selected to receive the first round of the complete household survey. Since adult mortality was still a relatively rare event, households that indicated recent experience with severe illness in the initial enumeration were oversampled. Including households that dropped out and were replaced, the total sample consists of 3368 observations on 911 households. Lundberg, Over and Mujinja (2000) describe the survey and the sample in greater detail.

Since we are concerned with the impact of a death in the household, and since we suspect that death is not randomly distributed across households, we conduct the multivariate analysis on a "matched" sample of households. That is, we begin with the sub-sample of households that experienced a death. For each one of those households, we try to find a household or households from among the sample that had not experienced a death, but which resembles it, as closely as possible, in the characteristics that we believe are associated with the death. This is known as "propensity-score matching" (see e.g. Rosenbaum and Rubin 1983; Heckman, Ichimura, and Todd 1998). The propensity score is the predicted probability of death, from an initial logit regression of actual death experience on the entire sample. Households that experienced a death, but for which we find no match among non-death households, are dropped from the sample. Similarly, households without a death, which do not find a match among those with a death, are also dropped. This gives us greater confidence that the differences we observe among the households and attribute to the experience of death are in fact due to the death, and not to some other characteristics that differ across death experience and which might be correlated with the dependent variable. The results of the logit regression that we use to predict the death is presented in Appendix Table 1.

Table 2 presents descriptive statistics and t-tests of household characteristics and differences in asset acquisition across households by wealth and death experience on this propensity-score-matched sample. Households that have experienced a death are slightly wealthier, as measured by the log of assets in wave 1, and they are larger, as measured by the log of adult-equivalent household size. They are less likely to have a male household head (which may be because male household heads are more likely to die), and an older household head, but there is no difference in the household head's education. Also, in this simplistic comparison, households with a death receive more formal assistance, but do not receive more informal (private) transfers. Households with a death also receive less credit than those without a death.

We use the log of assets in wave 1 as the measure of household wealth in the empirical work that follows. We distinguish "poor" and "rich" households in this table by membership in the bottom and top halves, respectively, of the distribution of wave 1 assets. Wealthier households are more likely to have older, male, and better-educated household heads than poorer households. Poorer households receive no more formal assistance than wealthier households, but they do receive more credit, and as Lundberg *et al*. (2000) found, wealthier households receive more informal transfers. While the first columns indicate that formal assistance is targeted to households that have suffered a death, these columns suggest that wealth is not used as a targeting mechanism. The value of informal transfers is many times greater than formal assistance or credit.

In our multivariate analysis below, we include dummy variables indicating whether the household dropped out of the sample prior to the end of the survey, and whether the household was chosen as a replacement for a departed household. In either case, the household is represented by fewer than four observations. Table 2 shows that households that drop out of the sample are slightly more likely to have suffered a death than households that remain, and households chosen as replacements are much less likely to have suffered a death. This is because households with a recent severe illness were oversampled from the original enumeration survey, but replacement households were chosen randomly from the remaining pool of households from the enumeration survey. Conversely, poorer households are significantly more likely to drop out of the survey than wealthier households, but replacement households are marginally more likely to be in the top half of the wealth distribution.

Table 3 describes the flow of selected assets to the household, similarly distinguished by wealth and death experience. Households that have suffered a death are significantly less likely to have net accumulation (positive savings) of total assets. However, they are also less likely to have negative savings than households without a death. It appears that asset stocks are more volatile among households that have not suffered a death. This is some evidence against the hypothesis that households that have suffered a death allow the stock of assets to fluctuate as a consumption-smoothing device. Households that have suffered a death do seem to save a larger amount (except, surprisingly, of financial assets) than households without a death. Much of this distinction may be explained by the fact that wealthier households are also more likely to experience a death, and wealthier households generally have larger savings than poorer households.[4] The second set of columns shows that wealthier households are indeed more likely to save, and more likely to dissave, than poorer households. Asset stocks seem to be more volatile among the wealthy.

It is likely that the simple bivariate comparisons of savings behavior are biased, in that the influence of wealth on savings confounds the influence of death on savings. To control for this in a casual fashion, Table 4 examines savings by death within wealth classes, and by wealth class within death experience. The first set of columns examines total savings. This table suggests that wealthier households without a death are no more likely to have positive savings than wealthier households with a death. Poorer households without a death are more likely to save and dissave than poorer households with a death. Controlling for death experience, wealthier households are generally more likely to save, and dissave, than poorer households. This relationship holds when we disaggregate savings into physical and financial capital. Wealthier households with no death are more likely to accumulate assets, and the wealthy are more likely to save and dissave than the poor.

These casual observations do not find a systematic relationship between savings and death – at least, not in the sense that we hypothesized above. In the cross-section, the probability that a wealthy household accumulates assets is greater among those wealthy households that have not suffered a death. Similarly, the probability that a poor household consumes or liquidates assets is greater among those poor households that have not suffered a death. However, these

[4] Note that the flow of assets includes inheritances. It might be supposed that inheritances are greater in households that have suffered a death. However, there is also evidence that assets are sometimes "inherited out:" that is, bequeathed by the deceased to someone outside his surviving immediate household.

statistics do not control for differences over time (that savings behave differently prior to and following a death).

Finally, in Table 5 we try to find a difference in savings between households before and after the death. This table includes only those households in which someone dies at some point during the survey period. This table presents contradictory evidence. Poorer households with a death are more likely to have positive savings prior to the death than afterwards, and they are more likely to have negative savings after the death. This is in contrast to Table 4, which showed that poor households without a death are more likely to save, and save more, than poor households with a death. This table shows that within the set of poor households that do experience a death, there is some evidence that savings behaviour is different before and after the death.

Although Table 5 provides *prima facie* evidence of precautionary savings among the poor (more savings before, and more dissavings after, the death), the differences in savings behaviour may simply represent secular trends in savings over the course of the survey period. Among both rich and poor households that have suffered a death, the likelihood of asset accumulation decreases during the survey period, and the likelihood of asset disposal increases; although the differences in the levels are insignificant among the wealthy. This is shown in Figure 2, which presents smoothed mean monthly probabilities of positive and negative net savings for rich and poor households that experience a death at some point during the survey period. This figure shows that poor households that have suffered a death increasingly dissave, and decreasingly save, over time.

These descriptive statistics provide limited and inconsistent evidence of precautionary savings. There may be some among poorer households, but none among the wealthy. On the other hand, the differences may reflect secular trends quite independent of the influence of the death. In order to distinguish among these factors, we now turn to the multivariate analysis, where we test explicitly whether changes in asset stocks vary by death experience, time, and household wealth.

Estimation issues

We model changes in savings as a function of the household's experience of death. In order to test the hypothesis that savings decisions are made in anticipation of changes in income due to the death, we include a set of variables describing the time until and following the death. If households engage in precautionary savings around a death, we would expect to see savings increase following the manifestation of the illness, and decline at the time of death (or prior to death, if income falls and expenses rise).

Previous studies of savings (e.g. Paxson) have emphasized the problems of measurement error. If savings are taken as the residual between income and consumption, measurement error in income leads to artificial correlation of *Y* with *S*: observed income $Y^o = Y^* + \mu$; observed (residual) savings $S^o = Y^o - C$; true savings $S^* = (Y^o - \mu) - C$; so S^o misstates true savings by the measurement error in income: $S^o = S^* + \mu$; and $Y^o - C = S^* + \mu$. Assuming the measurement error in income is uncorrelated with the measurement error in reported (as opposed to residual) savings, the solution is to use observed savings. However, the assumption of no correlation between the measurement errors in savings and consumption may be unsupportable; in addition, measurement error in independent variables themselves is a source of attenuation bias in parameters. We avoid this problem by examining recorded actual changes in assets, rather than the residual, as our definition of savings.

The data present a second potential problem, which is that savings are concentrated at zero – that is, many households have no savings at all. This is especially true of the individual components of the household's portfolio. Take land, for example: out of nearly 4,000 household-wave observations, 94 percent report no changes to landholdings. Similarly, only two percent report liquidating durable goods. This creates problems for estimation, since OLS regressions of values assume that the underlying variables are normally distributed, whereas the savings data are "leptokurtotic" (having a large and sharp peak) – in other words, the plurality of observations are zero.

Following Fafchamps and Lund (1997), we estimate instead the *probability* of having positive or negative savings, as a function of household characteristics including the time prior to and following the death. We have already controlled for selection on unobservable characteristics that determine the household's experience of death, by using the propensity-score matching method. We now estimate savings using a multinomial logit framework, in which any positive savings take the value 1, negative savings take the value –1, and zero savings remain zero. Thus we model the household's savings decision as a choice of one of three alternatives: to accumulate assets, to liquidate assets, or make no changes to the stock of assets.

The multinomial logit model allows us to estimate the probability that individual *i* makes choice *j*, by comparing of all possible pairs of choices (i.e., Prob[U(*i*,*j*) > u(*i*,*k*) for all *k* not *j*]). Formally, for a vector of regressors **X**, this can be stated as

$$P(i,j) = \frac{\exp[\beta' X(i,j)]}{\sum_{k=1}^{J} \exp[\beta' X(i,k)]} = \frac{\exp[\beta' X(i,j)]}{\exp\left[\log \sum_{k=1}^{J} \exp[\beta' X(i,k)]\right]}. \quad (4)$$

[5]

Finally, the descriptive statistics make us skeptical of finding any result on the mean. We expect, that the results will differ significantly by wealth. As Table 4 showed, there is some distinction between death experience and asset accumulation among better-off households, and between death and asset liquidation among the poor. We therefore split the sample as above, into the top and bottom halves of the wealth distribution, as measured by the initial stock of assets.

We estimate the probability of having positive or negative savings as a function of a parsimonious set of household characteristics, including the age, sex, and education of the household head, the household's initial wealth, and household size. We include two variables describing the person who died (whether male and whether he died in the household), and dummy variables that indicate whether the household dropped out of the sample or was added as a replacement.

To control for the possibility that savings are crowded out by other risk-pooling mechanisms, we include measures of the household's receipts of transfers, assistance, and credit. These are clearly endogenous to the household's savings decisions: I will be less likely to save if my wealthy family will provide assistance in times of crisis, or if I have easy access to credit. We instrument these three using a range of variables describing the household and the community (see Appendix Table 2). We instrument these variables in a first stage, and include the instrumented variables in the second-stage multinomial logits. This may result in serious bias in the second-stage covariance matrix and overly optimistic standard errors. To compensate for this, we bootstrap each model (on total, physical and financial capital), running 1000 regressions on random draws of three-quarters of the propensity-score-matched dataset. This yields a total sample of about 4 million observations for each outcome. The regressions on each wealth class use half of the total sample, by definition.

We present the results in the form of simulations based on the econometric estimates, varying the time to (following) death, and holding all other variables at their means within each wealth class. We construct wealth-class-specific counterfactuals, as the predicted probability of savings setting the death-related variables to zero. The bootstrapping conveniently yields 1000 simulations for each savings variable, which we use to construct means and confidence intervals around these simulations.

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[5] See Greene (1993).

Results

Here we present only a schematic representation of the main results, showing the evolution of the probability of asset accumulation and disposal around a death. Summaries of the full regression results are presented in Tables 6, 7, and 8. Each figure presents both the savings behavior of households that have suffered a death, and as a counterfactual, the mean probability of savings (dissavings) for households that have not suffered a death. In addition, we include 90 percent confidence bands around the mean predicted value. These simulations are presented for both the top and bottom halves of the income distribution.

Figures 3A and 3B show the probability of positive and negative savings of total assets, respectively, around the death for poor and wealthy households. Figure 3A shows that between 50 and 60 percent of households that did not suffer a death had positive savings over the sample period, roughly corresponding to the descriptive statistics presented above. The predicted probabilities are quite a bit lower, in both classes, among households with a death. Among the wealthier half of households, the upper confidence interval is lower than the no-death counterfactual from some point just before the death until two years after the death. In other words, among wealthier households, a death reduces the probability of accumulating assets for about two years. After two years, the wealthy household recovers to the counterfactual.

Among poorer households, the simulation is estimated with a fairly large confidence interval, but it descends below the poor-household counterfactual at about the same time (six months prior to the death). After that, the figure suggests that the probability of asset accumulation continues to decline until the end of the simulation period in month 36. That said, the two simulations presented here also show that we can't reject the hypothesis that the probability of positive savings is identical across the two wealth classes. Although the better-off households appear to recover, and the poor appear to continue falling, the 90 percent confidence bands overlap, perhaps separating after month 36.

Figure 3B shows the impact of a death on the probability of dissaving. Among wealthier households, there appears to be little impact. Wealthier households with a death are not more likely to liquidate or consume assets than wealthier households without a death. If anything, wealthier households appear slightly *less* likely to dissave after the death than wealthier households without a death. Among poorer households, the impact is unambiguous. Poorer households that suffer a death are far more likely to liquidate or consume assets than poorer households without a death. The probability continues to rise until well after the death, although it appears to reach a peak some time after month 30. For poorer households, a death raises the probability of dissavings well above the counterfactual, and well above the predicted dissavings of wealthier households.

Poor households respond to the death by consuming their assets. However, they do not appear to save in anticipation of the death. Figure 3A does not show that poorer households that will suffer a death are more likely to save than poorer households that will not suffer a death. The buffer stock hypothesis of precautionary savings requires that households save in anticipation of future falls in income, and consume their assets once income falls. According to these figures, poorer households obey the second of these rules (they dissave around a death), but they do not obey the first. They consume assets, but these assets were not set aside specifically to cover death-related expenses and death-related falls in income.

Figures 4 and 5 disaggregate total savings into physical and financial capital. Figure 4A shows that death has an impact on the probability of the accumulation of physical capital by wealthier households between months 6 and 24 following the death. Among the poor, the probability of accumulating physical capital falls below the counterfactual at some point between months 6 and 12. After that, while the wealthier half of households in the sample recover to the counterfactual, the poorer half does not (although it appears to rise again around month 30). As in Figure 3B, Figure 4B shows that wealthier households that suffer a death may be *less* likely to dispose of physical assets than wealthy households without a death, for the year following the death. Poorer households are more likely to dispose of physical assets during the second and third years after the death. Prior to month 12, there is no significant difference across poorer households by death experience. This figure relieves bit the pessimistic message of Figures 3A and 3B. Although poorer households consume their savings, the impact on the disposal of physical assets is relatively smaller.

This implies that much of the death-related movement in assets among the poor comes in the form of fluctuations in financial savings. Figure 5A shows that for both wealthy and poor households, a death significantly reduces the probability that the household will have positive financial savings. This reduction is on the order of half among wealthier households, and two-thirds among poorer households. This figure also shows no consistent trend back to the counterfactual among either wealth class. Households with a death remain less likely to accumulate financial assets throughout the simulation period. Indeed, among poorer households, the probability of financial savings rises to the counterfactual and then falls again after month 30, although this may be an artifact of the functional form.

The results on the disposal of financial assets are even stronger, especially among the poor. Figure 5B shows that death has no impact on the probability of liquidation of financial assets among the wealthy. At no point is the predicted evolution of financial asset disposal significantly different from the within-class counterfactual. Among the poor, it appears that death increases the likelihood that the household will dispose of financial assets, relative to the counterfactual and relative to the wealthier households in the sample. The probability of dissaving is higher even prior to the death, and continues to rise monotonically throughout the three years following the death. Again, this shows that the although the poor consume assets, they do not appear to save in anticipation of the crisis.

Conclusions

The figures presented above show that for poor households, death reduces the likelihood that a household will save, and increases the likelihood that a household will dissave. There is little impact among the wealthy, and wealthier households appear to recover as time passes. The exception to this is that even wealthy households are remain less likely to accumulate financial assets for many months after a death. For poorer households, the probability of asset accumulation may never recover to the level that would have obtained in the absence of the death.

The consequences to the household of continued dissaving would not be so severe if the household had been able to build up a buffer stock on which they could draw in times of crisis. However, there is no evidence to suggest poorer households accumulated assets prior to the death. There are many possible explanations for this. First, households could be poor prognosticators. They could misinterpret the extent to which income will fall and expenses will rise. As was noted above, we are habitually optimistic. Second, they may have already accumulated a buffer-stock prior to the beginning of the survey. This is possible, but unlikely, since the survey captured deaths in each of the four waves, and roughly a quarter of "time to death" observations are greater than two years. This is arguably enough time to begin saving in anticipation of the death. For this second alternative to hold, the household must prepare for a crisis more than two years in advance, and then do nothing as the crisis approaches. Third, it could be that poor households have no access to savings instruments which hold their value in times of crisis; or that existing savings instruments are lumpy, and inaccessible to poorer households with relatively small savings. Fourth, the household could have alternative insurance mechanisms on which it can rely to smooth consumption over the crisis. This is also not likely – the descriptive evidence presented above, and the evidence presented in Lundberg *et al*. (2000) shows that poor households are less likely than wealthier households to receive remittances. Finally, it may be that the buffer-stock precautionary savings model is inappropriate. Households may not act to smooth consumption over a crisis, for a combination of these reasons, on both the demand and supply sides, which the model fails to capture. Households may be limited in their foresight, and limited in their access to appropriate opportunities for savings.

In any event, the consequences for the poor household are ominous: they may continue to consume their savings for months and even years after the death. For the poor household, just as a death reduces current consumption, it also diminishes the capital stock that it needs to invest for future growth, and to maintain the welfare of its members.

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Tables and Figures

Table 1. Household coping mechanisms

	Ex ante	*Ex post*
Income	• diversification of plots, crops • varying input mix and intensity • diversification of activities (non-crop, non-farm) • forward sale • contingent contracts, share tenancy • migration	• changing household activities, wage labor • migration • changing household composition (increasing number of workers)
Consumption	• formal insurance • Roscas • precautionary savings • commodity storage • exogamous marriage • establish migration channels	• disposal/consumption of assets • borrowing • local informal assistance (e.g. *zakat*) • remittances from migrants, extended family • formal assistance (state, NGO, charity) • changing household composition (decreasing number of consumers) • changing diet, foraging (famine foods)

Table 2. Descriptive statistics, by wealth and death experience, on propensity-score-matched dataset

Variable	No death mean	No death (sd)	Any death mean	Any death (sd)	(t-test)[1]	Poorest 50% mean	Poorest 50% (sd)	Richest 50% mean	Richest 50% (sd)	(t-test)[1]
Household has experienced a death	..		..		..	0.39	(0.49)	0.46	(0.50)	(4.75) **
Log physical assets, wave 1	2.43	(0.64)	2.53	(0.68)	(4.78) **	1.99	(0.48)	2.95	(0.42)	(66.94) **
Male hh head	0.77	(0.42)	0.67	(0.47)	(7.11) **	0.66	(0.47)	0.80	(0.40)	(9.60) **
HH head age	48.47	(16.84)	49.75	(18.11)	(2.26) *	44.79	(17.44)	53.25	(16.30)	(15.82) **
HH head education	4.05	(3.15)	4.13	(3.18)	(0.85)	3.70	(3.20)	4.47	(3.08)	(7.78) **
Log adult equivalents	1.04	(0.54)	1.14	(0.51)	(6.29) **	0.90	(0.51)	1.27	(0.48)	(23.49) **
Gross remittances received	1.90	(12.92)	2.11	(4.92)	(0.69)	1.41	(3.38)	2.58	(14.14)	(3.59) **
Formal assistance received	0.27	(1.16)	0.41	(1.32)	(3.34) **	0.32	(1.35)	0.34	(1.10)	(0.46)
Credit received	0.27	(1.63)	0.16	(0.76)	(2.83) **	0.16	(0.61)	0.29	(1.78)	(3.12) **
Household is drop-out	0.08	(0.27)	0.10	(0.29)	(2.12) *	0.12	(0.33)	0.05	(0.21)	(8.96) **
Household is replacement	0.10	(0.30)	0.05	(0.22)	(5.37) **	0.07	(0.25)	0.09	(0.28)	(2.67) **
N	2282		1700			1991		1991		

Notes:

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

Table 3. Changes in assets, by wealth and death experience, on propensity-score-matched dataset

Variable	No death mean	Any death mean	(t-test)[1]	Poorest 50% mean	Richest 50% mean	(t-test)[1]
Proportion of households with positive savings						
Total assets	0.53	0.51	(1.66) +	0.50	0.55	(3.18) **
Physical assets	0.53	0.50	(1.72) +	0.49	0.54	(3.33) **
Financial assets	0.15	0.12	(2.23) **	0.12	0.16	(3.65) **
Proportion of households with negative savings						
Total assets	0.27	0.25	(1.61) *	0.24	0.28	(2.97) **
Physical assets	0.19	0.18	(0.74)	0.16	0.22	(4.63) **
Financial assets	0.18	0.16	(1.78) +	0.17	0.17	(0.17)
Mean net (unconditional) savings, thousand TSh.						
Total assets	1.85	3.10	(2.37) *	1.95	2.82	(1.80) +
Physical assets	1.88	3.14	(2.39) *	1.99	2.86	(1.81) +
Financial assets	-0.03	-0.04	(0.14)	-0.03	-0.04	(0.11)
N	2282	1700		1991	1991	

Notes:

[1] + significant at 10%, * significant at 5%, ** significant at 1%.

Table 4. Changes in assets, by wealth x death experience, on propensity-score-matched dataset[1]

	Total savings			Physical assets			Financial assets		
	No death	Death	(t-test)[1]	No death	Death	(t-test)[1]	No death	Death	(t-test)[1]
Proportion of households with positive savings [2]									
Not poor	0.56	0.54	(1.02)	0.56	0.52	(1.68) +	0.17	0.14	(1.46)
Poor	0.51	0.47	(1.68) +	0.50	0.48	(1.12)	0.13	0.10	(2.18) *
(t-test)[1]	(2.19) *	(2.53) *		(2.88) **	(1.98) *		(2.58) **	(2.92) **	
Proportion of households with negative savings [2]									
Not poor	0.28	0.27	(0.66)	0.22	0.22	(0.21)	0.18	0.17	(0.63)
Poor	0.25	0.21	(2.01) *	0.17	0.15	(1.44)	0.19	0.15	(1.91) +
(t-test)[1]	(1.73) +	(2.78) **		(2.99) **	(3.76) **		(0.61)	(0.69)	
Mean net (unconditional) savings, thousand TSh.									
Not poor	1.94	3.83	(2.15) *	1.97	3.88	(2.19) *	-0.03	-0.05	(0.45)
Poor	1.77	2.24	(0.91)	1.81	2.26	(0.88)	-0.04	-0.02	(0.49)
(t-test)[1]	(0.38)	(1.73) +		(0.35)	(1.77) +		(0.28)	(0.67)	

Notes:

[1] T-tests in parentheses. Row t-tests are of differences within wealth class, by death experience; column t-tests are within death experience, across wealth class; + significant at 10%, * significant at 5%, ** significant at 1%.

[2] T-tests of proportion of households with positive savings with respect to households with zero or negative savings, and of households with negative savings with respect to those with zero or positive savings.

Table 5. Changes in assets prior to and following death, on propensity-score-matched dataset[1]

	Total savings			Physical capital			Financial capital		
	Before death	After death	(t-test)	Before death	After death	(t-test)	Before death	After death	(t-test)
Proportion of households with positive savings									
Not poor	0.52	0.54	(0.44)	0.51	0.53	(0.43)	0.16	0.14	(0.56)
Poor	0.55	0.46	(1.71) +	0.56	0.46	(2.08) *	0.03	0.11	(3.69) **
All	0.53	0.50	(0.87)	0.53	0.50	(1.09)	0.11	0.13	(0.96)
Proportion of households with negative savings									
Not poor	0.29	0.27	(0.66)	0.23	0.21	(0.64)	0.12	0.18	(1.83) +
Poor	0.15	0.23	(2.01) *	0.10	0.15	(1.70) +	0.10	0.16	(1.99) *
All	0.23	0.25	(0.47)	0.18	0.18	(0.21)	0.11	0.17	(2.63) **
Mean net (unconditional) savings, thousand TSh.									
Not poor	0.58	4.57	(2.48) *	0.59	4.63	(2.52) *	0.00	-0.07	(0.86)
Poor	0.64	2.53	(3.21) **	0.68	2.55	(3.21) **	-0.03	-0.02	(0.44)
All	0.61	3.62	(3.15) **	0.62	3.66	(3.19) **	-0.02	-0.04	(0.67)

Notes:

[1] T-tests of differences between savings before and after the death; + significant at 10%, * significant at 5%, ** significant at 1%.

Table 6. Summary of results, total assets[1]

Variable	Entire sample Parameter estimate	(s.e.)	Poorer half Parameter estimate	(s.e.)	Wealthier half Parameter estimate	(s.e.)
Negative savings						
[1.1] Death	-0.216	(0.670)	1.600	(1.096)	-1.490	(0.859) +
[1.2] Death * time until (since) death	-0.014	(0.015)	0.010	(0.025)	-0.028	(0.020)
.[1.3] Death * time squared / 100	0.143	(0.111)	0.118	(0.178)	0.130	(0.154)
[1.4] Death * time cubed / 1000	-0.025	(0.024)	-0.029	(0.037)	-0.016	(0.035)
[1.5] Deceased died in the household	-0.030	(0.358)	-1.097	(0.584) +	0.715	(0.465)
[1.6] Deceased was male	-0.189	(0.179)	-0.273	(0.267)	-0.007	(0.256)
[1.7] Male household head	-0.012	(0.156)	0.132	(0.214)	-0.347	(0.252)
[1.8] Age of household head	-0.009	(0.004) *	-0.017	(0.006) **	0.007	(0.007)
[1.9] Education of household head	-0.028	(0.026)	-0.046	(0.036)	-0.001	(0.041)
[1.10] Log of adult equivalents	1.286	(0.128) **	1.056	(0.175) **	1.663	(0.201) **
[1.11] Wealth at wave one	0.204	(0.114) +	0.162	(0.195)	0.349	(0.241)
[1.12] Household left survey	-0.454	(0.332)	-0.558	(0.402)	-0.159	(0.661)
[1.13] Household is replacement	-0.043	(0.260)	-0.148	(0.359)	0.128	(0.396)
[1.14] Formal assistance received	-0.914	(0.176) **	-0.835	(0.269) **	-1.143	(0.245) **
[1.15] Remittances received	0.001	(0.040)	0.042	(0.059)	-0.069	(0.057)
[1.16] Credit received	2.177	(0.420) **	1.945	(0.585) **	2.636	(0.629) **
[1.17] Months since beginning of survey	0.013	(0.009)	0.016	(0.012)	0.015	(0.013)
[1.18] Intercept	-1.176	(0.340) **	-0.598	(0.522)	-2.620	(0.816) **
Positive savings						
[2.1] Death	-0.583	(0.608)	0.216	(1.038)	-1.390	(0.764) +
[2.2] Death * time until (since) death	-0.013	(0.013)	-0.003	(0.020)	-0.025	(0.019)
.[2.3] Death * time squared / 100	0.103	(0.099)	0.035	(0.147)	0.133	(0.142)
[2.4] Death * time cubed / 1000	-0.016	(0.022)	-0.010	(0.032)	-0.014	(0.032)
[2.5] Deceased died in the household	0.106	(0.323)	-0.291	(0.542)	0.537	(0.415)
[2.6] Deceased was male	0.116	(0.157)	0.031	(0.224)	0.276	(0.229)
[2.7] Male household head	0.219	(0.138)	0.276	(0.183)	0.007	(0.230)
[2.8] Age of household head	-0.013	(0.004) **	-0.023	(0.005) **	0.002	(0.006)
[2.9] Education of household head	-0.023	(0.023)	-0.059	(0.031) +	0.018	(0.037)
[2.10] Log of adult equivalents	1.337	(0.113) **	1.217	(0.154) **	1.573	(0.181) **
[2.11] Wealth at wave one	0.156	(0.100)	0.105	(0.160)	0.278	(0.223)
[2.12] Household left survey	-0.041	(0.265)	-0.194	(0.308)	0.080	(0.575)
[2.13] Household is replacement	-0.249	(0.241)	-0.744	(0.350) *	0.137	(0.364)
[2.14] Formal assistance received	-0.901	(0.155) **	-0.520	(0.231) *	-1.318	(0.223) **
[2.15] Remittances received	0.045	(0.036)	0.072	(0.052)	-0.017	(0.052)
[2.16] Credit received	1.674	(0.378) **	1.538	(0.511) **	1.977	(0.576) **
[2.17] Months since beginning of survey	-0.009	(0.008)	-0.013	(0.011)	-0.001	(0.012)
[2.18] Intercept	-0.086	(0.297)	0.612	(0.437)	-1.421	(0.750) +
Joint significance tests (Chi-squared, *df*)						
Negative savings						
Death [1.1-1.6] (*6*)		(13.901) **		(12.821) *		(12.362) *
Drop-out [1.12-1.13] (*2*)		(4.860) +		(8.316) *		(1.377)
Assistance [1.14-1.16] (*3*)		(61.845) **		(25.425) **		(48.364) **
Positive savings						
Death [2.1-2.6] (*6*)		(16.656) **		(15.803) **		(13.361) **
Drop-out [2.12-2.13] (*2*)		(3.202)		(7.096) *		(1.268)
Assistance [2.14-2.16] (*3*)		(63.896) **		(19.598) **		(59.345) **
Full model						
Death [1.1-1.4, 2.1-2.4] (*8*)		(17.130) **		(16.169) **		(13.637) **
Drop-out [1.12-1.13,2.12-2.13] (*4*)		(5.878) +		(8.847) *		(1.787)
Assistance [1.14-1.16,2.14-2.16] (*6*)		(70.122) **		(25.820) **		(60.991) **
All variables [1.1-2.18] (*34*)		(426.703) **		(219.652) **		(227.564) **
N		3982		1991		1991

Notes

[1] Results of multinomial logit regressions on 1000 draws, each of 75 percent of the total sample. For column 1, this yields a sample of nearly 4 million observations. Parameter estimates and standard errors (in parentheses) are means of the results of all draws. Significance tests are *z*-scores, calculated on the means: ** 99% significance, * 95% significance, + 90% significance. Savings = 0 is the base (omitted) category.

Table 7. Summary of results, physical capital[1]

Variable	Entire sample Parameter estimate	(s.e.)	Poorer half Parameter estimate	(s.e.)	Wealthier half Parameter estimate	(s.e.)
Negative savings						
[1.1] Death	-0.398	(0.688)	0.824	(1.162)	-1.155	(0.866)
[1.2] Death * time until (since) death	-0.017	(0.015)	0.016	(0.027)	-0.038	(0.019) *
.[1.3] Death * time squared / 100	0.172	(0.110)	0.163	(0.193)	0.155	(0.147)
[1.4] Death * time cubed / 1000	-0.031	(0.025)	-0.052	(0.041)	-0.010	(0.033)
[1.5] Deceased died in the household	0.093	(0.368)	-0.673	(0.621)	0.530	(0.466)
[1.6] Deceased was male	0.006	(0.185)	-0.064	(0.290)	0.171	(0.251)
[1.7] Male household head	0.235	(0.165)	0.409	(0.234) +	0.047	(0.252)
[1.8] Age of household head	-0.007	(0.005)	-0.011	(0.006) +	0.000	(0.007)
[1.9] Education of household head	-0.015	(0.026)	-0.033	(0.037)	-0.002	(0.039)
[1.10] Log of adult equivalents	1.490	(0.139) **	1.335	(0.199) **	1.698	(0.206) **
[1.11] Wealth at wave one	0.207	(0.118) +	0.071	(0.227)	0.276	(0.220)
[1.12] Household left survey	-0.452	(0.359)	-0.434	(0.453)	-0.616	(0.637)
[1.13] Household is replacement	-0.152	(0.282)	-0.363	(0.414)	0.134	(0.407)
[1.14] Formal assistance received	-1.269	(0.188) **	-1.076	(0.295) **	-1.590	(0.254) **
[1.15] Remittances received	0.035	(0.040)	0.087	(0.063)	-0.016	(0.055)
[1.16] Credit received	1.607	(0.417) **	1.180	(0.608) +	2.130	(0.601) **
[1.17] Months since beginning of survey	0.000	(0.009)	0.001	(0.013)	0.001	(0.013)
[1.18] Intercept	-2.144	(0.356) **	-1.649	(0.590) **	-2.751	(0.770) **
Positive savings						
[2.1] Death	-0.477	(0.564)	-0.154	(0.948)	-0.880	(0.715)
[2.2] Death * time until (since) death	-0.014	(0.012)	-0.003	(0.019)	-0.028	(0.017)
.[2.3] Death * time squared / 100	0.044	(0.093)	-0.018	(0.140)	0.076	(0.130)
[2.4] Death * time cubed / 1000	-0.002	(0.020)	-0.002	(0.030)	0.005	(0.029)
[2.5] Deceased died in the household	0.168	(0.300)	0.028	(0.497)	0.346	(0.386)
[2.6] Deceased was male	0.028	(0.146)	-0.050	(0.213)	0.185	(0.208)
[2.7] Male household head	0.221	(0.127) +	0.274	(0.171)	0.127	(0.205)
[2.8] Age of household head	-0.014	(0.004) **	-0.019	(0.005) **	-0.007	(0.006)
[2.9] Education of household head	-0.021	(0.021)	-0.040	(0.028)	-0.007	(0.033)
[2.10] Log of adult equivalents	1.387	(0.108) **	1.383	(0.149) **	1.427	(0.166) **
[2.11] Wealth at wave one	0.074	(0.092)	-0.033	(0.149)	0.063	(0.193)
[2.12] Household left survey	-0.107	(0.246)	-0.103	(0.290)	-0.420	(0.495)
[2.13] Household is replacement	0.050	(0.219)	-0.462	(0.317)	0.491	(0.331)
[2.14] Formal assistance received	-0.841	(0.144) **	-0.399	(0.215) +	-1.310	(0.205) **
[2.15] Remittances received	0.048	(0.033)	0.067	(0.048)	0.011	(0.047)
[2.16] Credit received	1.206	(0.338) **	0.920	(0.462) *	1.596	(0.510) **
[2.17] Months since beginning of survey	-0.021	(0.007) **	-0.024	(0.010) *	-0.015	(0.011)
[2.18] Intercept	-0.097	(0.274)	0.322	(0.408)	-0.290	(0.657)
Joint significance tests (Chi-squared, *df*)						
Negative savings						
Death [1.1-1.6] (*6*)		(8.404) +		(9.663) *		(10.966) *
Drop-out [1.12-1.13] (*2*)		(3.519)		(4.050)		(4.747) +
Assistance [1.14-1.16] (*3*)		(67.635) **		(21.249) **		(58.813) **
Positive savings						
Death [2.1-2.6] (*6*)		(11.617) *		(12.757) *		(12.428) *
Drop-out [2.12-2.13] (*2*)		(2.228)		(3.469)		(4.500)
Assistance [2.14-2.16] (*3*)		(52.903) **		(11.910) **		(58.334) **
Full model						
Death [1.1-1.4, 2.1-2.4] (*8*)		(11.970) *		(13.082) *		(12.759) *
Drop-out [1.12-1.13,2.12-2.13] (*4*)		(3.980)		(4.488)		(5.103) +
Assistance [1.14-1.16,2.14-2.16] (*6*)		(73.860) **		(21.690) **		(69.551) **
All variables [1.1-2.18] (*34*)		(492.913) **		(225.553) **		(266.352) **
N		3982		1991		1991

Notes

[1] Results of multinomial logit regressions on 1000 draws, each of 75 percent of the total sample. For column 1, this yields a sample of nearly 4 million observations. Parameter estimates and standard errors (in parentheses) are means of the results of all draws. Significance tests are *z*-scores, calculated on the means: ** 99% significance, * 95% significance, + 90% significance. Savings = 0 is the base (omitted) category.

Table 8. Summary of results, financial capital[1]

Variable	Entire sample: Parameter estimate	(s.e.)	Poorer half: Parameter estimate	(s.e.)	Wealthier half: Parameter estimate	(s.e.)
Negative savings						
[1.1] Death	0.392	(0.592)	1.786	(0.942) +	-0.348	(0.787)
[1.2] Death * time until (since) death	0.013	(0.015)	0.008	(0.025)	0.021	(0.020)
.[1.3] Death * time squared / 100	0.006	(0.110)	0.072	(0.178)	-0.059	(0.147)
[1.4] Death * time cubed / 1000	-0.008	(0.023)	-0.016	(0.036)	-0.001	(0.032)
[1.5] Deceased died in the household	-0.293	(0.321)	-1.039	(0.514) *	0.101	(0.426)
[1.6] Deceased was male	-0.116	(0.170)	-0.303	(0.267)	0.040	(0.227)
[1.7] Male household head	-0.101	(0.147)	-0.014	(0.209)	-0.332	(0.219)
[1.8] Age of household head	-0.007	(0.004) +	-0.015	(0.006) **	0.004	(0.006)
[1.9] Education of household head	-0.006	(0.023)	-0.037	(0.032)	0.032	(0.033)
[1.10] Log of adult equivalents	0.506	(0.120) **	0.509	(0.172) **	0.568	(0.175) **
[1.11] Wealth at wave one	-0.069	(0.103)	0.058	(0.192)	-0.121	(0.203)
[1.12] Household left survey	-0.298	(0.318)	-0.195	(0.380)	-0.566	(12727)
[1.13] Household is replacement	0.071	(0.229)	0.579	(0.323) +	-0.387	(0.344)
[1.14] Formal assistance received	-0.185	(0.162)	-0.338	(0.254)	-0.137	(0.214)
[1.15] Remittances received	-0.022	(0.035)	0.019	(0.056)	-0.063	(0.048)
[1.16] Credit received	1.536	(0.360) **	1.901	(0.530) **	1.392	(0.506) **
[1.17] Months since beginning of survey	0.043	(0.008) **	0.046	(0.011) **	0.041	(0.011) **
[1.18] Intercept	-2.132	(0.311) **	-2.172	(0.512) **	-2.452	(0.675) **
Positive savings						
[2.1] Death	-1.227	(0.802)	-9.602	(1.619) **	-1.222	(0.870)
[2.2] Death * time until (since) death	-0.001	(0.015)	0.111	(0.075)	-0.017	(0.016)
.[2.3] Death * time squared / 100	0.168	(0.109)	-0.182	(0.435)	0.104	(0.124)
[2.4] Death * time cubed / 1000	-0.038	(0.025)	-0.007	(0.073)	-0.017	(0.029)
[2.5] Deceased died in the household	0.408	(0.422)	4.136	(0.896) **	0.549	(0.461)
[2.6] Deceased was male	0.197	(0.190)	0.245	(0.328)	0.194	(0.242)
[2.7] Male household head	0.407	(0.176) *	0.428	(0.257) +	0.382	(0.266)
[2.8] Age of household head	-0.007	(0.005)	-0.016	(0.007) *	0.003	(0.007)
[2.9] Education of household head	-0.014	(0.025)	-0.062	(0.038) +	0.026	(0.035)
[2.10] Log of adult equivalents	0.514	(0.133) **	0.376	(0.202) +	0.656	(0.184) **
[2.11] Wealth at wave one	0.194	(0.117) +	0.187	(0.245)	0.189	(0.188)
[2.12] Household left survey	0.203	(0.308)	0.218	(0.408)	0.252	(0.503)
[2.13] Household is replacement	-0.381	(0.298)	-0.168	(0.483)	-0.524	(0.386)
[2.14] Formal assistance received	-0.566	(0.185) **	-0.407	(0.306)	-0.712	(0.241) **
[2.15] Remittances received	0.046	(0.038)	0.088	(0.066)	0.005	(0.048)
[2.16] Credit received	1.433	(0.398) **	1.581	(0.630) *	1.397	(0.526) **
[2.17] Months since beginning of survey	0.036	(0.009) **	0.039	(0.013) **	0.037	(0.012) **
[2.18] Intercept	-3.344	(0.358) **	-2.800	(0.639) **	-4.103	(0.677) **
Joint significance tests (Chi-squared, *df*)						
Negative savings						
Death [1.1-1.6] (*6*)		(11.181) *		(6494.556) **		(7.644)
Drop-out [1.12-1.13] (*2*)		(3.723)		(5.016) +		(3.880)
Assistance [1.14-1.16] (*3*)		(31.802) **		(20.863) **		(19.023) **
Positive savings						
Death [2.1-2.6] (*6*)		(11.323) *		(6269.860) **		(7.902) +
Drop-out [2.12-2.13] (*2*)		(3.634)		(5.229) +		(3.824)
Assistance [2.14-2.16] (*3*)		(38.030) **		(20.108) **		(26.957) **
Full model						
Death [1.1-1.4, 2.1-2.4] (*8*)		(11.763) *		(6494.787) **		(8.181) +
Drop-out [1.12-1.13,2.12-2.13] (*4*)		(5.096) +		(5.947) +		(4.823) +
Assistance [1.14-1.16,2.14-2.16] (*6*)		(39.175) **		(21.663) **		(27.410) **
All variables [1.1-2.18] (*34*)		(236.384) **		(152.236) **		(122.796) **
N		3982		1991		1991

Notes

[1] Results of multinomial logit regressions on 1000 draws, each of 75 percent of the total sample. For column 1, this yields a sample of nearly 4 million observations. Parameter estimates and standard errors (in parentheses) are means of the results of all draws. Significance tests are *z*-scores, calculated on the means: ** 99% significance, * 95% significance, + 90% significance. Savings = 0 is the base (omitted) category.

Appendix Table 1. Logit to predict household death experience[1]

Variable	Parameter estimate	(s.e.)
Household farms	1.127	(0.593) +
Household herds	-0.179	(0.204)
Household fishes	-0.701	(0.691)
Household has business	-0.220	(0.222)
Life has gotten worse since 1980	0.335	(0.308)
Household head is 25-29	-0.984	(0.459) *
Household head is 30-34	-0.613	(0.429)
Household head is 35-39	-0.747	(0.428) +
Household head is 40-44	-1.407	(0.446) **
Household head is 45-49	-0.982	(0.469) *
Household head is 50-59	-0.721	(0.401) +
Household head is 60+	-0.452	(0.386)
Head has 1-6 years schooling	-0.136	(0.214)
Head has 7 years schooling	0.054	(0.266)
Head has 8-13 years schooling	0.280	(0.371)
Head has 14+ years schooling	-1.240	(1.271)
Children	0.043	(0.044)
Female adults	0.046	(0.092)
Male adults	0.115	(0.092)
Household number / 1000	0.000	(0.000) *
Catholic church in community	-0.342	(0.270)
Post office in community	-0.578	(0.370)
Secondary school in community	0.242	(0.327)
Distance to dispensary	0.004	(0.029)
Health center in community	0.067	(0.569)
Agric extension services in community	0.115	(0.493)
Irrigated fields in the community	-0.266	(0.372)
Groundnuts grown in community	0.135	(0.287)
Coffee grown in community	-0.067	(0.413)
Cotton grown in community	-1.080	(0.748)
Maize grown in community	-0.018	(0.252)
Sorghum grown in community	0.656	(0.516)
Crop disease in community	0.759	(0.527)
Natural disaster in community	-0.083	(0.288)
Rain past 3 months	-0.005	(0.004)
Rain past 6 months	0.001	(0.007)
Rain past 9 months	0.006	(0.009)
Rain past 12 months	-0.005	(0.009)
Land market in community	-0.323	(0.416)
Product market in community	-0.336	(0.241)
Log price index	-4.739	(1.861) *
Price of banana/coffee land	0.002	(0.002)
Price of uncultivated land	0.004	(0.005)
Adult wage rate for clearing land	0.000	(0.001)
Population in 1988	0.000	(0.000)
Urban dummy	1.439	(0.535) **
Net arrivals since 1985	-0.152	(0.162)
Adult mortality rate	0.026	(0.026)
Epidemic in community	0.168	(0.542)
Intercept	0.190	(1.351)
Joint significance, all variables (Chi-2, *49 df*)		(93.10) **
Log-likelihood		(572.28)
N		908

Notes:

[1] + significant at 10%, * significant at 5%, ** significant at 1%.

Appendix Table 2. F-tests of excluded instruments in first stage regressions

Savings variable	Receipt variable	F-statistic (48 df)[1]
Total savings		
	Formal assistance	(5.127) **
	Informal transfers	(1.953) **
	Loans taken in	(1.314)
Physical capital		
	Formal assistance	(5.159) **
	Informal transfers	(1.950) **
	Loans taken in	(1.325)
Financial capital		
	Formal assistance	(5.139) **
	Informal transfers	(1.946) **
	Loans taken in	(1.309)

Notes:

[1] + significant at 10%, * significant at 5%, ** significant at 1%.

Figure 1. Stylized net flows of savings around a death

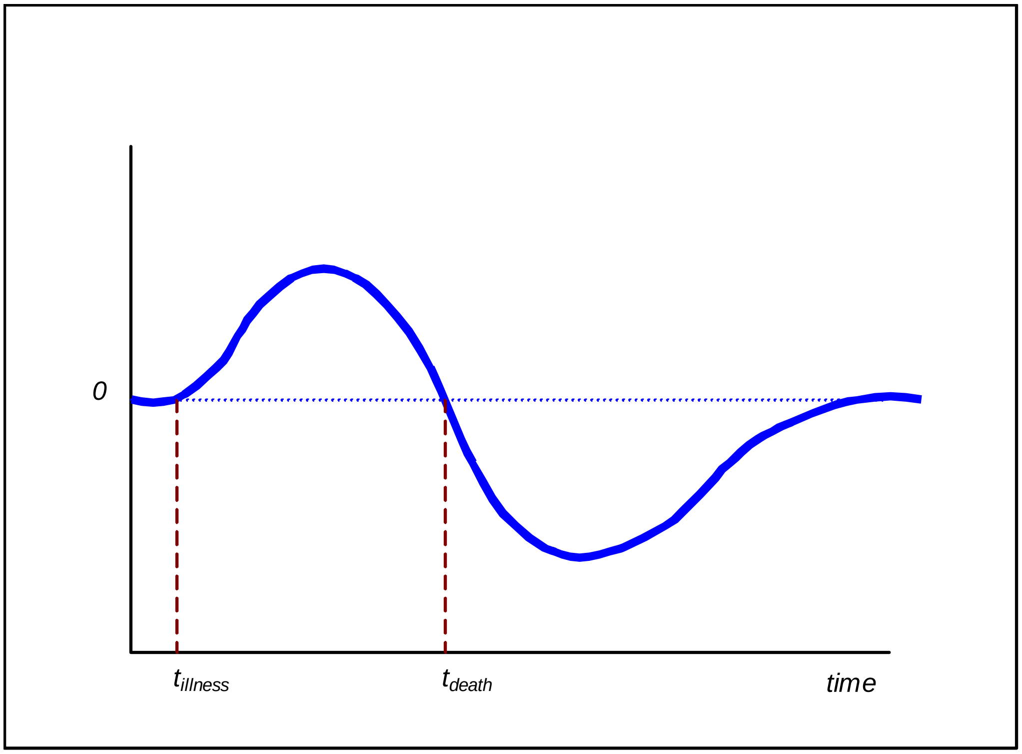

Figure 2. Smoothed probability of positive or negative total net savings, for the sample of households that experienced a death.

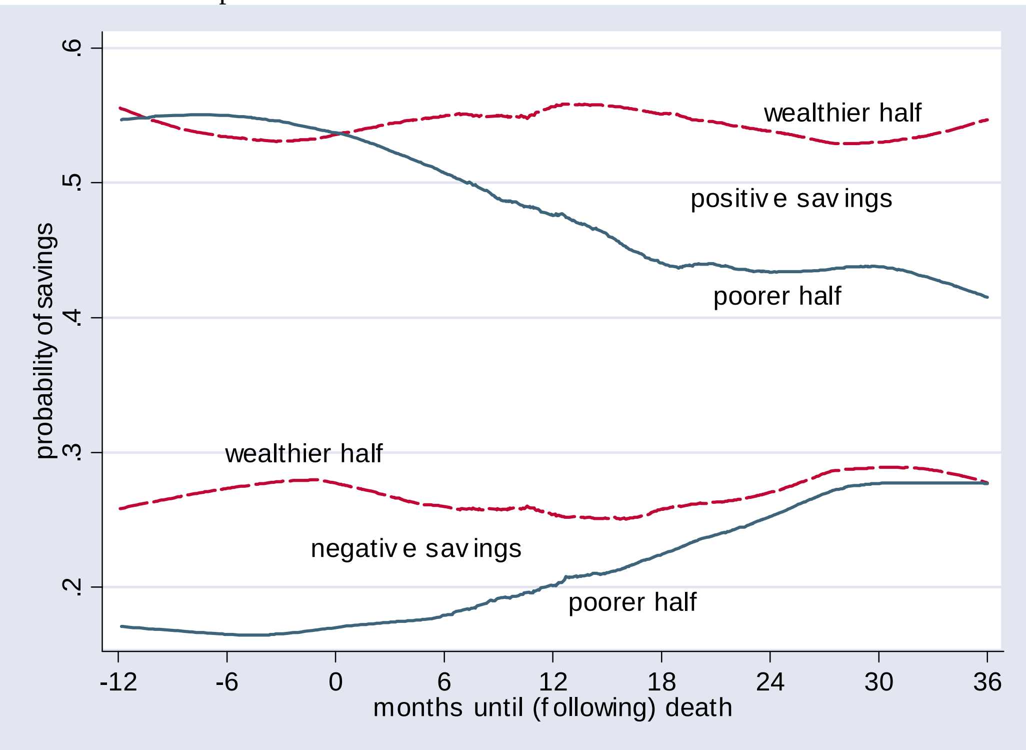

Figure 3A. Probability of positive net total savings

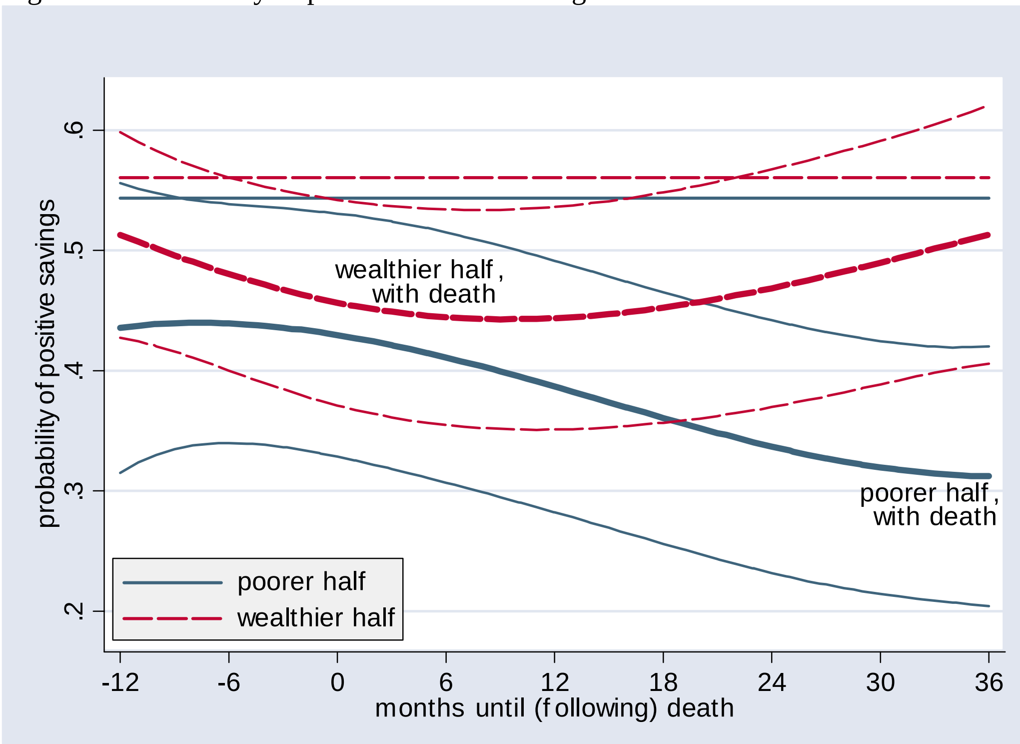

Figure 3B. Probability of negative net total savings

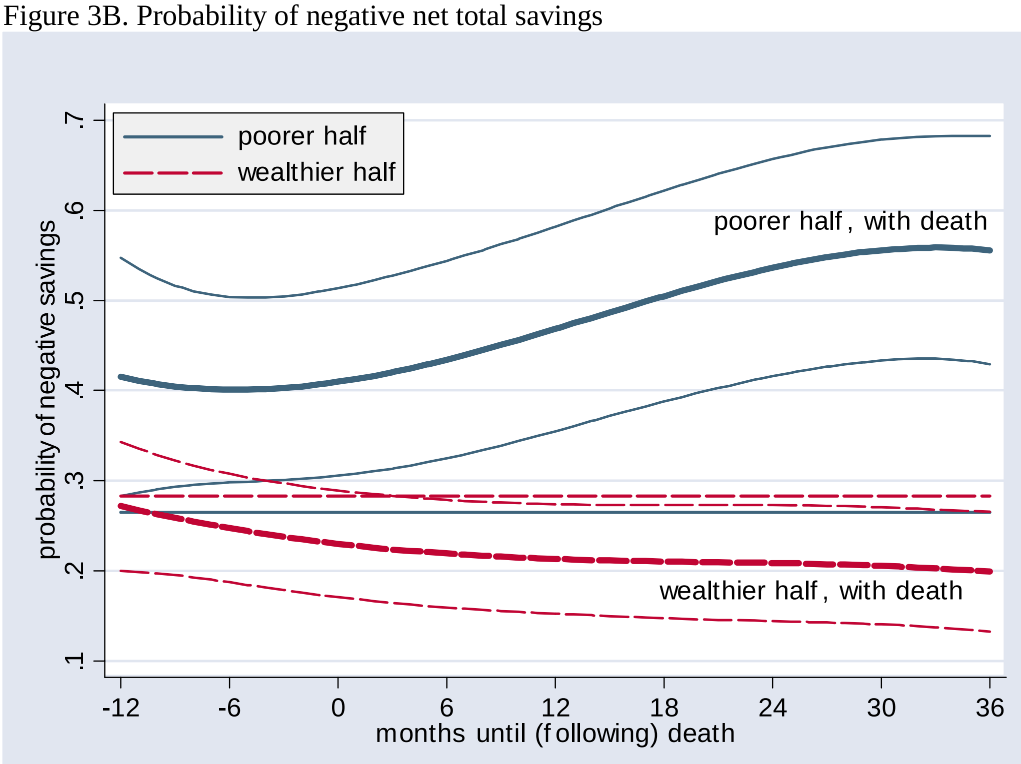

Figure 4A. Probability of positive net total physical savings

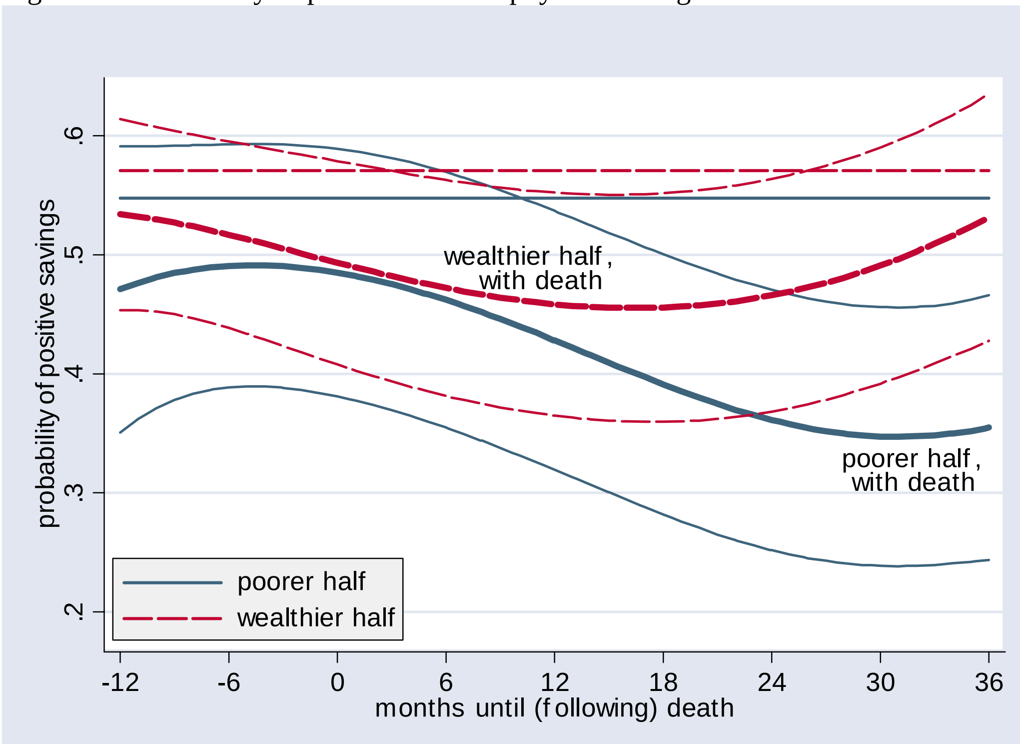

Figure 4B. Probability of negative net total physical savings

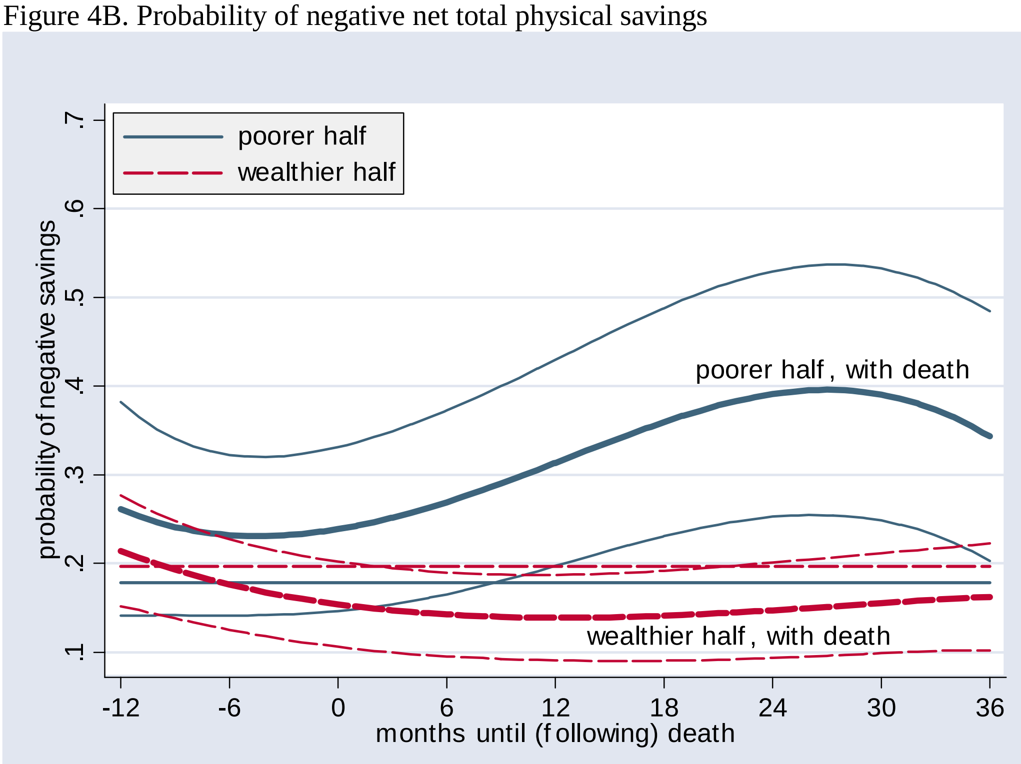

Figure 5A. Probability of positive net total financial savings

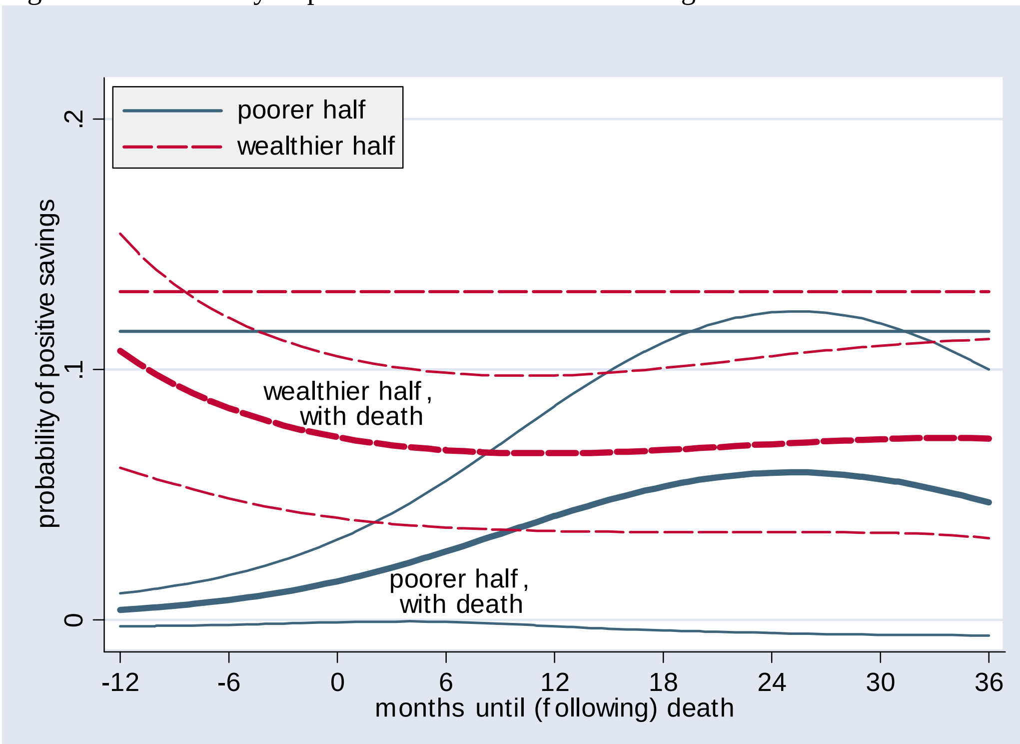

Figure 5B. Probability of negative net total financial savings