This is to certify that the

dissertation entitled

The Impact of Adult Mortality in Agricultural Households: Evidence from Rural Tanzania

presented by

Kathleen G. Beegle

has been accepted towards fulfillment of the requirements for

Ph. D. degree in Economics

Major professor

Date October 4, 1997

THE IMPACT OF ADULT MORTALITY IN AGRICULTURAL HOUSEHOLDS: EVIDENCE FROM RURAL TANZANIA

By

Kathleen G. Beegle

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Economics

1997

ABSTRACT

THE IMPACT OF ADULT MORTALITY IN AGRICULTURAL HOUSEHOLDS: EVIDENCE FROM RURAL TANZANIA

By

Kathleen G. Beegle

Sub-Saharan populations are challenged with increasing adult mortality rates due to the HIV/AIDS epidemic, although there is a lack of research on the impact of this epidemic at a household level. This dissertation explores issues surrounding the impact of prime-age (15-50) mortality on individual and household behavior in one rural region of Tanzania. Drawing on panel data from the Kagera region, the main chapter of this thesis focuses on time allocation of survivors and household activities. Hours in farming and home production as well as nonfarm labor participation rates are examined. Surviving individuals are divided into six demographic groups (by age and sex) to study the potential differential impact of deaths across groups. Various activities of households with respect to farming as well as household composition are investigated.

Generally, adjustments in hours in the two activities examined were not significantly associated with prime-age deaths of household members. Participation rates in wage employment were lower only in households with an adult death in the future 6 months. Households with past adult deaths had a significantly higher probability of new adults joining the household. Farming activities showed adjustments in participation of individuals across various crops and reductions, but no response in

acres cultivated per adult resident. Among household with a male death 7-12 months past, participation in subsistence food crops (maize, cassava and beans) declined while in tree crops (coffee and banana) participation was not reduced.

Utilizing the same data set, the second chapter explores the consistency in the retrospective reporting of deaths in households. Comparing the first full household interview with the baseline (enumeration) survey revealed significant underreporting of deaths in the former survey. Notwithstanding the differences in the survey instruments, these differences are hypothesized to be linked to inconsistency in classification of the deceased as a household member and errors in dating of deaths and age of deceased. Additionally, change in headship was significantly associated with probability of underreporting. In addition to informing the dialogue on the quality of retrospective data, the results of this analysis were applied to the use of the retrospective data in the first chapter.

ACKNOWLEDGMENTS

I would like to express my gratitude and sincere appreciation to my advisor, Professor John Strauss, for guidance, advice, counsel and encouragement. I would also like to thank the other members of my committee, Professors David Neumark and Robert LaLonde, who provided insight and valuable input.

I am indebted to Martha Ainsworth and Mead Over for bringing me onto their project, allowing me access to its data and their numerous helpful comments. The Population Council provided funding in 1995-1996 for which I am grateful.

I have had the good fortune of making many friends at Michigan State. I especially want to thank Jen Tracey, Kelly Hallman, Heather Bednarek and Jess Reaser for their invaluable support in this last year. They always make me laugh and try their best to keep me focused and a little less crazy.

I give special thanks to my family. They never ask too many questions and always listen to my complaints. Finally, though she will never read this, I thank my mother whose memory is with me always.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

THE IMPACT OF ADULT MORTALITY IN AGRICULTURAL HOUSEHOLDS: EVIDENCE FROM RURAL TANZANIA

I. Introduction

An estimated 1.9 million adults have died of Acquired Immune Deficiency Syndrome (AIDS) in Africa through 1994 (World Health Organization, 1995). Despite the projected decline in the number of new Human Immunodeficiency Virus (HIV) infections by the year 2000, deaths from AIDS in Africa will continue to rise well into the next century. While there are other more prevalent diseases in Africa, the characteristics of HIV/AIDS suggest that its economic and demographic impact will be profound.[1] In the absence of the AIDS epidemic, prime-age deaths are relatively rare in Africa, about six deaths per 1,000 persons ages 15-50 per year. In an area with high levels of HIV infection, prime-age mortality rates can double, triple or even quadruple (World Bank, 1993). Moreover, HIV/AIDS is not restricted to poorer populations. Unlike other major diseases in Africa, HIV/AIDS is prevalent among the better educated and higher income Africans in urban areas, with some evidence indicating higher rates among these groups. Although HIV/AIDS is typically considered to be primarily an urban epidemic, there has been increasing concern about the implications of HIV in rural areas where rates appear to be increasing (National Research Council, 1996).

---

[1] See Ainsworth and Over (1994a) for an overview of the economic implications of the AIDS epidemic in the context of African development.

Barnett et al. (1995) assert that in rural areas the main burden of the impact of HIV/AIDS falls on the labor economy of the household, but little empirical evidence exists of this effect. They hypothesize that increased adult mortality and morbidity associated with HIV/AIDS will result in, among other outcomes, a reduction in range of crops grown, in particular cash crops, due to loss of labor available to the household, an inability to purchase farm inputs, and diminished capacity to manage household economies and market agricultural produce. As households try to sustain farm production and shift labor towards farming, other important activities, such as fetching clean water, will be compromised.

Drawing on a panel data set from the Kagera region of Tanzania, the Kagera Health and Development Survey (KHDS), this dissertation estimates the impact of prime-age deaths on activities and time allocation in rural households among surviving household members. The potential reallocation of time by individuals and changes in household activities are of interest for several reasons. First, adjustments in labor supply may give insight into the mechanisms that households use to smooth consumption in the event of the death of an adult member. Much research has shown that households in rural areas are able to smooth consumption in the face of weather and other income-related shocks, though the means by which they smooth are not well researched (Townsend, 1994). From the data used in this study, there is evidence of consumption smoothing among households experiencing an adult death (Over and Dorsainvil, 1996).

Second, if time allocation is adjusted to buffer households from the shock of an adult death, it may be the case that individuals within the household have differential outcomes, where some groups bear a larger share of the adjustments. In other words, household level outcomes may mask differential outcomes across household members as households smooth consumption or otherwise cope with an economic shock. To date, most research examining household responses to various types of income shocks have emphasized that certain types of households (e.g. landed versus landless) may be better able to smooth consumption. Much less analysis has examined the potential differential effects of income shocks on individuals which may be an important factor in the design and implementation of policies (Quisumbing, 1996).

Third, changes in labor activities may be associated with changes in diversification over income sources. In a rural region like Kagera, diversification can provide security against the volatile income stream associated with agriculture.[2] The economic viability of households may be compromised if, for example, households must shift participation of household members away from off-farm activities or cash crops to subsistence farming.

Understanding the interaction between individual labor participation rates of survivors and prime-age adult mortality will be informative in the application of macroeconomic simulations used to estimate the impact of the HIV/AIDS epidemic on economic growth. Cuddington (1993) proposes that this type of analysis can be used to evaluate the economic outcomes associated with different health sector interventions.

[2] See the study by Collier et al. (1990) for a description of the degree of diversification over economic activities by households in rural Tanzania. Collier et al. note that while rural households have a narrow range of employment activities these households engage in an array of distinct economic activities within farming. Reardon (1997) finds that earnings from nonfarm wage employment (not necessarily in the farm sector), in addition to nonfarm self-employment, is of dominant importance to rural farm households in Africa. The effectiveness of income diversification at reducing income risk depends on the covariance between income sources. The lower the covariance between sources, the greater the potential reduction in total income risk.

Analysis of individual and household behavior can, in turn, inform those undertaking these types of simulations. Finally, if high rates of adult mortality result in farm labor shortages that cannot be easily made up for by hiring in labor, then we may observe a decrease in crop production, as speculated in World Bank (1992). This has implications for food security. Brown et al. (1994) contend that diminished labor quantity and/or quality will increase the incidence and depth of household poverty and, thereby, food insecurity. They conclude that the implications of the AIDS epidemic for food security across Africa are "potentially huge" where labor power is crucial to agricultural production. Furthermore, this effect may be heightened by arguably equal or higher HIV infection rates among women who, in some parts, account for the majority of the agricultural labor force. Moreover, agricultural production in Sub-Saharan Africa shapes the availability and price of food for urban markets and is a major export good.

We anticipate that labor supply (both participation rates and hours across sectors) will serve as a response mechanism to deaths or other idiosyncratic shocks in households in part because there are very limited options for risk coping and management in this region.[3] Rural regions like Kagera lack formal credit and insurance markets, and have limited options for savings and asset accumulation, i.e. a lack of financial institutions and a thin land market. While informal institutions and arrangements among households may

[3] Alderman and Paxson (1992) broadly classify strategies that mitigate risk into two groups: risk-management and risk-coping strategies. The former attempts to reduce income variability and the latter attempts to smooth consumption within and across households. Risk-coping arrangements that strive to smooth consumption across households are classified as risk-sharing strategies. See Dercon (1996) for further discussion regarding the limited options for risk coping and management in Tanzania. Dercon examines whether risk management is different depending on households' level of liquid asset holdings. The analysis in this study, on the other hand, focuses on potential risk-coping mechanisms within households, specifically those tied to time allocation.

partially accommodate households, labor serves as the pivotal resource to all households. Although Kagera lacks a large local urban labor market, off-farm labor opportunities do exist, in addition to nonfarm self-employment.

With respect to farm and household chore hours, this analysis finds that in general neither male or female prime-age deaths are associated with changes in farm hours of surviving household members. Other analysis of these data finds that new household members are joining households affected by a prime-age death, thereby mitigating the extent of labor loss which would restrict the need of others to increase hours in households with a past death. These results suggest that one adult death is not necessarily a one-person reduction in the size of the labor pool of the household. Hiring of labor, an alternative to acquiring a new member, was not associated with an adult death. Short-run participation in coffee farming, the main cash crop, and banana farming decreases after a male death, but this decrease does not persist. Allocation of labor to other food crops (maize, cassava and beans) *declined* in households with a distant male death. While acres of land cultivated decreased in households experiencing a past male death, acres cultivated per resident adult was not lower in households reporting a death. Thus, households undertake strategies ranging from bringing in new members and changing some aspects of farming at least temporarily after an adult death. On the other hand, while the lack of a sustained increase in farm hours among survivors in households experiencing a prime-age death is suggestive, the question of the impact of adult mortality on total and per capita farm output is unresolved.

Nonfarm wage employment participation among adult men declines in the months *preceding* a death, but is not significantly lower in the months following an adult death. Wage employment is a important source of cash income and income diversification for rural households. Contrary to speculation by Barnett and Blaikie (1992) and others, surviving members in these data do not reduce participation rates in the wage sector

This chapter is organized as follows. Section II reviews the existing literature with respect to time allocation studies and studies specifically examining the impact of HIV/AIDS. A basic model of time allocation is presented in Section III. Section IV describes the Kagera Health and Development Survey (KHDS), the panel data used. The empirical specifications estimated are presented in Section V and results are described in Section VI. Section VII concludes and draws tentative policy implications from these results.

II. Literature Review

Economics of Time Use

There is a large literature on the theory and determinants of labor supply, as well as some empirical evidence bearing on the economics of time use in developing economies (see Becker, 1965; also see Juster and Stafford, 1991, for a review of this literature). Some of this research focuses on total or off-farm labor supply. Rosenzweig (1980) analyzes market labor supply responses to wage rates in India, finding evidence consistent with the neoclassical-competitive model of labor markets. Jacoby (1993) shows that Peruvian peasant households respond in total time worked to the productivity (or the shadow-wage) of its members. Other work has examined time allocation across activities in agricultural households (such as Evenson et al., 1980, Khandker, 1988, and Mueller, 1984). For example, Skoufias (1993) demonstrates that the intrafamily opportunity cost of time (market wages in this case) is an important determinant of time allocated to the market, domestic production, schooling and leisure for adults and children in rural Indian households.

A few researchers have also examined the responsiveness of time allocation in rural households to income shocks, such as weather shocks. Rose (1995) finds that Indian farm households in areas with greater dispersion of rainfall have higher labor market income, indicating a greater allocation of labor to off-farm labor activities *ex ante*, an alternative to own-farm production. At the same time, households compensate *ex post* for the productivity effects of short-run weather shocks by increasing their work in the labor market afterwards. Likewise, Fafchamps (1993) explores the relationship between the risk associated with farming facing West African farmers and their farm labor allocation across seasons only. Kochar (1996) examines labor supply changes as a method to smooth consumption and finds that rural Indian households adjust labor market hours in response to idiosyncratic crop income shocks. Kochar emphasizes that in developing countries *idiosyncratic* shocks which are independently distributed across households are more important than *aggregate* shocks at the village level. One difficulty in analyzing the former is developing a measure of this idiosyncratic shock. Kochar constructs a measure of profit shocks from observed profit to analyze labor supply responses. However, the shock measure, profits which are not net of family labor, is a function of endogenous labor supply decisions. Jacoby and Skoufias (1995) observe adjustments in child school attendance in response to seasonal income and wage movements in rural India. They find negative impacts on schooling of negative shocks which can help explain low rates of human capital accumulation in the region.

Adjustments in time allocation in response to illness shocks and health status have also been examined. Morbidity will lower the patient's productivity and can imply time spent caring for the ill individual, usually by other household members who may also be otherwise be engaged in productive work. Pitt and Rosenzweig (1990) provide evidence of the reallocation of time from market activities and school to household "care" activities of adult women and adolescent children associated with infant illness in Indonesia. In response to infant morbidity, teenage daughters significantly increased participation in household activities and decreased school and market activities, as compared to response of teenage sons. Kochar (1995) found that market labor supply responds to the prevalence of illness among other household members using data from rural India. She concludes that farm households may in fact be more vulnerable to demographic shocks than to crop income shocks.

Own-illness, either chronic or acute, will also impact an individual's own time allocation decisions. In work by Pitt and Rosenzweig (1986), using data from Indonesia, short-term illness of an individual or their spouse is shown to decrease labor supplied by farmers. Pitt et al. (1990) examine the relationship between one's own health endowment and labor market activities, concluding that individuals with greater health endowment are more likely to participate in activities in which productivity is sensitive to health status.

While the occurrence of prime-age adult mortality in households is similar to economic shocks examined in the studies cited above, certain characteristics of this type of shock distinguish it. First, while morbidity diminishes labor capacity over the duration of illness, a death results in the *permanent* loss of an individual. This implies that households will need to adjust to the long-term loss of this individual's labor and related income, in addition to the loss of management skills and acquired human capital investments. Second, in the case of higher mortality due to AIDS, the deaths are preceded by *severe* debilitating illness resulting in extreme limitation in daily living activities and typically necessitating care by others. Moreover, this shock is targeting prime-age workers who are typically the most economically productive household members. Finally, the shock of adult mortality due to illness may be anticipated to some extent by the household. Thus, households may adopt *ex ante* strategies to cope with an impending adult death. These characteristics of prime-age mortality suggest that we cannot equate it with other sorts of economic shocks facing agricultural households, such as variation in weather.

AIDS and the Macroeconomy

Most of the empirical analysis of the economic impact of high prime-age adult mortality due to HIV/AIDS and other fatal illnesses has been at the macro level. There is a significant body of research estimating population projections under the AIDS epidemic (see, for example, Bongaarts, 1996). A handful of studies have addressed the macroeconomic impacts of the epidemic, simulating economic growth rates and GDP per capita given HIV/AIDS incidence projections. If the epidemic only reduced population size and growth rates, we would actually expect per capita income to rise as a result.[4]

Cuddington (1993a) and Cuddington and Hancock (1994) modify the standard neoclassical (Solow) growth model to simulate the impact of the AIDS epidemic on key macroeconomic aggregates for Tanzania and Malawi, respectively. In these studies, AIDS is hypothesized to impact growth through its negative effect on the size of the labor force and reductions in domestic (private and public) savings resulting from increased medical expenditure. In addition, workers afflicted with AIDS are modeled as having lower productivity due to morbidity associated with their affliction. Non-afflicted workers can also suffer lower productivity (or increased labor days lost) due to the affliction of others although their participation rates in the labor market do not change, nor do we see in-migrants with respect to the labor pool. Cuddington and Hancock (1994) find that the epidemic depresses the annual growth rate of real GDP in Malawi, but they find little effect on per capita GDP growth rates. Cuddington (1993a) finds that under the "medium" case scenario GDP is 15-25 percent smaller in Tanzania by 2010 than it would be without an AIDS epidemic while per capita GDP is reduced by 0-10 percent. Both these studies use the simplifying assumption of full employment.

---

[4] As noted by Over (1992) and citations therein, the large reduction in population size due to bubonic plague of 14th century Europe resulted in increases in wages and incomes for survivors. However, the characteristics of the HIV/AIDS epidemic are very different from the bubonic plague for a number of reasons including rate of transmission, length of infection and mode of transmission.

Cuddington (1993b) adapts his model of Tanzania by incorporating labor surplus (unemployment or idle capacity) and dual labor markets. Surprisingly, his simulations produced roughly similar estimates of the impact of AIDS to those produced in his single sector model. All three of these studies note that the macroeconomic effect depends critically on the labor productivity and saving loss parameters assumed. These parameters capture the fraction of worker productivity and savings lost due to an AIDS-related illness. Because little empirical work has addressed this topic at the household level, these studies typically rely on assumptions about "reliable" ranges for responses among households and individuals, such as identifying "medium" case scenarios for reduced productivity or savings.

Kambou et. al (1992) construct an 11 sector computable general equilibrium model of the impact of AIDS in the Cameroon economy. They examine the consequences of the epidemic where the impact is modeled as a one-time 0.8 percent decline in overall size of the labor force, with disproportionate reductions among urban (generally more skilled) labor. They conclude that the effect on the economy is "devastating" with average annual GDP reduced by 1.7 percentage points from 4.3 percent. Per capita estimates are not reported. Over (1992) models the effect of the epidemic over the years 1990-2025 drawing on aggregate data from 30 sub-Saharan African countries. In his analysis, as well as reducing savings, AIDS can disproportionately impact labor supply across different skill categories. Over calls this the "socio-economic" gradient of the epidemic. He finds that under the scenario where half of medical costs are financed from savings and AIDS cases are twice as frequent among more skilled labor, GDP growth rate is reduced by nearly one percentage point and GDP per capita growth rate falls by .15 percentage points per year. These reductions in GDP growth rate are relatively large given the low or stagnant levels of growth observed in most African economies in the late 1980s.

These studies may overstate the negative effect of AIDS on economic growth for several reasons. First, these simulations rely on AIDS case projections that may overstate the number of future cases as individuals may be adapting or changing their behaviors in response to superior knowledge of HIV/AIDS. Reliable estimates of the future number of HIV/AIDS cases is further confounded by the serious under-reporting of present cases in many developing regions. As Bongaarts (1996) emphasizes, the data on levels of infection are considered to be least reliable for Africa.

Second, Bloom and Mahal (1997) note that extended family networks and community based organizations may provide medical services which mitigate the explicit costs associated with the illness. In addition, given the paucity of data, reasonable assumptions of savings or consumption responses to increases adult morbidity and mortality are unclear. They even suggest that households with an HIV infected member may increase precautionary savings. Although given that the amount of HIV testing is very low, especially in rural areas, and, therefore, for most individuals HIV status is unknown, it may be that precautionary savings will respond to the *probability* of an HIV infected household member. Bloom and Mahal comment that another reason these studies may overstate the macroeconomic impact is that AIDS may be more prevalent among the poor who have lower productivity, earnings and utilization of medical services. This characteristic of the epidemic appears to be generally true for Asian countries, but is not apparent for those in Africa.[5] As Cuddington (1993b) addresses, Bloom and Mahal reiterate the possibility that many developing countries have surplus labor that could mitigate potential output losses. These previously cited studies all assume that, while productivity effects for persons afflicted with AIDS may vary, an AIDS death results in the reduction of one laborer in the economy. They do not allow for the possibility that some surviving labor may work *more* in response to one lost laborer, even in economies with no labor surplus.

Rather than simulate the impact of the epidemic, Bloom and Mahal estimate the effect of AIDS prevalence on the rate of growth of GDP per capita using cross-country data from 51 developed and industrial countries over the period 1980-1992. They conclude that the effect is insignificant, while controlling for other covariates and the possible simultaneity in AIDS prevalence and economic growth. Furthermore, they stress the need to explore this result "in terms of labor supply and relative shifts in labor supply...caused by AIDS morbidity and mortality." The lack of a significant impact of the epidemic is not surprising given the small sample size, the combination of developed and developing countries, and the possibility that the characteristics of the epidemic with respect to socioeconomic factors, as note above, may vary across

[5] See references in Bloom and Mahal of evidence of the link between HIV and poverty, or lower socioeconomic background, among Asian populations. See Over (1992) and Ainsworth and Over (1994b) for citations noting the positive link between socioeconomic status and HIV prevalence in Africa. It is possible that this relationship in Africa may reverse itself as those with higher income and education are also more knowledgeable about the disease and may be more likely to take precautions against contracting HIV. In Africa at least, as yet this has not been observed (National Research Council, 1996).

countries, particularly in the sample of countries most severely affected by the epidemic (those in Africa and Southeast Asia).

Impact of AIDS at the Household Level

A handful of studies have examined outcomes of the epidemic at the household level. Gillespie (1989a, b) models the hypothesized impact of AIDS on farming systems in Rwanda using data on household labor supply by gender to crops across seasons. He does not have data on deaths experienced in households, but rather evaluates households' ability to cope with loss of labor. For several crops and within each of 5 geographical zones and 4 months, Gillespie calculates the "labour balance" as the difference between "labour availability" and "labour requirement". Labour availability is computed as the time remaining after subtracting the time spent in essential nonfarm tasks (water and fuel collection, food processing, housework, private needs and sleep). Labour requirement is the time spent on the crop within zone and month. He assesses regional vulnerability to adult mortality by focusing on the labour balance available to households for each crop. Gillespie's conclusions characterized the Kagera piedmont, the western region of Rwanda bordering the Kagera region of Tanzania, as a relatively secure system with respect to sensitivity to loss of labor via AIDS morbidity and mortality. His analysis does not allow for changes in labor allocated by gender or the potential for hired labor (or even other farm inputs) to accommodate labor shortages. Cleave (1974), for example, surveys a large number of studies of African farmers and finds that traditional allocations of work between sexes are modified in response to labor shortages as well as to accommodate cash-crop production.

Barnett and Blaikie (1992), using a detailed field study, present mixed anecdotal evidence about the farming systems and activities of 129 households in the Rakai district of Uganda in response to an AIDS death. They find no significant change in agricultural production in the district. Barnett et al. (1995) and Barnett (1994) analyze data from rapid assessment surveys of households in Uganda and communities in Tanzania and Zambia. They find some discernible evidence of impact in only one community in Uganda where they note a shift over the period of 1989-1993 to subsistence crops most pronounced for poorer households. In the Tanzanian communities, these studies found little evidence of an impact of morbidity and mortality due to the epidemic. In Zambia, those farming systems most vulnerable to labor loss are not the severely exposed regions with respect to HIV prevalence and number of AIDS cases.

Tibaijuka (1997) draws on data collected in 1989 from households in one village in the Kagera region of Tanzania. Of the 220 households surveyed in this village, her study focuses on the 10 households that reported an AIDS death since 1985 which was confirmed in a hospital.[6] She evaluates the impact of the death on labor both before and

---

[6] The restriction of this analysis to these 10 households based on *hospital* confirmation of cause of deaths may produce a rather atypical sample of households experiencing an adult death. For example, average per patient hospital costs for the 12 adult deaths in these households was about 30,000 Tanzanian shillings. Consequently, most households reported selling assets (including productive ones such as land and cattle) or borrowing funds to pay for these expenses while a few were able to pay with family savings. In comparison with the KHDS data (the data used in this study) on deaths of adults due to AIDS as diagnosed (not necessarily *confirmed*) by any health practitioner (about 60 individuals) and unadjusted for price level changes, Tibaijuka's hospital costs are more than *double* the amount reported for *all* medical expenditures (hospitalization, drugs and consultations) in the KHDS. Furthermore, in Tibaijuka's sample, 9 of the 10 households reported the death of the household head (in all but one case,

after the event. For the impact preceding the death, she estimates labor supply response based on the reported length of illness and composition of the household.[7] For adult deaths, she assumes that the labor days diverted by illness of the victim and nursing care by a surviving adult is double the length of illness, on average 6 months. This presumes that every day of illness preceding the death results in the reallocation of one laborer to nursing among survivors as well as zero labor activity of the sick individual. Given this approach, it is not surprising that the percent of potential labor days diverted (computed for the year preceding the death) is quite large, about 30 percent on average but as high as 57 percent in one household. The assumption that each sick day pulls one survivor completely out of labor activities into nursing care seems rather extreme especially in light of the main economic activity of self-employed farming that may be more flexible in terms of caring for sick household members. Tibaijuka does not offer any evidence to validate this assumption.[8]

Tibaijuka further explores the impact of death on labor stock by comparing levels of labor before and after the death(s) where labor is calculated as the man-equivalent amount of labor by weighting individuals across age categories and summing. In all cases, household labor stock declined, but dependency burden (labor stock divided by consumption units) was worse in less than half (4) of the households after the death(s).

---

the head was also a male). In the KHDS, only a quarter of households with any prime-age death reported the death of the household head.

[7] It is not clear if length of illness is the duration of illness when the patient was bedridden or when the victim had to be nursed, as opposed to the observed onset of illness.

[8] Analysis of the KHDS data suggests that this assumption vastly overstates time devoted to nursing a fatally ill household member. The average weekly hours reported in caring for a sick household member among prime-age women (the main care givers) in households with an adult death sometime over the next 6 months was under 5 hours; for other survivors, average weekly hours were well under 5 hours.

Tibaijuka's study does not compare any of these outcomes to events occurring over the same period in households experiencing no death. So, it is unclear that the changes observed from the period before to after the death are necessarily unique to households in which someone dies of AIDS (or, more generally, any illness resulting in death) rather than outcomes linked to events occurring across all households.

The lack of studies of the impact of an adult death at the household level or across individuals stems mainly from the difficulty in collecting data with the appropriate information to analyze the issue of adult mortality within households. By examining adjustments in time allocation in households before and after the event of an adult death using a detailed panel data set, this study extends the literature in several ways. It expands our understanding of how rural households smooth consumption in the event of economic shocks. Evaluating changes in time allocation of individuals will be insightful for evaluating the burden of increasing prime-age mortality across different demographic groups. In particular, are children (females) more hours absolutely and relative to adults (males). This is also a test of Sen's (1966) model of labor surplus in peasant agriculture in which remaining members work harder after a person leaves either through out-migration or in this case mortality.

The results also will be useful in applications to macro projections on the impact of the AIDS epidemic which incorporate labor supply responses across different sectors. For example, in rural labor markets, if individuals are, in the short-run at least, working more in response to one adult death *ex post*, then modeling labor supply reductions as equal to the number of prime-age deaths will overestimate potential output losses. Analysis of adjustments in time allocation will also inform the reasonable range of estimates of productivity reductions (as assessed by hours) due to the illness preceding death for both non-survivors and surviving individuals. For instance, do we observe reductions in hours among survivors in the months preceding a death? This work may also lend evidence towards the issue of food security and cash crops production in households with a prime-age adult mortality.

III. Model

A Basic Model of Time Allocation

In the basic model of time allocation, households maximize utility which is a function of a vector of home-produced agricultural commodities consumed by the households (C_a), a vector of market-produced and purchased goods (C_m), a set of home produced, non-marketable goods (C_h) and a vector of leisure over all household members (T_l), conditional on Z, which is a set of taste/preference shifters[9]:

(1) $$U = U(C_a, C_m, C_h, T_l; Z)$$

---

[9] This approach in which *households* make decisions to maximize *household* utility (a *unitary* model of household decision making) greatly simplifies the process of intrahousehold decision making. The reduced forms estimated are generally consistent with collective models of household decision making as well as a unitary model, although collective models suggest that who owns assets and nonlabor income is important.

Furthermore, the following model is static. It ignores the time dimension to utility maximization where households maximize the discounted sum of utility over its lifetime. Therefore, it does not capture the implications of an intertemporal planning problem such as insurance, savings, and even household composition adjustments over time. Glomm and Palumbo (1993), for example, model optimal intertemporal consumption decisions in which households face endogenous survival probabilities. Their results emphasize that understanding the pattern of income is necessary to interpret consumption decisions. In this study, the nature of the variable we are examining, *time*, to some extent minimizes the intertemporal issue. In particular, your stock of time can not be transferred across periods.

Time is divided between the following non-overlapping activities: farm labor (f), wage employment (w), domestic work (h) and leisure (l). Where T is a vector of time over all members,

(2) $$T = T_f + T_w + T_h + T_l$$

Each individual's health status is produced as follows:

(3) $$H = H(C_a , C_m , C_h , T_l , \upsilon_i , \upsilon_{hh})$$

where health depends on consumption of home-produced and market-purchased commodities, leisure, and unobservable individual (i) and household (hh) specific health endowment (υ). There exists some latent threshold level of health, H*, below which the individual dies.[10]

Home produced, non-marketable goods, C_h, are produced as a function of time and health, implicitly effective time in this activity:

(4) $$C_h = C_h(T_h , H)$$

Farm output (Q) is produced in accordance with a farm production function which includes effective hired labor (L^e_h), effective family labor (L^e_f) and a fixed stock of farm assets (A). Effective units of hired and family labor are assumed to be perfect substitutes in farm production. Effective labor in some activity j is a function of time allocated to the activity and the health status of the individual:

(5) $$L^e_j = L^e_j(T_j , H)$$

[10] In a dynamic model, current health would also depend on lagged health. Current health status could alternatively be modeled as the lagged stock of health plus gross investment minus depreciation, where households choose and produce gross health investment in each period (Grossman, 1972). Moreover, in addition to its impact on effective time in different activities, health could be included in the utility function.

In this construct, poor health can reduce the productivity of each time unit of labor. In the extreme, at some point, poor health can drive effective labor to zero (even before reaching H*, death).

The household's budget constraint is given by:

(6) $$p_m C_m = p_a(Q[L^e_h + L^e_f , A] - C_a) - wL_h + wT_w + Y$$

where the p's are vectors of prices for market and home-grown marketable commodities, w is a vector of wage rates, and Y is non-labor income. Wages are not the same for all individuals, but can vary across household members and hired labor types. The budget constraint can be re-evaluated such that the market value of consumed goods (including leisure) must equal full income where full income is farm profit, the value of all time available and non-labor income.

With respect to time allocation, the solution to this problem yields the conventional result that our time demand function for individual i in activity j will be a function of prices, wages and full income. Full income consists of farm profit (π), the value of the total stock of time to all household members and non-labor income. Additionally, individual and household-level unobservables enter this equation:

(7) $$T^j_i = T^j_i(p_m, p_a, w, T, \pi, Y, \upsilon_i , \upsilon_{hh}; Z)$$

Unobservable specific variables were introduced through the health production function but could feasibly be incorporated elsewhere. For example, household-level unobservables could enter in farm production and individual specific endowment may affect effective labor, conditional on health. Market wage offers may also respond to unobservables.

In this framework, household farming decisions are separable from consumption decisions. In other words, under the assumption that households can find market substitutes for labor used in farming, household decision making is recursive. One substantial prediction of this recursive model is that while changes in demographic characteristics of the household may affect consumption and time allocation decisions, they will not affect total farm labor demand, output or profits. That is, under separability, farm decisions made with respect to some level of maximized profit (π) are not affected by an adult death or health status of household members.[11] This is not to say that the household's farm labor supply is unaffected by the morbidity and mortality of household members. Farm labor supply, as well as time allocated to other activities, will respond to taste and preferences, and full income. In addition to π, full income includes the value of the total stock of time of all household members and non-labor income which will be affected by an adult death and the preceding illness.

If separability does not hold, then, in addition to the impact on labor supply of household members, deaths may impact outcomes at the household level with respect to farming practices such as total farm labor demand and output. In other words, decisions made with respect to maximization of farm profit will be a function of the demographic composition of the household.

[11] See Singh, Squire and Strauss (1986) for a full discussion of the topic of separability or recursivity in agricultural household models. Pitt and Rosenzweig (1986) develop a similar model focused specifically on farmer's responses to health with regard to farm labor and profit; they test for and do not reject their assumption of separability of consumption and production decisions using data on households in Indonesia. The restrictive assumptions underlying separability make these results difficult to generalize to other settings. Newman and Gertler (1994) develop a model considering multiple activities in a multiple-person household under the assumption that consumption and production are joint decisions.

Dynamic Impact of Death

One shortfall of the above model of time allocation is the lack of dynamics with respect to an adult death and outcomes for surviving household members. As an economic shock, we expect that there will be a time dimension in the various possible ways that households respond. The static model considers only permanent adjustments to the economic shock of a prime-age death. Clearly, household responses to a death are not constrained to a once-and-for-all adjustment. First, if prime-age deaths are caused by illness, as in the case of HIV/AIDS, households may anticipate the death and adopt coping strategies preceding the event. These *ex ante* adjustments can extend over the duration of the illness leading to death.

Ex post, household responses may also vary over time for a number of reasons.[12] For example, if households cope with a death by initially selling nonproductive assets, then time allocation may be unaffected by a death only up to the point where households exhaust this wealth. If other households temporarily aid household experiencing an adult death, then, again we will be more muted responses closer to the event. On the other hand, time allocation responses might be larger in the period closest to the death if, for instance, replacement labor is not readily available.

Time Use, Household Activities and Prime-Age Adult Death

[12] Barnett and Blaikie (1992), for example, hypothesize that the impact of AIDS deaths occurs over a period of at least five years particularly in settings where multiple members die of HIV/AIDS.

The preceding illness and subsequent death of a household member will affect the allocation of time of remaining members through full income.[13] There are several aspects to this full-income effect. First, an adult death changes the total stock of household time available for allocation in two ways. First, the total time of the deceased is gone. Among individual survivors, the death also implies constraints in the short-run on time use. For example, we normally associate deaths with customs such as funerals and mourning, which includes social customs mandating periods of mourning where mourners cease participation in economic activities. A death due to illness such as AIDS may imply demands on non-afflicted members' time in caring for the ill and assistance in seeking medical care prior to death. While these are not necessarily exogenous constraints on time, they are, nonetheless, activities that now compete with other activities to which individuals allocate their time.

We expect that the illness that precedes death will affect the effective time of the dying household member through health status.[14] As well, the quality of labor inputs of

---

[13] This treats the event of death as an exogenous shock to the household. It should be noted that even in cases of a fatal disease, such as AIDS, life can be prolonged depending on health inputs. For example, higher levels of health care and more advanced medications is one reason cited for significantly longer durations of AIDS in HIV/AIDS patients in the U.S. than in African countries (see, for example, Ryder and Mugerwa, 1994). To this end, households can potentially influence the *timing* of death. In the region studied in this analysis, these high-cost health care and advanced medication options are not available to households so it is presumed that the degree to which households can prolong life for household members afflicted with "full-blown" AIDS is minimal. Furthermore, given the low level of testing for HIV in Africa, especially in rural areas, health care intended to delay the onset of AIDS is not considered. For diseases that are not always fatal, but nonetheless are the cause of death for some individuals, it is more difficult to assert that the death is exogenous because health inputs, endogenous to households, most likely influenced the outcome of death.

[14] Obviously the extent to which individuals suffer physical disability or limited activities will depend upon the specific illness with which they are afflicted. O'Dell et al. (1996) study physical function among a sample of American adults with AIDS and find mild to moderate disability in instrumental activities of daily living (such as grip and reach) although severe disability is rare. Their results may understate morbidity among Africans with AIDS where general levels of health are quite lower. At the same time, this implies that the differential in health status between adults with a fatal illness and others

other members may be diminished if they contract illnesses themselves from the presence of infections and diseases.[15] Health status of afflicted and non-afflicted adults can impact effective labor across activities. If potential employers can make inference regarding individual effective labor, wage offers in the labor market will respond to health status. Of course, piece-rate wages would automatically adjust for changes in effective labor. Time-rate wages may also adjust, albeit imperfectly, for changes employers perceive in effective labor, via health status.

An adult death usually mandates expenditures on terminal medical care and funerals which can be a significant portion of household cash income.[16] Households experiencing a death may need to raise cash to accommodate these expenses while at the same time maintain other basic needs expenditures. Estimates from the Rakai district of Uganda found that medical and funeral costs were approximately one to three months of median household cash income (Konde-Lule et al., 1995). Two-thirds of households sold property to supplement cash income to pay for these expenses. The majority of these expenses can be funeral costs rather than medical costs. The data from Kagera, Tanzania, used in this study, indicate that funeral expenses were at least double that of medical expenses for deaths of prime-age adult household members. Cost of burial and mourning ceremonies can be quite high when social norms mandate that households pay for food,

---

may not be larger in African countries relative to developed regions, as non-afflicted adults in the former have lower levels of health.

[15] The illness that results in adult mortality is also an important consideration with respect to the potential morbidity among survivors as a consequence of this illness. AIDS deaths are associated with numerous opportunistic infections, unlike other fatal illnesses such as cancer.

[16] See references cited in National Research Council (1996) for evidence of the economic burden of medical care and funerals for AIDS-related deaths in Sub-Saharan Africa.

lodging and, perhaps, transportation of mourners. These expenditures result in a reduction of full income, and, thereby, may affect time allocation.

In addition to the expenditure associated with death, assets such as land rights and other property held by the individuals may be inherited by individuals outside the household after a death. Women may be especially vulnerable to the loss of a spouse and, consequently, ownership of productive or otherwise valuable assets.[17]

Finally, the event of deaths of non-member relatives may also influence full-income through non-labor income. These deaths may be associated with financial and labor shocks to households with no household member deaths if there exist reciprocity arrangements across households. This may result if, for example, some non-members are actually former household members who migrated for employment purposes and no longer met the criterion for membership. Consequently, remittances received by a household may be vulnerable to deaths of non-household members. At the same time, households may contribute to medical and funeral expenses for deaths in their extended family. Therefore, not only are potential remittances into the household decreased with non-household member deaths, but expenditures associated with deaths may be incurred in households in which *no* death had occurred.

Ties across households in the Kagera Health and Development Survey are apparent in the flow of resources over the course of the panel. Over each of the 6 month intervals between the four household interviews of the panel, we observe at least one new

[17] Women's access to and legal title over land, in particular, may be susceptible to customs that restrict the rights of women to own or inherit land. Tibaijuka (1997) comments that a widow without children is especially vulnerable to being forced to leave her dead husband's estate and she is usually not welcomed back to her natal clan.

adult (15-50) member in approximately 15 percent of households. One or more adults are observed leaving about 20 percent of households between each interview of the panel. In addition to the movement of individuals, households are observed lending or receiving money or goods as loans or gifts. Moreover, there is evidence in these data that a portion of funeral expenses in households experiencing a death were financed by remittances sent into the households for that specific purpose. In addition, households reported sending remittance to other households to assist in funeral expenses. Thus, the event of non-household member deaths as well as household member deaths may affect changes in current-period full-income.

We can extend the full-income effect of an adult death to include an impact on farm profits if we drop the assumption that effective hired labor and family labor are not perfect substitutes. If farm production and consumption decisions are not separable, then farm profit will also depend on the health status of household members.

The death of an adult member also implies the loss of some of the managerial capacity or stock of experience available to the households in farming. If no market exists for these farm inputs, then separability also fails and, consequently, farm productivity and profits can be negatively affected. Rosenzweig and Wolpin (1985) present empirical evidence from India which suggests that farm-specific, experientially obtained knowledge in rural farm households contributes to agricultural profits.

While analysis of individual time allocation can be informative about differential outcomes across groups in households, it cannot be used to infer changes in activities at the *household* level. As noted earlier, changes in the household's portfolio of farming will not be affected by demographic changes if farming decisions are separable from consumption and leisure choices. Even if hours of individuals are not fully adjusting for lost labor supply incurred by a death, cash income or farm output may be maintained if households pull in new household members or, in the case of farming, hire more labor on-farm. Therefore, issues such as the impact of deaths on agricultural output need to be addressed by examining variables at the household level. Changes in farming patterns at the household level associated with a prime-age death would suggest that farming and consumption decisions are not recursive.

IV. Data

Data Setting

The data for this study are drawn from a research project conducted by the World Bank and the University of Dar es Salaam in the region of Kagera in Northwest Tanzania. The explicit objectives of the project were to measure the economic impact of fatal illness in the region and to propose cost-effective strategies to help survivors. This study was originally undertaken as one part of this multifaceted project. Other areas researched by this project include analyzing the impact of adult mortality on various outcomes such as household composition, child nutrition, and consumption. Figure 1 presents a map of Tanzania and the Kagera region.

Tanzania and a host of other countries generally clustered around Lake Victoria (for example, Uganda, Kenya, Rwanda, Malawi and Burundi) are some of the most seriously HIV/AIDS affected countries in the world.[18] Circa 1990, HIV seroprevalence among 15-49 year olds in Tanzanian urban and rural areas was 8.9 and 5.4 percent, respectively (Over and Piot, 1993). Kagera is estimated to be one of the regions in Tanzania most affected by the HIV/AIDS epidemic (World Bank, 1992). Across the six districts in Kagera, there is substantial variation in HIV prevalence and adult mortality. Population based estimates from 1987 for 15-54 year olds identify the most affected district as Bukoba town, the regional capital of and only urban area in Kagera, with HIV sero-prevalence levels at 24.2 percent (Killewo et al. 1990).[19] Bukoba rural and Muleba have lower, although quite high, sero-prevalence levels, both at 10 percent. Karagwe observed a sero-prevalence rate of 4 percent. The least affected districts, and most rural, were Biharamulo and Ngara (both under 1 percent).

Killewo et al. (1994) describe the socio-geographical patterns of HIV transmission in Kagera region mainly in terms of distance of wards (small geographical areas within districts) by road from Bukoba town. They conclude that the spread of infection stems from urban areas through which two main roads to Uganda pass. On the other hand, the truck route that passes through Biharamulo and Ngara from Zaire via Rwanda and the frequent crossing of people between Ngara and neighboring

[18] It should be noted that in Africa HIV/AIDS is primarily contracted through heterosexual contact.

[19] Killewo et al. (1990) employed a multistage cluster sampling technique to generate regionally representative seroprevalence estimates for the population of Kagera. As noted in National Research Council (1996), information on national or regional representative seroprevalence levels in Africa is rarely available. Seroprevalence studies are more widely available for subgroups with the highest risk of HIV infection (i.e. commercial sex workers or patients receiving treatment for sexually transmitted diseases). Other studies focus on HIV incidence among low-risk populations such as pregnant women seeking prenatal care and blood donors, both of which are presumably not representative of the overall population. Bongaarts (1996), in fact, reports HIV prevalence for only urban populations in Africa (circa 1993) for lack of comparable data for rural areas.

Burundi have not spread HIV in these districts. Despite having much less contact with the neighboring country to the west (Rwanda) than the other border district of Ngara, the Karagwe district has a notably higher rate of infection.

One could argue that to best estimate the impact of adult mortality you would want to examine households in an area with a low incidence of HIV/AIDS so that the event is unanticipated for all households. Despite the fact that HIV levels are very high in Kagera, the probability of a prime-age adult death is still quite low. According to the 1988 Census, the annual number of prime-age deaths per 1000 was 15 in the most affected districts of Bukoba rural and Bukoba urban. If households do anticipate the event of a prime-age adult death even before the onset of illness we may see more muted responses in time allocation than we would otherwise observe if the event (death and the preceding illness) was unanticipated. This raises an alternative issue which this study does not focus on: household responses to the perception of *risk* of an adult death.[20]

Kagera Health and Development Survey

The Kagera Health and Development Survey (KHDS) surveyed over 800 households in the Kagera region four times from 1991-1994 with an average interval

[20] Households in the Kagera region do appear to participate in at least one type of risk-sharing activity: indigenous/informal savings and emergency associations, called "bujuni". These organizations, organized and run predominantly by women, appear to serve as insurance against a variety of potential crises. They also fund income generating activities for members. Further evidence of risk-sharing can be inferred from remittances across households, such as those tied to funeral expenditures (and other expenditures tied to illnesses).

between surveys of 6-7 months.[21,22] These four interviews will be referred to as "waves" 1-4. The sample is a random stratified set of households where households thought to have a high risk of an adult death were over-sampled. Households are drawn from 51 communities, mostly villages (also referred to as clusters), in the six districts of Kagera. Appendix 1 details the sampling strategy and household attrition during the panel; this analysis does not exclude households that do not complete the panel. The KHDS has information on time use and other individual and household characteristics, including detailed data on past deaths of household members and non-member relatives. In addition, data on physical infrastructure, assistance programs, schools, health facilities and commodity prices in the community were collected in each wave.

The panel nature of the data has advantages over cross-sectional data. It allows for the test and potential control for time-invariant, unobservable variables. In addition, for households with deaths during the panel, we have information *before* and *after* death occurs. This will enable us to examine effects of a future death, without relying on retrospective data about behaviors individuals or households engaged in during the time preceding a death.

In the KHDS questionnaire, data on participation in and time allocation over the last 7 days to several activities were collected for household members seven years and

---

[21] For further description of the project and data see Ainsworth et al. (1992) and World Bank (1993).

[22] A key component of this analysis is response of individuals labeled as household members. There are numerous ways to define household membership. In this study, the criterion for household membership was living in the same dwelling as the head and eating meals with the head for at least three of the 12 months preceding wave 1. Recent joiners, individuals who were not residing in the households in the previous interview, were considered household members if they intended to stay in the household until the next interview.

older. Individuals were also asked about retrospective participation in activities covering the last 12 or 6 months.[23] Participation describes the supply of labor in the last 7 days and in the last 12/6 months. These activities are defined as follows:

· Wage employment: primary and secondary employment hours working for a firm, the government or an individual other than a fellow household member. This would include wage employment in agriculture.

· Nonfarm self-employment: self-employment hours working for yourself or someone in the household, such as trader/merchant and including fishermen and excluding self-employment in farming or livestock activities.

· Farm self-employment: hours supplied to a farm owned by someone in the household. The hours spent in the last 7 days were collected over several agricultural activities: work on the household's shamba(s)/garden(s); work on collective land for the community; processing crop output for sale; tending livestock; and processing animal products for sale. Allocation of time to specific tasks in farming (such a weeding, planting or harvesting) is not available.

· Home production: hours in various other activities aggregated into one measure of home production hours: fetching water, collecting firewood, preparing meals, cleaning house, and caring for ill household members.

Individual Time Allocation Patterns

[23] Henceforth, 12/6 will be used to denote the reference periods in waves 1-4. The reference period in wave 1 is the 12 months preceding the interview date. For the following waves, the reference period is the time between interviews which is generally between 6-7 months.

Participation rates across three main economic activities by age and gender for the last 7 days are presented in Figure 2. These are locally weighted scatterplot smoothing ("lowess") curves for participation rates (Cleveland, 1979). The sample used is based on the first wave of data collected in late 1991 and early 1992.

Overall, 70 percent of the sample reported working last week in one of the three areas of economic activity: wage-employment, nonfarm self-employment and farming. Prime-age adults (15-50 years) had the highest levels of participation in economic activities in the last week and over the past year. About 80 percent of prime-age men and women reported working in one of these areas last week. Over the last year, 18 percent of all individuals reported no work; unemployment over the last year is 6 and 5 percent for prime-age men and women (15-50) respectively. The vast majority of individuals who were engaged in at least one economic activity (wage employment, nonfarm self-employed, or farm self-employed) in the last year reported farming as the area of their main job in the past year (93 percent of prime-age women and 77 percent of prime-age men). Only a small fraction of adults, predominantly men, did not participate in farming in the past year.

At least two-thirds of the entire sample in any wave of the survey had farmed in the last 7 days. As an indicator of participation in agricultural activities, this figure provides a lower bound, given that the category "wage employment" includes farming or working in other agricultural activities for others.[24] Among wage earners, however, only a quarter reported working in farming.

[24] Kagera is predominantly made up of small-holder coffee-banana farms and observes two cropping seasons, although tree crops and cassava have fairly continuous cultivation over the year. Although bananas

Agriculture in sub-Saharan Africa, as in other developing regions, typically displays a gender division of labor in agricultural tasks and across crops. In the KHDS sample we find that a significantly higher percent of prime-age women reported farming the main food crops (beans, maize, cassava, potatoes, yams, groundnuts and sorghum) in the last 7 days than prime-age men. Although, farming of the main tree crops (bananas and coffee) and even sugar cane in the last week was not reported more often by men. Tibaijuka's (1984) earlier 1982-1983 survey of Kagera finds a similar pattern of the gender division of labor, where women are involved in almost all activities. Including cash crop farming, with the exception of livestock rearing, her study finds that women generally exhibit higher hours in various farm activities than men.

Average weekly hours in farming among the KHDS sample are low compared to Western standards. Individual farm hours *per day worked* in the last week averaged just over 4 hours among prime-age men and women. Of course, daily average hours computed for *all* persons (including those with zero hours) for the last week are lower, well under 3 hours for prime-age adults. While this may suggest that farmers are

---

are typically considered a food crop, they are becoming increasingly commercialized. Almost all the households in the sample from the KHDS had some land holdings (93 percent). Average landholdings of households was 4.2 acres while median acreage was 2.8. In addition, on average households used .5 acres of land owned by persons outside the household (for which no rent payments in cash or kind were made to the owner(s) in the vast majority of cases). Among specific farm tasks, less than 4 percent of persons reported farming community plots or processing either crop output or animal products in the last 7 days. While Collier's et al. (1990) study of a national sample of rural Tanzanian households from 1980 does report that most of the labor force was primarily involved in farming, the study also found that the time on the communal shamba represented approximately 15 to 21 percent of total work time in rural villages. This is a drastically higher share than found in this sample of households from Kagera. Furthermore, a negligible number of households in the KHDS reported owning any land jointly with other households. This difference may be in part explained in a historical context by Ujamaa villages and the process of collectivization during the period 1967-1980. Other evidence suggests that communal farming even ten years before the KHDS was rare in Kagera. Tibaijuka's (1984) 1982-1983 survey of agricultural households in Kagera identified all tree-crop land as under clan or individual ownership. In almost all villages, communal tenure was found only on marginal "rweya" land, the surrounding grassland.

underemployed, low average daily hours alone are not necessarily evidence of underemployment. Cleave (1974) surveys a large numbers of studies of agriculture in Sub-Saharan Africa and notes that seasonal peak times may be associated with much higher time spent of agriculture and competing demands for time in nonagricultural activities also need to be considered. In Kagera, seasonal labor demands are less pronounced for farms with permanent banana and coffee holdings.

A large number (20%) of prime-age adults reported no participation in the last week across the set of economic activities (wage, nonfarm and on-farm employment). Nearly a third (31%) of prime-age adults reported illness as the primary reason for not participating. However, for the entire sample of the prime-age adults, those reporting a chronic or acute condition (43% of all adults) are not less likely to have worked in the last week.

Household Activities

The households sampled by the KHDS clearly have strong ties to agriculture. In wave 1, three-quarters of households report having at least one adult member engaged in farming in the last 7 days; over the past year, 98 percent reported having at least one adult engaged in farming on household lands. At the same time, a large share of households had members engaged in other income-generating activities. Forty-three percent had a member employed for wages, while 30 percent had a member in a nonfarm self-employment activity in the last year. Sixty percent of households had a member participating in either wage employment and/or nonfarm self-employment. Only 9 percent reported only farming as an income source among wage employment, farm self-employment, nonfarm self-employment and remittances from individuals.

Households also hired labor for farming activities. In every wave of the survey, roughly one-quarter to one-third of households reported hiring labor in the last 12/6 months.[25] With the exception of manure (which was used but typically not purchased), few farms used other non-labor farm inputs such as pesticide or fertilizer in farm production.

Reporting of Prime-Age Deaths

Households report deaths for the 24-month period prior to wave 1 and in the intervals between waves for two groups of people: household members and non-coresident relatives. The definition of household membership of the deceased was left to the respondent for those deaths reported in wave 1. During the panel, the deceased was considered a household member if he/she had qualified as a member in the previous wave *or* had been residing in the household at the time of death. So, some people who moved into the household just prior to death were considered to be household members.

Almost all adult deaths (at least 95 percent) were attributed to illness, rather than accident or injury, childbirth, suicide or homicide. The average length of illness was 12 months. Cause of death was reported by households and, if diagnosed,

[25] The KHDS does not contain detailed information on use of hired labor on farms. Tibaijuka (1984) found that hired labor in Kagera is used for weeding and harvesting coffee sometimes, but only on larger farms. Otherwise, she found that hired labor is mainly employed in the strenuous task of clearing land for establishment of perennial crops.

confirmed by a medical practitioner. About half of deaths were reported to be caused by AIDS; another third were cited as unspecified or unknown illness. Other illnesses cited as cause of death include: asthma, cancer, diarrhea, dysentery, gonorrhea, parasite, malaria, malnutrition, measles, meningitis, poison, syphilis, tetanus, and tuberculosis.

Without reliable diagnosis by medical practitioners (or, more specifically, laboratory-confirmed diagnosis), it is difficult, if not impossible, to infer the true proportion of deaths due to HIV/AIDS. Households may incorrectly identify the cause of death because of lack of information, misconceptions and stigma surrounding HIV/AIDS. In any case, this study is concerned with the event of an adult death, and not isolating deaths due to AIDS from other illnesses that afflict prime-age adults.[26]

The KHDS relies on households to accurately report information about deaths experienced therein and was not designed to assess the consistency in the reporting of deaths by households. While the panel does not have overlapping recall periods, the enumeration data collected in the baseline, which was fielded about 8 months prior to wave 1, can be used for comparison with the wave 1 data. The enumeration (baseline) survey consisted of interviewing every household in the 51 villages selected for participation and collecting data on prime-age deaths in the last 12 months. The sample of 838 households was then drawn from the entire sample of enumerated households (see Appendix 1). About 7-8 months later, in wave 1, those households selected report

[26] As mentioned in the previous section, it is important that we believe that deaths were, in most cases, not caused by potentially curable illnesses. Otherwise, after contraction of a disease which itself may be an endogenous occurrence, the consequence of death would be endogenous to household and individual health care decisions.

prime-age deaths in the last 24 months. Therefore, we would expect all deaths reported at enumeration to be re-reported in wave 1 if we believe that the survey instruments which are not identical are adequately similar. Comparison of these data revealed marked underreporting of deaths in wave 1. These recall errors are hypothesized to be primarily linked to membership classification and dating errors in reporting of deaths by households. In the former case, households may be re-classifying deaths between household membership and non-membership.[27] This is of concern because the analysis takes into account both the classification of deaths (member versus non-member relative) and the date of death. In a more general context, this highlights concerns about collecting retrospective data even when the event is something as serious as a death in the household.[28]

About a third of adult deaths during the panel (after wave 1) are individuals who joined the household between interviews. Thus, they resided in the household for less than 7 months before death which may indicate that these individuals entered the household specifically because they were seriously ill. Some of the reasons these individuals would go to these households include seeking terminal care and saving the

[27] One would expect that the problem of memory effects plagues reporting on minor events, such as expenditure for minor items (see Deaton, 1997), as opposed to seemingly major events such as deaths. Thus it is presumed that deaths reported at enumeration are not forgotten by wave 1, but rather, inaccurately dated or reported as non-household members.

[28] This conclusion to this finding suggests not separating deaths of household members from non-coresidents, but rather modeling responses to *either* type of reported death. The number of non-coresident deaths reported is large and includes distant and closer relations. Furthermore, it is possible that respondents selectively report non-resident relatives who died from a larger set of deceased non-coresident relatives.

family the cost of shipping a body.[29] This raises the concern that the event of an adult death in a household is not exogenous if fatally ill individuals are selecting households in which they will die.[30] It is the case that all of these persons were related to someone in the household and most were close relatives, primarily with a parent in the household and also siblings or a spouse.

V. Empirical Specification

Time Allocation

For estimation of individual time allocation equations, the sample has been divided into 6 groups: children (7-14), young women (15-19), young men (15-19), adult women (20-50), adult men (20-50) and older adults (51+ years). Young adults are separated from other prime-age adults (20-50) mainly because school participation is still a decision for these individuals. In fact, 66 percent had been enrolled in the past 12 months in wave 1. While this would seemingly reflect secondary-level enrollment, due to repetition and late entry, a number are in fact still at the primary level (grade 7 or less) despite their age.

Two equations are estimated for time allocated to activity j by individual i in period t as derived from equation 7:

---

[29] In a 1990 study in Abidjan, Cote d'Ivoire, research suggested that AIDS-related deaths were probably understated due to the desire of seriously ill persons to die in their home areas (National Research Council, 1996).

[30] This point alludes to the notion that contracting HIV/AIDS is also not exogenous but the result of distinct patterns of behavior, particularly with respect to sexual activity. This is of concern because potentially the observed "impact" of a death in the household may be identifying the impact of other characteristics of the individual or household, not controlled for in other right-hand side variables. This is addressed below.

(8) $$T^{j}_{it} = \beta_0 + \beta_1 V_{ht} + \beta_2 X_{it} + \beta_3 Z_{ht} + \beta_4 D_{ht} + \upsilon_i + \upsilon_{hh} + \varepsilon_{it}$$

and:

(9) $$(T^{j}_{it} - T^{j}_{it-1}) = \phi_0 + \phi_1 V_{ht} + \phi_2 D_{ht} + \varepsilon_{it}$$

V is a vector of village by wave dummy variables to capture all village-level price and infrastructure effects. V also includes dummy variables for the month and the year of interview for seasonal effects and overall changes in regional prices across years.

X is a vector of individual characteristics including age, education and headship to capture the individual's marginal productivity on farm and proxy for individual wage rate.[31] For children and young adults (15-19 years), education and headship are excluded, as these individuals may still be in school and very few are household heads. For these samples, some parental information is included describing orphan status, presence of parents in the household, education of parents, and status as child of the household head.

Household production characteristics (components of full-income), which include characteristics of the household head (age, sex, and education) and a measure of assets (inherited land), are in the vector Z. Land purchased with either cash or credit, which is likely to be endogenous with respect to past labor supply decisions, is excluded from the

[31] Village-by-wave interactions are presumed to pick up market wage effects. Wages as an explanatory variable were examined, but are not included in the estimation for several reasons. First, the wages reported for various agricultural tasks in the community questionnaire were missing numerous observations and showed little variation across adult males and females. Given the low numbers of women with wage employment and probable gender and wage differentiation by agricultural task, it seems dubious to apply one community wage rate to all adult men and women. Because of the low numbers of individuals working for wage employment in the sample, calculation of cluster averages of reported wages or predicted wages from individuals in the sample of households would have to be based on very low numbers of observations. Measures of marginal productivity or shadow wages, which are probably a better estimate of productivity or the value of time given the high fraction of adults who are farmers, cannot be adequately estimated from the data.

land measure. Household composition variables, which are also believed to be endogenous, will be excluded from the right-hand-side. The age and sex composition among surviving individuals within the households is posited to be influenced by the occurrence of adult deaths and other covariates.[32] Variables describing health status of individuals and other household members are also excluded because of problems with the self-reported nature of the data (with the exception of weight and height measures) and the simultaneity of current health status and time allocation.

D is a set of variables describing deaths, explained in detail below. The terms υ_i and υ_{hh} are individual and household time-invariant unobservables, respectively. The "typical" error component, which is assumed to be independently and identically distributed with mean 0 and variance σ^2_ε is ε_{it}.

In equation 8, the set of variables describing deaths, D, will measure the effect on levels of hours in activity j for individuals in households with a particular death shock (specified as, for example, a past/future or male/female death). In equation 9, the set of variables describing deaths, D, assess the differential in the change in hours across periods associated with deaths. A potential concern in regards to equation 9 is timing of deaths where deaths occurring before t-1 will affect T^j_{it-1} as well as T^j_{it}. Even if deaths occur between t and t-1, both are affected if future deaths influence hours or participation. In these cases, the vector D describes changes observed in households with versus those

[32] Other analysis of household composition in the KHDS sample showed a high level of turnover of household members of all ages and revealed a significant impact before and after the death of a member on the probability of another adult joining or leaving the household (Ainsworth et al., 1995). This issue is addressed in more detail below. See Rosenzweig (1988) for a discussion of the supposition that household composition responds to the economic environment facing households.

without deaths *over time* although it cannot necessarily be used to infer differences in levels of hours or participation for individuals in households experiencing a death to those with no deaths.[33]

D is a vector of variables describing the future and past deaths of adults 15-50 years who are household members. Variables describing future deaths capture two simultaneous occurrences. Future death variables should identify households with very ill household members, which may influence time allocation -- regardless of the household's expectation or knowledge of the impending death. At the same time, households may be adjusting activities, not only to account for a potentially ill household member, but in preparation for an anticipated death. The future death variables, therefore, identify an *ex ante* death coping strategy and an *ex post* illness response. If it is the case that households cannot (or do not) accurately anticipate deaths, then the future deaths variables will capture only the latter effect. Past death variables describe *ex post* responses to factors such as income shock associated with funeral expenses and shock to potential stock of labor in the household.

While this model motivates the inclusion of death as an economic shock, among other covariates, it does not lead us towards any particular specification of the effect of death. The shock of an adult death has several dimensions that need to be captured: the discrete event itself, the time to and from the event and characteristics of the deceased.

[33] For example, suppose individuals in households increase hours in the months preceding a death while following the death hours return to the level which would be observed had no death occurred (some "normal" amount of hours). Households with a death will exhibit a decrease in hours compared to those with no death, although levels in hours after the death will not be different, *ceteris paribus*.

Several alternative depictions of this impact were explored and the results of one of these are presented.[34]

The death variables identify households in which at least one person died while residing in the household.[35] This includes individuals who joined the household and died shortly thereafter. These new arrivals are, in some cases, individuals who joined the household and died between interviews -- residing in the household less than 6 months. As noted above, about a third of all deaths during the panel are such cases; we cannot identify these cases for deaths preceding wave 1. Ideally, we would like to separate deaths of household members into those that were "long-term" members and the new arrivals, but small cell sizes in this larger, more descriptive set of death variables restrict us to grouping them together. Whereas some individuals move into the household shortly before death, it is also possible that some of the non-member relative deaths reported are individuals who recently exited the household, although these cases cannot be identified.

---

[34] The various alternative specifications examined included, for example, variations in an Almon polynomial in the months since/to an adult death (see Greene, 1990) and dummy variables for less aggregated monthly groupings (such as single month intervals and 3 month intervals). Characteristics such as education of the deceased could also be introduced. The small number of deaths, especially once prime-age deaths are segregated by sex, makes obtaining results from a more descriptive set of variables increasingly difficult.

[35] Household members need not be related to other household members, although in most cases the deceased is closely related to the head or otherwise has a close relative in the household (such as a child, spouse, parent or sibling). Originally, this analysis included deaths of relatives who were reported as living elsewhere divided into two categories: close relatives and distant relatives. Close relatives included any individuals identified as having a child, sibling, or parent in the household or being related to the head as a spouse, grandchild, grandparent, niece/nephew, or in-law (child, parent, or sibling). Distant relatives included any other relative of the head or spouse of the head not aforementioned. Generally the deaths of adult relatives residing outside the household were not significantly associated with changes in participation or hours. These measures of non-household member deaths are problematic in that we can not differentiate those deaths that are more "economically" significant from the full sample of deceased relatives. Furthermore, the full set of variables describing death may be multicollinear. For example, households recently experiencing a death may have better information received during funeral and mourning ceremonies about deaths of non-member relatives. This does not appear to be the case as the results presented below are strikingly similar to those estimated which included the corresponding variables describing deaths of relatives who are non-household members.

A set of variables are included to identify any male or female prime-age (15-50) death in the household in the future and past between certain time intervals from the interview date. The set of time intervals includes deaths occurring within 12 months from the interview date.[36] This interval is subsequently divided into two periods to infer differences of the impact of death depending on distance of death from the interview date: 0-6 months and 7-12 months from interview date.[37] Each dummy variable is 1 if such a death occurred and 0 otherwise. The data on deaths used from the panel is collected from 7 months preceding wave 1 through the deaths reported in wave 4. As noted earlier in the text, the deaths reported over the 24 month recall period in wave 1 are suspected to be reported with measurement error in both timing and classification of deaths as members versus non-members of the household (See Chapter 2 for a more detailed analysis of these potential recall errors). To circumvent this problem, the wave 1 data on deaths has been truncated to include those deaths reported in under 7 months of wave 1. Although there is no way to infer at what length in the recall period the data become inconsistent, a 7 month retrospective for wave 1 approximately matches the retrospective period for waves 2-4 -- the time between households surveys, roughly 7 months on average. Nevertheless, in one sense the data collected in waves 2-4 may be more reliable. The surveys in waves 2-4 elicit information about the status of all

---

[36] This categorization will not distinguish between households never experiencing a death and those with a death outside the 12 months to/from the interview data. Thus, the control group is not households that do not experience a death, but rather those that had no death within a year.

[37] Few deaths occurred within 2 weeks of the interview date, where we would expect to observe periods of mourning and other funeral activities. Thus it is presumed that this approach of categorizing deaths in periods covering 0-6, 7-12 and 0-12 months in the past will not be capturing these types of short-run activities associated with deaths.

individuals previously recorded as household members in the last interview, some of whom may have died. In wave 1, there is no roster to infer membership in the household 7 months in the past.

Only the most recent death for each category is identified and so the dummy variables do not take into account multiple deaths within a household over the specified time interval. This is rarely observed given the classification of deaths by sex, limitation to deaths of household members and truncation of deaths prior to 7 months preceding wave 1.[38]

The panel has information on deaths over a period of up to 28 months for those households that completed all four waves of the panel. To capture the censoring of observed future and past deaths, variables were included to identify the length the panel ahead and in the past for each household. For a household observed in wave 4, the survey has no information on future deaths, despite appearing to signify the household as having *no* future deaths. Therefore, dummy variables to identify the last interview and second-to-last interview, where future death variables are truncated, are included. This is not the equivalent to identifying the first, second or third interview because the sample will include individuals in households that do not complete the panel. Likewise, a variable to identify the first interview, where no deaths are observed 7-12 months past, is included.

---

[38] The 157 deaths of prime-age adults occurred in 140 households. Five households had two deaths of different sexes and seven had two deaths of the same sex. One household reported three deaths and one reported four not of the same sex. The majority of these deaths occurred at least two waves apart, so most of the future and past death variables are accurately capturing the *number* of deaths (one) within category.

The activities that are examined are farm hours, home hours, wage-employment participation, and self-employment nonfarm participation. The participation equations are estimated for prime-age men, given the very low levels of participation for other demographic groups and the high degree of censoring in hours for wage employment and nonfarm self-employment.

Table 1 presents a description of the original samples of individuals and the sub-sample used for estimation. The original sample of individuals initially includes persons that subsequently die over the course of the panel (labeled "Non-survivors"). This is not the full sample of deaths, but rather those deaths where the deceased was *surveyed* at least once before dying. This means that the category "Non-survivors" excludes all household member deaths from wave 1 and those individuals who arrived into and died in the household between waves of the survey (so-called short-term non-survivors). Non-survivors reported in Table 1, persons who were observed in one wave and subsequently die during the panel, have been excluded from the samples used as this analysis does not want to confound the impact of an individual's future death or current illness on their *own* current time use with the impact of a past or future adult death on *other's* time use.

Household-Level Activities

As an extension to analysis of individual farm hours, some specific household-level farm activities are also examined; these include indicators of labor hiring, area of land cultivated, area cultivated per adult 15+ years resident, and the farming of coffee, banana and other food crops. In addition to these changes in farming, the probability that households had an adult joining the household is also explored.[39,40] Joiners do not include non-survivors (i.e. individuals who die during the course of the panel).

Analysis of hired labor is limited due to lack of detailed information about farm inputs collected in the KHDS. The data pertaining to hired labor include only total man-days hired and total amount paid to laborers for farm activities over the last 12/6 months, both suspected of being very noisy measures of hired labor usage. Analysis of these measures as well as an indicator of any hired labor was restricted to waves 2-4 because in wave 1 the past death variables (only past 0-6 months in wave 1) do not precede the recall period of hired labor (12 months). Like hired labor, area of land cultivated refers to the preceding 12/6 month period, and therefore excludes wave 1. Area of land cultivated by the household is reported by the household respondent and

---

[39] The majority of individuals who migrate into households during the panel come from within Kagera region. Among all joiners, about half are children and half are prime-age adults; there were few joiners over the age of 50. Women make up about two-thirds of all prime-age adults joining households. Almost all individuals who identified marriage or divorce as the reason for in-migration were prime-age women. "Other family problems" and "Other reasons" account for the largest share of reason for in-migration. See Ainsworth et al. (1995) for a more detailed description of in and out migration over the KHDS panel.

[40] As noted above, Ainsworth et al. (1995) also examine changes in composition in response to deaths experienced by households. The analysis here differs in several significant ways, aside from various differences in the set of explanatory variables used. First, Ainsworth et al. do not separate male and female deaths. This may be an important consideration as the results for farm hours show that responses vary by sex of the deceased. Second, they include a set of variables that includes a dummy variable if a death occurred and then a variable for the months since/to the death (as well as months squared and cubed), where households with no death have these variables set to zero. Their past death variables include those that occurred in the past 6 months. Thus, with respect to past deaths, the event of a leaver and joiner can not be confirmed as necessarily occurring *after* the death since both events occurred during the span of some 6 month period. (While date of death is documented, date that an individual joined the household is not.) Ainsworth et al. point this out, but they conclude that their results simulating probabilities past these 6-7 months are not problematic. The coefficients used to derive these simulated probabilities were estimated from the data that include the aforementioned data covering the 6 month preceding the interview. Thirdly, unlike Ainsworth et al., I truncate the retrospective data from wave 1. As a result, I have *significantly* fewer past deaths in my sample. Finally, their analysis did not include controls for the censoring of future deaths as well as the variability of the length of past and future death observations across waves. Although they examine probability of adults joining and leaving the households, the analysis in this study is restricted to adults joining the household. Probability of an adult leaving was examined but not found to be significantly associated with adult male or female deaths.

not measured by the survey team. Area of land cultivated is a measure of the extensiveness of farming while area of land cultivate per resident adult (15+) describes the intensity of farming. These short-run measures of cultivation may not be very responsive to shocks given the predominance of tree-crops in Kagera and analysis of changes in number of trees under cultivation (which is available) may need to be examined under a longer panel.

The probabilities of any household member reporting farming coffee, banana and other food crops in the last seven days, potentially more responsive variables than land cultivated, are also examined.[41] Other food crops includes any member farming maize, cassava and beans. Although these probabilities cannot reveal information about output or yields, they may indicate the extent to which crops, tree crops in particular, are neglected as a consequence of an adult death.

The estimations of these household activities include the same set of household characteristics as the individual time allocation regressions for equation 8: characteristics of the household head (age, sex and education), acres of inherited land, and month and year of interview. Variables to identify number of past interviews as well as cluster-by-wave interactions are also included. The latter set of interactions should capture spatial and temporal variation in, for example, weather and prices that may influence farming decisions.

Estimation Techniques

---

[41] Area of land cultivated is reported for all crops. The data do not have measures of area cultivated for specific crops, which would be difficult to assess given the high degree of intercropping of plots.

The analysis of time allocation is confounded by two econometric issues: censoring of the dependent variable and potential omitted variable bias. Censoring is of greater concern in the analysis of wage employment and nonfarm self-employment where a large share of the sample do not participate and, thus, a large fraction of the sample have hours censored at zero. Under censoring, Ordinary Least Squares (OLS) estimates will be biased; this problem is typically addressed using a Tobit model.[42] For analysis of participation decisions, probit estimation can be used with a binary dependent variable which is zero for non-participants and 1 for participants.

The omitted time-invariant variables υ_i and υ_{hh} may result in bias of OLS estimated coefficients. These unobservables may be a "random effect" in which case the heterogeneity is distributed randomly across cross-sections and is not correlated with other explanatory variables, Random effects can be estimated efficiently using a Generalized Least Squares (GLS) approach. On the other hand, if the time-invariant heterogeneity is correlated with other explanatory variables (either at the household level or among individuals), then the random effects estimator will produce biased and inefficient estimates. The fixed effect approach will control for this form of time-invariant heterogeneity.

Household unobservables in particular may be correlated with the death variables as follows. Death occurs if health, which is a function of household unobservables and

[42] The Tobit model does not necessarily address self-selection by individuals into activities. Further, Tobit estimation restricts the parameters on participation in the activity to be equal to those determining hours allocated to the activity (see Greene, 1990). These problems could be addressed using Heckman's two-step estimation. Ideally one would want identifying variables to appear in the participation equation but not in the hours equation. Such instruments in this context are difficult to identify.

the non-survivors' individual unobservable component (see equation 4), falls below some threshold level. If all deaths were caused by *fatal* illnesses *randomly* distributed in a population, then we would not suspect the set of death variables to be correlated with households unobservables or the unobservables of survivors. The presumption is that a significant portion of deaths are caused by AIDS, a disease typically contracted through distinct patterns of behavior.[43] Conditional on household unobservables, the individual specific unobservables of *survivors* would not seemingly be correlated with the variables describing deaths of others which are a function of household and the *non-survivor's* individual effects. Controlling for individual heterogeneity will address households unobservables in addition to survivors' individual time invariant characteristics that may bias OLS estimates such as ability and motivation.

The fixed effects approach also addresses the stratified choice based sampling employed to construct the KHDS sample where households that had already experienced as death or had sick adults were much more likely to be surveyed (see Appendix 1). In this analysis, the stratification criterion, those with and without any sickness or past death, is not included in the estimation equations although the concern is that it is correlated with the right-hand-side variables indicating death. That is, the stratification presumably emphasized households that were more likely to experience a death after the enumeration survey. Where the selection variables are right-hand-side variables (and there is random sampling within strata), Wooldridge (1997) shows

[43] Philipson and Posner (1995) consider the rational choice individuals make to engage in risky sexual activities (such as unprotected sex and multiple sex partners) that influence the contraction and spread of HIV/AIDS and other sexually transmitted diseases in sub-Saharan Africa.

unweighted estimators are better than weighting in specific cases including fixed effects models.

Presence of individual specific unobservables will be tested using the Breusch-Pagan Lagrange multiplier test in the farm and home hours equations, which have high participation rates (less censoring) across the 6 demographic groups. The Breusch-Pagan test compares the random effects estimates with those produced by OLS. Hausman tests are estimated for all variables across the random and fixed effects estimations, as well as for the subset of variables describing deaths in the household. For the participation equations, the probit model is estimated with Huber-adjusted standard errors for clustering at the household level.[44]

VI. Results

The means and standard deviations of the samples are presented in Table 2.[45] Results for response of hours in farming as well as house hours to past and future deaths are presented in Tables 3a-c for any death in the past/future 0-12 months. Tables 4a-c present results for deaths in the past/future 0-6 and 7-12 months. In all cases, the Breusch-Pagan test is rejected suggesting that heterogeneity is present. In most instances, the Hausman test of the individual fixed versus random effects specification did not reject the null hypotheses that the individual unobservables are uncorrelated with the set of

---

[44] Chamberlain's (1980) fixed effects logit model (or conditional logit) was estimated as well as. Results from these estimates exclude men who were never observed entering or leaving the activity at least once and, thus, samples were significantly smaller.

[45] Only the results for the set of variables describing deaths are included in the tables of the main text; results for other explanatory variables are presented in Appendix 2 in addition to summary statistics for variables omitted in Table 2.

explanatory variables. The Hausman test on the subset of variables describing the deaths of household members is rejected in most cases, but not necessarily in every instance where the overall Hausman test is insignificant.[46] The individual fixed effects estimates are presented in the set of Tables 3 and 4; for comparison, the random effects estimates are presented in Appendices 3 and 4.[47,48]

Farm Hours

There no evidence that surviving members work more hours per week on the farm as a consequence of an adult death in the past or future year. That is, almost all estimates for level of farming hours in Tables 3a-c are small (under 3 hours) and statistically insignificant. The only statistically significant estimate is for women 15-19 years, where female deaths within the future year are associated nearly 6 hours less per week in farming. With respect to the *change* in weekly farm hours associated with deaths over the 0-12 month period, likewise, most estimates are small and statistically insignificant. Women 20-50 years and children had decreasing hours associated with male deaths in the

[46] In comparison with the results from this study, Skoufias (1993) examined time allocation in rural India also using a panel data set and adopted random effects estimates after failing to reject the null hypothesis of exogeneity of the heterogeneity component. He notes that his results imply that "...OLS estimates from individual time allocation data in a cross section are likely to be free from omitted variable bias (p.292-293)." Re-evaluated at a 10 percent level of significance rather than 1 percent half of his 12 estimations reject the Hausman test statistic.

[47] Fixed effects estimates are the mean-differenced estimates. First-differencing produced similar results.

[48] This is an unbalanced panel since some households drop out and individuals enter and exit households during the panel. In addition, observations for some individuals were not used due to missing values. Consequently, some individuals are observed only once during the panel; these observations are not observed in the fixed effects estimations. Random effects and Hausman tests were estimated on both the full sample and the subsample of individuals with multiple observations. The results of these tests were generally very similar and the coefficients in the two random effects estimates were very similar. Furthermore, household fixed effects models were also estimated (within each of the 6 demographic groups) and produced estimates very similar to the individual fixed effects estimates on the set of death variables.

past year, while women 15-19 had increasing farm hours for past female deaths. In levels, however, both groups of women did not have significantly different hours in farming from other households with no such death. Farming hours increased across waves for men 15-19 and children in households experiencing a future male death with the former group increasing hours by slightly more than 5 per week. Although the estimates of levels of hours for men 15-19 is of similar magnitude, it is not statistically significant.

When the 0-12 month period is divided into two segments, we observe some significant differences in weekly hours across individuals in households with or without an adult death (Tables 4a-c). Women 20-50 in households with a male death occurring sometime in the future 6 months work 6 hours more in farming activities over the last week compared to women in households with no death. Future male deaths are also significantly associated with large increases in farming hours across waves for these women. Consistent with higher hours for women with future male deaths, women with a recent *past* male death had significantly *declining* hours in farming from the previous interview, about 9 hours, despite having insignificant, albeit lower, hours in farming for a recent past male death when assessed in levels. This shows that difficulty in using change in hours across interviews to assess the impact of deaths when these events may have *ex ante* and *ex post* impacts. For adult men male and female adult deaths were not statistically associated with differentials in levels or changes in hours in farming.

Among younger adults, 15-19, men had 7 more hours in farming in households with a male death within the upcoming 0-6 months. Female deaths within 0-6 months are associated with 7 *lower* hours among young women. Children experiencing a male death had *lower* hours in farming for deaths 0-6 and 7-12 months past, consistent with the lower hours observed for past males death in the overall 0-12 month period.

Among older adults, 51-65, the impact of deaths was very imprecise. Despite large coefficients, most estimates were not statistically significant. Female deaths in the future 7-12 months were associated with an almost 10 hour reduction in farming compared to households with no such death.

Other covariates included in the estimations are very briefly discussed. Most of the set of individual and household variables are not individually significant, although jointly, they are in some cases (see Appendix 2, Tables 2a-c and 3a-c). This may because a large factor in time allocation in farming and home activities in this area is one's demographic group which has already been accounted for in the segmentation of the sample. Young men (15-19) whose father is deceased are working many more hours in farming per week (about 12). Young women (15-19) that are children of the household head are working fewer hours (about 10) per week than other young women, perhaps because they are more likely to advance to secondary levels of schooling. Children in households with more inherited land report significantly higher weekly hours in farming. Increased education of the household head is also positively and significantly associated with farming hours for children. In almost every case, the set of month and year dummy variables are jointly significant as are the village-by-wave interactions.

Farming Activities of Households

Despite a handful of significant differences in farm hours among households with and without death, the results find little association between prime-age deaths and adjustments in farming hours. This may imply that overall farm hours and output have fallen, or that labor on Kagera farms is underemployed in which case output can be maintained despite the decrease in total hours. The possibility that output has declined has serious implications for food security for Kagera households where food consumption is the dominate category of household consumption expenditure and the majority of food consumption expenditure is on home-produced items. Alternatively, households might increase hired labor to maintain output. Households might even use unhired labor. In the short-run, it may be the case that individuals residing in *other* households are supplying labor to households with a prime-age death. Over time, households may even acquire new members to increase the stock of labor. These possibilities suggests that linkages across households and within villages not only in terms of cash or in-kind remittances but also with respect to the movement of individuals (in the short or long term) are potentially important methods for coping with an economic shock such as an adult death. These issues also point out the complexities of assessing the labor endowment available to households. If labor resources of households transcend the composition of the household unit then policy makers may not be able to effectively assess relative vulnerability of households to the AIDS epidemic in terms of labor endowment (see Barnett et al., 1995).

While the labor supplied by neighboring households is not measured, we can assess the movement of new individuals into households in response to an adult death.

Table 5 presents results of probit estimates of prime-age adults entering households over the 6-7 month period from the previous interview. Because these individuals join sometime over this 6-7 month period, we cannot know if deaths in the same period (0-6 months past) preceded or followed the event of a joiner. Two sets of past death intervals were estimated: 0-12 and 7-12 months. In the latter case, we know that deaths preceded the addition of a new adult resident. Future deaths 0-12 months are included in both estimations.

Female deaths 7-12 months past are not associated with new members (male or female), female deaths in the past year are associated with an increased probability of an adult joining by 10 percentage points. This is a sizable increase from the mean probability of an adult joining the household between any two waves (around 15 percent). Male deaths are significantly associated 7-12 months and 0-12 months in the past. The probability of a prime-age adult joining more than doubles for households with a death in past 0-12 months. Future deaths are not associated with significant changes in the probability of adults entering.

Separate regressions for male and female joiners revealed that the effect of a past male death is significantly associated with an adult *female* joining the household.[49] On the other hand, adult males were more likely to enter households that had experienced an adult female death as well as those experiencing a male death in the past 0-12 months.

[49] Because of the infrequency of future deaths and probability of any adult joining the households, future deaths had to be combined into 0-12 months rather than divided into 0-6 and 7-12 month periods. Likewise, because of the low probability of both males joining households and any future male/female death, estimates on the impact of future deaths could not be produced for the probit analysis of males joining households in response to a death.

Female deaths rather than male deaths had a stronger association with males joining. Thus, male and female deaths draw new members *of the opposite sex* into the household after the event. Members who die are apparently not replaced with members of the same sex. The focus on the probability of adults joining stems from the presumption that new prime-age adults are actually participating in labor activities. In the first interview since joining the household, prime-age joiners had average hours in farm and domestic activities slightly lower than other individuals. In households with a past prime-age death, there is no significant difference in hours of adults who joined the household in the last 6 months and other resident adults already residing in the household (Table 6). Given the mean predicted probability that a new adult will join after a death (about .3) and the average hours of new joiners (9), the average household with a past death will have 3 hours of labor supplied by a new member.

The probability of entrance of new adults is significantly higher in households with older or better educated household heads for both male and female joiners. Acres of land, however, was significantly associated with the probability of a prime-age man joining and not a prime-age woman in spite of the higher levels of farm hours among adult women.

In addition to replacing the labor stock with new members, households could offset a death by hiring in more labor to work on the farm. Three indicators of hiring practices are analyzed and results are presented in Table 7. As in the case of probability of joiners, our measures of hired labor cover the span of the preceding 6-7 months. Two sets of past death variables are examined (7-12 months and 0-12 months). Future death variables have been omitted from these analyses. The probability that households hired labor in the last 6 months was not associated with a death more than 7 months in the past or deaths 0-12 months past. Acres of land inherited and years of schooling of the household head were both significantly associated with a higher probability of hiring of labor.

Any hired labor may be too crude a measure to capture affects on hired labor. Fixed effects estimates of mandays of hired labor also showed no association with past deaths. On the other hand, total expenditure (in nominal Tanzanian shillings) on hired labor (cash and in-kind) was significantly lower in households experiencing a past female death.[50]

The lack of an impact of deaths on labor hiring practices along with the increased probability of new residents suggest that households prefer to replace labor with new members rather than hiring in labor. Households suffering a death lose not only farm labor but also labor in domestic activities (for which a labor market is presumably non-existent).[51]

If households are not completely replacing the lost labor of the deceased via individuals joining the household or hiring labor, we may expect that the extensiveness of farming will decrease. Indeed, acres of land cultivated in the past 6 months significantly declined for households with a male death 7-12 months past by nearly one acre (see Table

---

[50] With respect to the household fixed effects estimates of mandays of labor hired and total labor expenditure, it should be noted that there is a high amount of censoring of the dependent variable at zero as only a third of households reported hiring any labor.

[51] This hints of the notion that households have some optimal size and composition in terms of permanent members.

8). Intensity of farming, as measured by land cultivated per resident adult (15+), was not significantly associated with the death of a female or male adult in the household. Given the preponderance of tree-crops, we would expect that farms do not drastically alter cultivation on lands to which it has access.[52] Acres of land inherited by members of the household was significantly associated with a greater extensiveness and intensity of farming (acres cultivated and acres cultivated per adult resident, respectively). As well, cultivation is positively associated with age of household head, but not the schooling of the head. Female headed households, about a quarter of all households, cultivated significantly less acres controlling for acres of land inherited. Intensity of cultivation was not significantly different for female headed households from that of male headed households.

If it is the case that total labor hours devoted to the farm do fall after a prime-age death, then we expect to see output and maybe yields from farms fall, unless the marginal productivity of the deceased member was very low (i.e. there is under-employment on-farm or underutilization of labor along the lines of Arthur Lewis' labor surplus model). This would be contrary to the conclusions of Collier et al. (1990) of a labor shortage in Tanzanian rural labor markets surmised from the small numbers of individuals looking for work. Ignoring possible seasonal shortages, labor shortage in the Kagera sample of households may be unlikely given the low number of hours adults are reporting in economic activities. Unconditional on numerous factors such as poor health, average hours do not appear to be constrained in the KHDS. It is interesting to note that lower

[52] Land areas cultivating only food crops (not including banana) are presumed to take up a small share of cultivated lands as opposed to lands intercropped with tree-crops and food crops.

farm output (not per capita output) is not *necessarily* a negative outcome given that these households also have one less member to feed and shelter. However, even if this were true, decreased production of certain crops (such as export cash crops) may be of concern to the national economy.

Table 9 presents results for the probability of any household member farming of various crops in the last 7 days. Households with a male death in the past 0-6 months showed decreased participation in coffee farming. This suggests that, at least in the months immediately following a male death, cash cropping may be curtailed in favor of food crops. Participation in coffee and banana crops is *not* lower for households experiencing a death more that 6 months in the past. This may reflect the previous evidence that male deaths are associated with new adults joining the household over a 6 month period, thereby re-establishing farming of trees within 7 months of the death. Households with a more distant (7-12 months) death did not show lower participation in coffee or banana farming but did have significantly lower activity in farming of maize, cassava and beans. This decline is consistent with the reduction in the number of persons for which these subsistence, non-commercialized foods are being grown, although they cannot tell us about outcomes on a per capita level. It is contrary to the perception that an adult death will result in a labor crisis and in increased production of subsistence crops relative to export crops (see, for example, National Research Council, 1996). To what extent these result holds in the long term is not certain. Barnett et al. (1995) found evidence from Uganda that households shifted farming *away* from cash crops over a four year period.

House Hours

Results for hours in various household activities are also included in Tables 3a-c and Tables 4a-c. The category of house hours includes specific household chore activities as well as caring for ill household members. These activities make up a large portion of weekly non-leisure hours, particularly for women, although caring-for-ill hours are a relatively small portion (for example, 6 percent of hours for women 20-50). In addition to the loss of potential labor for household chore activities (similar to the loss for farming), a fatally ill resident requiring care by others places a *new* demand on other household members. The extent to which these demands on labor constrain individuals can explain the lack of increase in farming hours. We might not see increases in farm hours if survivors have to spend more time in household chore activities as well as caring for an ill member in the months preceding death.

In levels of hours, men 20-50 are the only group that showed significantly different hours in house activities for a death within 12 months, with nearly 6 more hours per week associated with future male deaths. For women 15-19 and 20-50, hours were decreasing by 5-7 hours per week in response to future male deaths. As households approached a future male death, women were working less in house activities than households with no future death. On the other hand, past deaths of both males and females were associated with increasing hours (just under 4 hours) for older adults (51-65 years).

When months are divided into two periods, in a handful of cases deaths within 7-12 months are associated with changes in hours across waves and in levels. Given the inclusion of caring for the ill in the measure of house hours, we would have expected closer future deaths (within 0-6 months) to have a larger impact than deaths farther from the interview date. Furthermore, in several cases these coefficients are negative. For example, women 20-50 in households with a male death 7-12 months in the future worked 8.5 less hours per week.

As in the case for farming hours, most of the set of individual and household variables are not individually significant, although jointly, they are in some cases (see Appendix 2, Tables 2a-c and 3a-c). Men 20-50 who are the head of household work significantly more hours in household activities, about 6 hours per week. The village-by-wave interaction variables and the month and year dummy variables are significant for both the OLS estimates and the individual fixed effects estimates.

Farm and House Hours by Per Capita Expenditure

A household's ability to cope with an adult death may be dependent on the household's level of wealth. Wealthier households will have more assets and, perhaps, greater access to credit, both of which will affect the extent of time allocation adjustments. For instance, some households will be better able to finance medical and funeral costs through sale of assets. Likewise, such households will be better able to hire replacement labor for an ill or deceased household member. To address the concern that the poorer households are most vulnerable to an adult death, the sample of households was separated into two groups based on median expenditure per capita. Households are categorized on the basis of their wave 1 expenditure per capita where number of residents is adjusted for length of residence and adult equivalency.

Results for farm and house hours for these separate samples are presented in Appendices 5 and 6. Generally, individual farm and hours were not significantly associated with adult deaths for persons from either set of households.

Nonfarm Self-employment and Wage Employment

Changes in wage employment and nonfarm self-employment are important because these activities are the main sources of cash income to rural households. As mentioned above, notwithstanding the possible loss of income after an adult death, adult deaths are associated with large, immediate expenditures for both medical expenses and funeral activities. Due to low levels of participation among most samples, only adult males 20-50 were examined. Participation in wage employment is nearly three-times that of nonfarm self-employment (30 percent to about 10 percent). Low levels of participation in self-employment required aggregating future and past death variables into one indicator of any male/female death in the past/future. These results are presented in Table 10.

Men in households with a female or male death were significantly less likely to report participation in wage employment within 6 months of a *future* death. For past deaths, there was no difference in participation for men in households with or without a death. The magnitude of decreased participation was large for both male and female deaths, at least 50 percent of the mean level of participation. In fact, the magnitude of deceased participation probability was larger for male than female deaths (20 to 15.6 percentage points). Nonfarm self-employment participation showed no significant changes associated with male or female deaths.

Activities such as wage employment, that pull individuals out of the households, may be more difficult to sustain in times when the household has a fatally sick resident. Individuals in households with an ill female may incur additional household responsibilities, including caring for the ill individual as well as children, even if hours in farming or house activities do not increase in response to future deaths. Considering the emphasis on the importance of diversification of income sources in rural settings where the main activity, farming, has a high level of risk , we tentatively find that one crude measure of diversification (participation in wage employment) is not compromised by prime-age adult deaths.

VII. Conclusion

Despite much concern about the impact of the AIDS epidemic on households in developing countries, little empirical research has addressed this topic at the household level. This study examines one area of the potential impact of a prime-age adult death: adjustments in time allocation and household activities. Using a panel data set from rural Tanzania, participation in activities across different demographic groups and at the household level was examined. Understanding the impact of prime-age mortality on these outcomes serves multiple purposes. This section links the results outlined in the previous section with goals established in the introduction.

Analysis of farm and house hours across six demographic groups generally found small and insignificant changes in labor supply of individuals in households experiencing any prime-age adult death. The lack of any increase in hours for past deaths is notable for children in particular for whom deaths are presumed to result in higher farm hours assuming there will be an acute shortage of farm labor (Barnett and Blaikie, 1992). This ties back to one of the points raised earlier that some of the areas in the region around Lake Victoria which are most affected by the HIV/AIDS epidemic are those least vulnerable to labor shortages. While we do not observe increases in farm hours, this cannot be used to infer changes in school participation, a very important activity for children omitted from this analysis. School participation could decline due to inability to pay for school fees, uniforms and other costs.

Both female and male deaths are associated with an increased probability of new prime-age adults entering the household. At least in the short-run (the 2-year length of this panel), new members may help households smooth consumption by compensating for lost labor of the deceased. Although given that the mean probability of a new adult joining is around .30, new joiners are not observed in most households that experience a prime-age death. For those that do, this partially explains the lack of increases in hired labor or hours in farming of surviving household members after a death. It also suggests that households most vulnerable to prime-age deaths may be those without access to new household members. At the same time, it challenges policymakers to consider how to infer relatively vulnerability to deaths in terms of access to labor that may not be easily observable to outsiders.

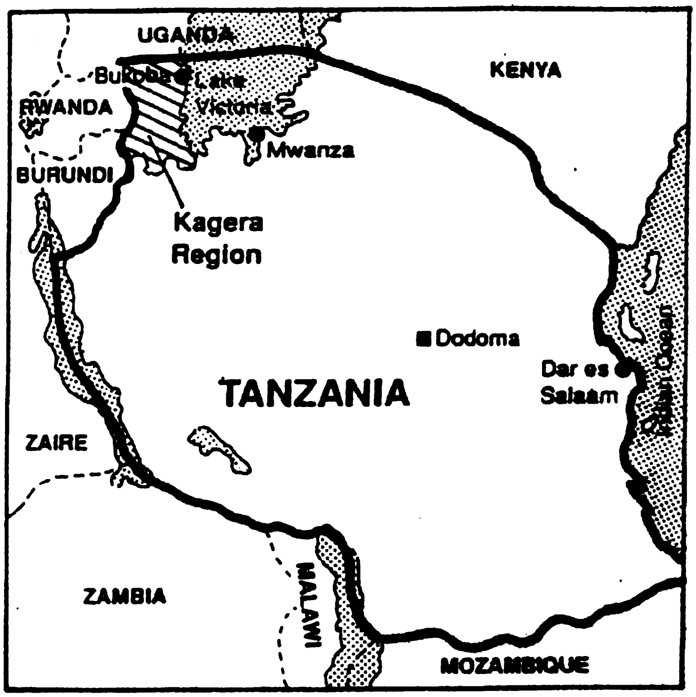
To infer the impact of deaths on farming activities, further research examined another farm input (hired farm labor), crops grown, and land cultivated. These results help identify outcomes of increasing adult mortality rates for household level food security as well as outcomes for the agricultural sector. While deaths were not associated with changes in hiring of labor, coffee and banana farming in the last 7 days by any household member did *decrease* in the 6 months following a male death in the household. This is suggestive that some farm activities are temporary scaled back as a result of male deaths. This analysis did *not* find that households experiencing a death shift cultivation towards subsistence food farming. In fact, participation of individuals in farming of other subsistence food crops (maize, cassava and beans) in households with a male death 7-12 months past declined. Without measures of aggregate output, we cannot draw conclusions about per capita changes in output. Nevertheless, the reduction in participation of individuals in these subsistence food crops but not tree crops among households with a male death draws attention to the point that prime-age adult deaths are a loss of labor but also a reduction in the number of individuals consuming food and other goods.

Results on changes in acres cultivated showed declines in acreage associated with more distant male deaths. Intensity of farming (area cultivated per adult resident) was unaffected by adult death indicating that yields will be maintained. To further explore the affect of deaths on agricultural outcomes, more detailed data on farming practices would be need. For example, one extension of this analysis would be to examine outputs across different crops to see if households produce proportionately more cash crops to food crops. Ideally, we would carefully follow households across cropping seasons, rather than use aggregated indicators of activities in the last 6 months or past 7 days.

Households experiencing a death do not appear to have reduced their diversification over income sources. While we see significant decreases in wage employment of adult men in response to a future female or male adult death, past deaths are not associated with changes in either wage employment or nonfarm self-employment. Likewise, as mentioned, coffee farming is not lower in households with a death more than 6 months past. This may have important implications for households' ability to cope with the often large costs associated with deaths if a household's cash income stream is interrupted in the months preceding a death. Further examination into net changes in assets or even net sales of livestock may provide evidence on how households finance the high costs of funerals, not to mention medical care, associated with prime-age deaths.

These results can be applied to macro estimations of the impact of AIDS in a few dimensions. They suggest that an adult death of males participating in the rural labor market may *not* be offset by male survivors in the household, at least as measured by participation. Cuddington's (1993) comments in his analysis of the macroeconomic impact of AIDS in rural Tanzania that estimates of the associated labor supply loss for an AIDS-stricken worker and survivors *before* death and the reduction in the labor pool *after* the death are not available. He assumes (as do other macro studies cited) that one AIDS-related death reduced the labor pool by one. This is not true for household labor available to households for farming, as deaths are associated with a higher probability of new adults joining. Application of this result to regional measures of labor participation requires understanding where new members came from and their previous labor supply including their sector of employment. Areas with increasing mortality rates may draw down labor in *other* areas. These results also shed light on the affect of a future AIDS death on labor supply of non-afflicted adults. Lack of *ex ante* adjustments in time allocation among survivors narrows the range of reliable estimates of the fraction of labor productivity (hours) lost per AIDS case to equal to or under one.

This analysis has focused on time allocation and activities of agricultural households using a large and detailed panel data set in comparison to the few studies in this area which have, to date, been small and illustrative. To complete the picture of the impact of HIV/AIDS, though, these results ultimately need to be incorporated into results on an array of adjustments and outcomes that households in this region may undertake when confronted with an adult death. These would include issues such as liquidation of assets, nutritional status of survivors and schooling of children. Further, these results need comparison to other types of farming systems, such as areas with lower population density and without tree crops.



Source: Mukoyogo and Williams (1991)

Figure 1: Tanzania and Kagera Region

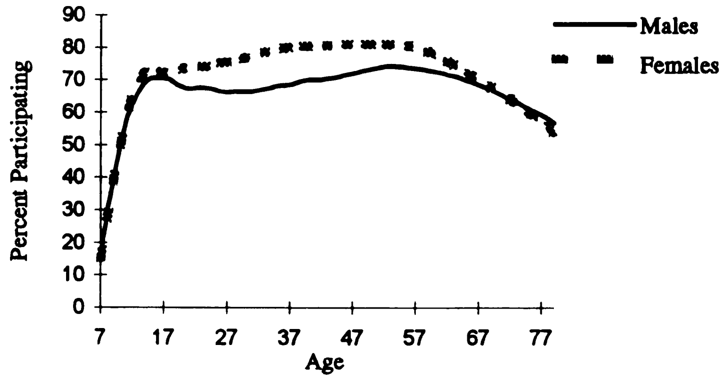


Figure 2.A: Farming Last 7 Days

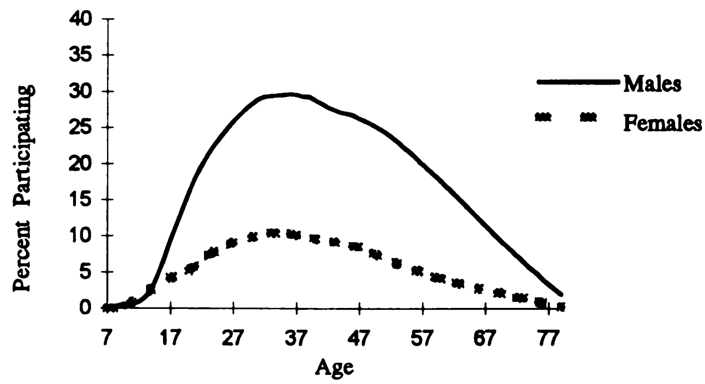


Figure 2.B: Wage-employment Last 7 Days

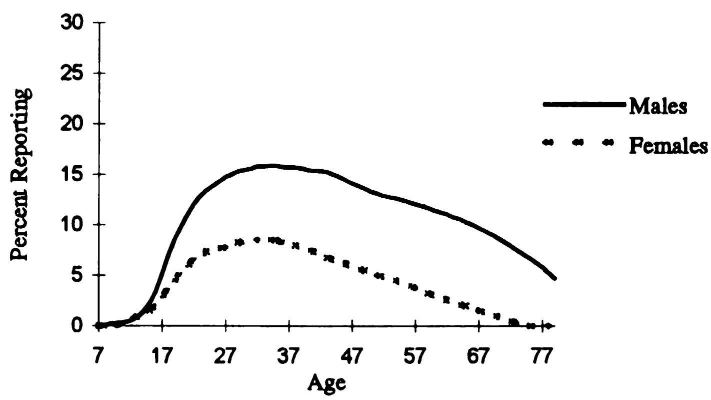


Figure 2.C: Nonfarm Self-employment Last 7 Days

Table 1: KHDS Sample of Individuals

	Ever-observed during the panel				Survivors observed with at least 2 observations	
	Pooled cross-section		Individuals		Pooled cross-section	Individuals
	Survivors	Non-survivors	Survivors	Non-survivors		
Sample	(1)	(2)	(3)	(4)	(5)	(6)
Children 7-14 years	4196	12	1401	7	3912	1117
Females 15-19 years	1364	2	479	2	1254	369
Males 15-19 years	1269	3	404	3	1204	339
Females 20-50 years	2766	69	896	41	2596	726
Males 20-50 years	2018	51	661	29	1894	537
Adults 51-65 years	1420	42	390	19	1393	363

Notes: See Appendix 1 for a full description of observations excluded from samples due to, *inter alia,* missing values. Non-survivors are individuals observed at least once, but who die during the course of the panel.

Table 2: Sample Statistics

Dependent Variables	Children 7-14 years		Females 15-19 years		Males 15-19 years		Females 20-50 years		Males 20-50 years		Adults 51-65 years	
Farm hours last 7 days	6.679	(8.907)	11.129	(11.435)	11.378	(12.445)	15.338	(12.826)	13.126	(13.622)	16.569	(13.726)
Household hours last 7 days	10.402	(9.545)	17.868	(11.099)	10.161	(9.535)	20.467	(13.426)	5.914	(8.840)	11.290	(12.568)
Wage employment participation last 7 days (1 if yes, else 0)	0.006	(0.080)	0.029	(0.167)	0.097	(0.296)	0.091	(0.287)	0.303	(0.459)	0.098	(0.298)
Nonfarm self-employment participation last 7 days (1 if yes, else 0)	0.013	(0.111)	0.045	(0.207)	0.074	(0.262)	0.114	(0.318)	0.185	(0.389)	0.133	(0.339)
Explanatory Variables												
Female household member death:												
Past 0-6 months	0.030	(0.171)	0.037	(0.188)	0.037	(0.188)	0.026	(0.160)	0.024	(0.154)	0.025	(0.157)
Past 7 -12 months	0.018	(0.134)	0.026	(0.160)	0.018	(0.134)	0.016	(0.125)	0.016	(0.125)	0.022	(0.145)
Future 0-6 months	0.017	(0.130)	0.017	(0.128)	0.024	(0.153)	0.013	(0.112)	0.016	(0.125)	0.011	(0.103)
Future 7-12 months	0.009	(0.097)	0.010	(0.101)	0.017	(0.128)	0.007	(0.083)	0.010	(0.097)	0.008	(0.089)
Male household member death:												
Past 0-6 months	0.018	(0.134)	0.018	(0.134)	0.025	(0.156)	0.018	(0.133)	0.017	(0.131)	0.022	(0.148)
Past 7 -12 months	0.012	(0.109)	0.014	(0.116)	0.015	(0.121)	0.011	(0.105)	0.012	(0.107)	0.017	(0.130)
Future 0-6 months	0.013	(0.111)	0.014	(0.119)	0.015	(0.121)	0.010	(0.100)	0.008	(0.089)	0.012	(0.110)
Future 7-12 months	0.007	(0.083)	0.003	(0.056)	0.007	(0.086)	0.005	(0.068)	0.004	(0.065)	0.007	(0.084)
Sample size	3912		1254		1204		2596		1894		1393	

Notes: Means are in first column and standard deviations are in parentheses. Home hours consist of collection of firewood, fetching water, preparing meals, cleaning house, and caring for ill household members. This table contains a subset of the explanatory variables used in the analysis; see Appendix 2 Table A2.1 for the sample statistics of the other regressors used in the estimation.

Table 3a: Impact of Adult Household Member Deaths (15-50) on Hours

	Women 20-50				Men 20-50			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Female death past 0-12 months	1.515	0.151	3.885	3.483	1.644	1.167	-0.866	1.960
	(1.403)	(1.938)	(2.415)	(2.126)	(1.977)	(2.223)	(1.629)	(1.568)
Female death future 0-12 months	2.289	-1.565	3.929	-0.923	2.396	-2.317	-1.006	0.279
	(2.326)	(2.514)	(3.259)	(2.757)	(2.061)	(2.775)	(1.751)	(1.943)
Male death past 0-12 months	-4.531**	-2.603	-0.716	-2.148	1.206	1.313	-1.107	-1.662
	(1.976)	(2.162)	(2.201)	(2.371)	(2.454)	(2.932)	(1.301)	(2.068)
Male death future 0-12 months	2.882	2.749	-5.031**	-3.562	1.384	0.854	0.075	5.717**
	(2.476)	(2.804)	(2.182)	(3.075)	(3.069)	(4.019)	(2.002)	(2.835)
R^2	0.212	0.221	0.121	0.141	0.211	0.241	0.147	0.196
P-value for joint significance:								
Female death past & future	0.348	0.760	0.091	0.126	0.327	0.370	0.807	0.383
Male death past & future	0.060	0.109	0.051	0.468	0.790	0.904	0.691	0.009
Sample Size	1851	2596	1851	2596	1344	1894	1344	1894

Notes Standard errors are in parentheses and, for the OLS estimates, have been corrected for clustering at the individual level. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Appendix 2, Table A2.2 for additional regressors included but not reported here.

Table 3b: Impact of Adult Household Member Deaths (15-50) on Hours

	Women 15-19				Men 15-19			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Female death past 0-12 months	3.639**	-0.946	0.865	-2.609	-1.179	0.826	0.367	-1.070
	(1.783)	(2.084)	(2.275)	(2.075)	(1.608)	(2.437)	(1.492)	(2.154)
Female death future 0-12 months	0.270	-5.794*	-5.519	-2.717	0.851	-3.395	-3.096	-1.891
	(2.393)	(3.033)	(4.020)	(3.019)	(2.897)	(2.785)	(2.207)	(2.461)
Male death past 0-12 months	0.109	-2.910	1.574	1.508	-0.874	-2.133	2.508	-1.948
	(1.950)	(3.355)	(2.026)	(3.340)	(2.425)	(2.703)	(2.224)	(2.389)
Male death future 0-12 months	1.176	-0.216	-7.053*	2.118	5.299*	5.251	3.579	1.194
	(3.174)	(4.270)	(3.853)	(4.250)	(3.127)	(3.604)	(2.560)	(3.185)
R^2	0.318	0.351	0.313	0.318	0.249	0.297	0.226	0.264
P-value for joint significance:								
Female death past & future	0.124	0.142	0.373	0.428	0.726	0.302	0.370	0.732
Male death past & future	0.929	0.555	0.126	0.870	0.223	0.078	0.124	0.482
Sample Size	874	1254	874	1254	854	1204	854	1204

Notes: See notes for Table 3a.

Table 3c: Impact of Adult Household Member Deaths (15-50) on Hours

	Children 7-14				Adults 51-65			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Female death past 0-12 months	0.055	-0.839	-1.459*	0.081	-0.611	0.628	3.375*	-2.067
	(0.682)	(1.018)	(0.834)	(1.067)	(2.259)	(2.583)	(1.948)	(2.082)
Female death future 0-12 months	2.329	-1.873	0.396	0.775	3.536	-3.691	-2.289	-3.190
	(1.396)	(1.335)	(1.330)	(1.400)	(4.729)	(3.975)	(4.702)	(3.204)
Male death past 0-12 months	-2.940***	-3.280**	-0.091	-0.440	0.332	-1.840	3.591*	0.967
	(0.948)	(1.326)	(1.159)	(1.390)	(2.095)	(2.879)	(1.818)	(2.321)
Male death future 0-12 months	2.709*	1.466	1.364	1.289	1.581	1.375	-3.322	-0.194
	(1.569)	(1.619)	(1.661)	(1.698)	(2.844)	(3.919)	(4.724)	(3.159)
R^2	0.149	0.182	0.114	0.134	0.235	0.237	0.179	0.215
P-value for joint significance:								
Female death past & future	0.198	0.367	0.217	0.841	0.754	0.500	0.206	0.504
Male death past & future	0.007	0.001	0.686	0.517	0.842	0.600	0.139	0.872
Sample Size	2776	3912	2776	3912	1026	1393	1026	1393

Notes: See notes for Table 3a.

Table 4a: Impact of Adult Household Member Deaths (15-50) on Hours

	Women 20-50				Men 20-50			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Female death past 0-6 months	1.409	-0.450	3.502	2.616	1.698	0.666	3.231	2.097
	(2.077)	(2.106)	(3.853)	(2.312)	(2.427)	(2.506)	(2.232)	(1.767)
Female death past 7-12 months	1.919	1.264	3.885	4.882*	1.578	1.946	-1.745	1.838
	(2.307)	(2.546)	(3.383)	(2.795)	(3.734)	(2.893)	(2.626)	(2.040)
Female death future 0-6 months	0.182	-1.790	7.150	0.894	4.092	-0.993	-2.148	0.132
	(3.529)	(2.643)	(5.254)	(2.902)	(3.461)	(3.026)	(1.913)	(2.133)
Female death future 7-12 months	5.894	-1.016	-4.055	-4.352	-0.064	-5.044	0.901	0.706
	(5.673)	(3.417)	(6.912)	(3.752)	(3.346)	(3.696)	(4.813)	(2.606)
Male death past 0-6 months	-9.446***	-2.735	-0.652	-1.121	0.090	0.230	-1.216	-1.926
	(2.833)	(2.426)	(3.793)	(2.664)	(3.726)	(3.205)	(2.457)	(2.259)
Male death past 7-12 months	0.628	-1.498	-0.486	-2.625	2.311	3.298	-1.405	-1.497
	(3.590)	(2.800)	(3.571)	(3.075)	(2.781)	(3.645)	(1.531)	(2.570)
Male death future 0-6 months	13.206**	6.188**	1.332	-1.470	-1.776	-0.141	-1.079	3.327
	(5.417)	(3.054)	(3.874)	(3.354)	(4.535)	(4.443)	(2.573)	(3.125)
Male death future 7-12 months	-7.661*	-6.915	-12.101**	-8.524*	6.571	2.277	2.363	10.160***
	(4.087)	(4.260)	(5.679)	(4.678)	(8.444)	(5.371)	(2.672)	(3.786)
R^2	0.212	0.226	0.124	0.143	0.212	0.242	0.149	0.199
P-value for joint significance:								
Female death past	0.477	0.726	0.314	0.201	0.672	0.798	0.304	0.441
Female death future	0.535	0.791	0.397	0.406	0.453	0.381	0.513	0.962
Female death past & future	0.603	0.894	0.177	0.168	0.493	0.506	0.360	0.729
Male death past	0.003	0.528	0.965	0.693	0.704	0.600	0.534	0.685
Male death future	0.040	0.008	0.054	0.189	0.737	0.891	0.604	0.028
Male death past & future	0.005	0.010	0.149	0.432	0.835	0.874	0.591	0.013
Sample Size	1851	2596	1851	2596	1344	1894	1344	1894

Notes: Standard errors are in parentheses and, for the OLS estimates, have been corrected for clustering at the individual level. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Appendix 2, Table A2.3 for additional regressors included but not reported here.

Table 4b: Impact of Adult Household Member Deaths (15-50) on Hours

	Women 15-19				Men 15-19			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Female death past 0-6 months	4.624	-2.062	-1.775	-4.357*	-2.930	1.025	-0.943	-1.115
	(2.989)	(2.423)	(4.158)	(2.409)	(2.573)	(2.585)	(2.226)	(2.286)
Female death past 7-12 months	3.054	0.197	2.480	-0.736	0.647	0.884	1.280	0.140
	(1.626)	(2.539)	(2.822)	(2.525)	(3.255)	(3.517)	(2.503)	(3.111)
Female death future 0-6 months	-3.292	-7.778**	-8.742**	-4.551	3.798	0.713	1.870	0.315
	(5.029)	(3.463)	(3.737)	(3.444)	(4.327)	(3.064)	(2.980)	(2.710)
Female death future 7-12 months	5.070	-3.346	-0.853	-1.192	-7.031	-5.463	-12.309**	-2.823
	(4.859)	(3.999)	(7.178)	(3.977)	(5.489)	(3.356)	(4.810)	(2.968)
Male death past 0-6 months	0.192	-2.066	1.686	0.636	-4.720	-1.883	-2.002	-3.973
	(3.464)	(3.863)	(3.606)	(3.841)	(3.936)	(3.083)	(2.942)	(2.727)
Male death past 7-12 months	-0.502	-4.158	1.172	2.012	3.570	-0.769	7.291*	1.044
	(1.507)	(3.808)	(4.424)	(3.787)	(2.795)	(3.387)	(3.195)	(2.996)
Male death future 0-6 months	3.874	0.242	-6.827	1.017	7.455	7.016*	-2.144	-0.548
	(3.538)	(4.417)	(4.710)	(4.392)	(6.476)	(4.063)	(3.372)	(3.594)
Male death future 7-12 months	-7.446	-1.176	-0.786	6.033	0.519	-0.355	6.787*	1.192
	(8.693)	(7.519)	(7.670)	(7.477)	(4.860)	(5.053)	(4.976)	(4.460)
R^2	0.320	0.353	0.315	0.321	0.258	0.302	0.240	0.269
P-value for joint significance:								
Female death past	0.138	0.620	0.639	0.171	0.506	0.921	0.831	0.852
Female death future	0.570	0.081	0.063	0.409	0.388	0.172	0.038	0.554
Female death past & future	0.351	0.219	0.086	0.374	0.625	0.373	0.146	0.835
Male death past	0.530	0.550	0.776	0.859	0.219	0.829	0.072	0.184
Male death future	0.393	0.980	0.349	0.718	0.424	0.169	0.377	0.930
Male death past & future	0.530	0.794	0.568	0.924	0.440	0.188	0.115	0.386
Sample Size	874	1254	874	1254	854	1204	854	1204

Notes: See notes for Table 4a.

Table 4c: Impact of Adult Household Member Deaths (15-50) on Hours

	Children 7-14				Adults 51-65			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS.	F.E.
Female death past 0-6 months	-1.259	-1.511	-1.644	0.212	0.484	-0.960	1.278	-4.046*
	(1.231)	(1.119)	(1.168)	(1.178)	(3.852)	(2.390)	(3.201)	(2.420)
Female death past 7-12 months	1.827	-0.044	-1.246	-0.222	-0.692	0.543	4.344	0.313
	(1.132)	(1.315)	(1.366)	(1.383)	(3.316)	(2.607)	(2.715)	(2.531)
Female death future 0-6 months	3.345**	-0.600	0.766	0.960	8.221	-3.439	-0.806	-4.853
	(1.728)	(1.427)	(1.747)	(1.502)	(4.727)	(3.632)	(5.062)	(3.617)
Female death future 7-12 months	-2.534	-5.585***	-0.214	0.389	-6.228	-9.834**	-1.235	-2.570
	(2.258)	(1.802)	(2.278)	(1.896)	(9.347)	(4.303)	(8.676)	(4.178)
Male death past 0-6 months	-5.369***	-3.145**	-0.387	-0.152	-3.294	-4.463*	3.958	0.182
	(1.465)	(1.521)	(1.903)	(1.600)	(2.894)	(2.602)	(4.162)	(2.635)
Male death past 7-12 months	0.422	-2.819*	0.106	-0.750	3.450	-1.352	3.371	1.821
	(1.403)	(1.590)	(1.384)	(1.673)	(3.508)	(3.006)	(3.247)	(2.921)
Male death future 0-6 months	5.851**	3.070*	-0.291	1.481	1.177	-1.824	-9.410	-2.955
	(2.674)	(1.766)	(2.564)	(1.858)	(4.055)	(3.438)	(6.913)	(3.441)
Male death future 7-12 months	-3.997*	-2.195	3.853	1.256	-0.676	-2.286	6.273**	5.778
	(2.326)	(2.173)	(2.550)	(2.286)	(7.263)	(4.549)	(3.144)	(4.425)
R^2	0.154	0.188	0.114	0.134	0.238	0.227	0.183	0.222
P-value for joint significance:								
Female death past	0.237	0.333	0.204	0.950	0.976	0.965	0.217	0.167
Female death future	0.086	0.005	0.908	0.812	0.158	0.202	0.977	0.405
Female death past & future	0.138	0.017	0.521	0.969	0.396	0.446	0.541	0.348
Male death past	0.001	0.077	0.978	0.897	0.392	0.625	0.134	0.807
Male death future	0.053	0.029	0.302	0.712	0.958	0.949	0.077	0.149
Male death past & future	0.003	0.001	0.636	0.830	0.757	0.814	0.108	0.350
Sample Size	2776	3912	2776	3912	1026	1393	1026	1393

Notes: See notes for Table 4a.

Table 5: Impact of Adult Household Member Deaths (15-50) on Probability of an Adult Joining Household in Last 6 Months

	Male or female joiner		Female joiner		Male joiner	
Explanatory Variables	1	2	3	4	5	6
Female death past 7-12 months	0.233	-	-0.196	-	0.700***	-
	(0.198)	-	(0.252)	-	(0.252)	-
	[0.061]	-	[-0.033]	-	[0.163]	-
Female death past 0-12 months	-	0.392***	-	0.152	-	0.590***
	-	(0.146)	-	(0.167)	-	(0.164)
	-	[0.108]	-	[0.031]	-	[0.128]
Female death future 0-12 months	-0.102	-0.079	-0.057	-0.031	-	-
	(0.275)	(0.278)	(0.239)	(0.241)	-	-
	[-0.023]	[-0.018]	[-0.010]	[-0.006]	-	-
Male death past 7-12 months	0.485**	-	0.472**	-	0.100	-
	(0.235)	-	(0.242)	-	(0.342)	-
	[0.140]	-	[0.114]	-	[0.017]	-
Male death past 0-12 months	-	0.632***	-	0.603***	-	0.380*
	-	(0.148)	-	(0.158)	-	(0.221)
	-	[0.190]	-	[0.153]	-	[0.074]
Male death future 0-12 months	-0.054	-0.013	0.242	0.279	-	-
	(0.311)	(0.310)	(0.317)	(0.316)	-	-
	[-0.012]	[-0.003]	[0.052]	[0.061]	-	-
Pseudo R^2	0.088	0.095	0.073	0.078	0.085	0.090
P-value for joint significance:						
Female death past & future	0.489	0.027	0.717	0.660	-	-
Male death past & future	0.113	0.001	0.107	0.000	-	-
Sample Size	2128		1912		1536	

Notes: Results are estimated using probit with standard errors in parentheses corrected for clustering at the household level; in brackets, coefficients have also been converted to change in probability (dp/dx) evaluated at the mean of all other regressors, which represents a discrete change for dummy variables from 0 to 1. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Appendix 2, Table 2.4 for additional regressors included but not reported here.

Table 6: Farm Hours of Adult Joiners and Other Resident Adults, Sample of Households with Any Past Death

	Women 15-50	Men 15-50
Adults who joined household in last 6 months	9.66	9.46
	(10.45)	(7.78)
	[34]	[24]
Other resident adults	9.61	9.76
	(9.38)	(12.96)
	[67]	[60]

Notes: Standard deviations in parentheses; sample size in brackets.

Table 7: Impact of Adult Household Member Deaths (15-50) on Hired Labor in Last 6 Months

	Any hired labor Probit		Number of mandays Household Fixed Effects		Total expenditure Household Fixed Effects	
Explanatory Variables	1	2	3	4	5	6
Female death past 7-12 months	-0.180	-	-18.135	-	-6031.916*	-
	(0.192)	-	(31.509)	-	(3326.852)	-
	[-0.061]	-	-	-	-	
Female death past 0-12 months	-	-0.033	-	-19.841	-	-10943.210***
	-	(0.153)	-	(26.613)	-	(2798.426)
	-	[-0.016]		-	-	-
Male death past 7-12 months	0.091	-	10.943	-	535.274	-
	(0.224)		(37.356)	-	(4000.758)	-
	[0.033]	-	-		-	-
Male death past 0-12 months	-	0.055	-	-10.273	-	363.463
	-	(0.166)	-	(31.055)	-	(3266.197)
	-	[0.016]	-	-	-	-
R^2	0.125	0.126	0.101	0.102	0.079	0.087
P-value for joint significance:						
Female & male death past	0.606	0.927	0.815	0.708	0.193	0.000
Sample Size	2302		2312		2302	

Notes: R^2 for probit estimations is the Pseudo R^2. Standard errors are in parentheses and, for the probit estimates, have been corrected for clustering at the household level; in brackets, for probit estimates, coefficients have also been converted to change in probability (dp/dx) evaluated at the mean of all other regressors, which represents a discrete change for dummy variables from 0 to 1. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Appendix 2, Table A2.5 for additional regressors included but not reported here.

Table 8: Impact of Adult Household Member Deaths (15-50) on Land Cultivated in Last 6 Months, Household Fixed Effects

Explanatory Variables	Area of land cultivated 1	2	Area of land cultivated per adult resident 3	4
Female death past 7-12 months	0.296	-	0.191	-
	(0.381)	-	(0.177)	-
Female death past 0-12 months	-	-0.156	-	0.167
	-	(0.322)	-	(0.150)
Male death past 7-12 months	-0.850*	-	-0.282	-
	(0.452)	-	(0.210)	-
Male death past 0-12 months	-	-0.496	-	-0.249
	-	(0.375)	-	(0.175)
R^2	0.332	0.331	0.227	
P-value for joint significance:				
Female & male death past	0.132	0.360	0.238	0.210
Sample Size	2323		2643	

Notes: Standard errors are in parentheses. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Appendix 2, Table A2.6 for additional regressors included but not reported here.

Table 9: Impact of Adult Household Member Deaths (15-50) on Crops Farmed by Any Household Member in Last 7 Days, Probit

Explanatory Variables	Coffee 1	Banana 2	Maize, Cassava or Beans 3
Female death past 0-6 months	0.127	0.121	0.253
	(0.157)	(0.171)	(0.165)
	[0.050]	[0.040]	[0.066]
Female death past 7-12 months	0.035	-0.017	0.253
	(0.216)	(0.216)	(0.201)
	[0.014]	[-0.006]	[0.080]
Female death future 0-6 months	0.336	0.285	0.251
	(0.228)	(0.242)	(0.237)
	[0.133]	[0.088]	[0.079]
Female death future 7-12 months	0.285	0.007	-0.029
	(0.291)	(0.303)	(0.312)
	[0.113]	[0.002]	[-0.010]
Male death past 0-6 months	-0.456**	-0.385**	0.161
	(0.200)	(0.204)	(0.178)
	[-0.171]	[-0.142]	[-0.057]
Male death past 7-12 months	0.217	-0.099	-0.648***
	(0.278)	(0.257)	(0.253)
	[0.084]	[-0.035]	[-0.246]
Male death future 0-6 months	-0.009	-0.353	0.289
	(0.253)	(0.261)	(0.241)
	[-0.004]	[-0.130]	[0.090]
Male death future 7-12 months	-0.755**	0.153	-0.346
	(0.365)	(0.388)	(0.366)
	[-0.263]	[0.050]	[-0.127]
Pseudo R^2	0.230	0.254	0.205
P-value for joint significance:			
Female death past	0.722	0.775	0.192
Female death future	0.216	0.500	0.565
Female death past & future	0.502	0.738	0.291
Male death past	0.055	0.140	0.022
Male death future	0.110	0.358	0.254
Male death past & future	0.070	0.242	0.033
Sample Size	2643	2889	2893

Notes: Standard errors are in parentheses and have been corrected for clustering at the household level; in brackets coefficients have also been converted to change in probability (dp/dx) evaluated at the mean of all other regressors, which represents a discrete change for dummy variables from 0 to 1. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Appendix 2, Table A2.7 for additional regressors included but not reported here.

Table 10: Impact of Adult Household Member Deaths (15-50) on Nonfarm Self-employment and Wage-employment of Men (20-50)

Explanatory Variables	Wage-employment 1	Wage-employment 2	Nonfarm Self-employment 3
Female death past 0-6 months	-0.020	-	-
	(0.221)	-	-
	[-0.007]	-	-
Female death past 7-12 months	0.127	-	-
	(0.282)	-	-
	[0.046]	-	-
Female death past 0-12 months	-	-0.288	0.143
	-	(0.216)	(0.198)
	-	[0.012]	[0.038]
Female death future 0-6 months	-0.527**	-	-
	(0.252)	-	-
	[-0.156]	-	-
Female death future 7-12 months	0.193	-	-
	(0.329)	-	-
	[0.070]	-	-
Female death future 0-12 months	-	0.034	0.105
	-	(0.204)	(0.270)
	-	[-0.092]	[0.028]
Male death past 0-6 months	-0.011	-	-
	(0.262)	-	-
	[-0.004]	-	-
Male death past 7-12 months	0.169	-	-
	(0.311)	-	-
	[0.061]	-	-
Male death past 0-12 months	-	0.067	0.220
	-	(0.237)	(0.257)
	-	[0.024]	[0.061]
Male death future 0-6 months	-0.754*	-	-
	(0.436)	-	-
	[-0.201]	-	-
Male death future 7-12 months	-0.490	-	-
	(0.541)	-	-
	[-0.145]	-	-
Male death future 0-12 months	-	-0.647	-0.697
	-	(0.425)	(0.503)
	-	[-0.181]	[-0.121]
Pseudo R^2	0.178	0.177	0.140
P-value for joint significance:			
Female death past	0.867	-	-
Female death future	0.070	-	-
Female death past & future	0.218	0.359	0.771
Male death past	0.822	-	-
Male death future	0.225	-	-
Male death past & future	0.501	0.278	0.169
Sample Size	1793		1622

Notes: Probabilities are estimated using probit with standard errors in parentheses corrected for clustering at the household level; in brackets coefficients have also been converted to change in probability (dp/dx) evaluated at the mean of all other regressors, which represents a discrete change for dummy variables from 0 to 1. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Appendix 2, Table A2.8 for additional regressors included but not reported here.

APPENDICES

APPENDIX 1

APPENDIX 1

Sampling Strategy and Attrition

The KHDS surveyed a stratified choice based sample of households in Kagera, where households thought to have a high risk of illness were over-sampled. A random survey even in a high HIV sero-prevalence region such as Kagera will yield few observed prime-age deaths over a two-year panel. While the region has a high HIV infection rate, there is much variation across the six districts, with Muleba, Bukoba-Urban and Bukoba-Rural having the highest rates of infection (Killewo et al., 1990).

A total of 838 households completed the first wave of interviews; of these, 757 complete all four interviews over a period of more than 2 years (see Table A1.1). The selection of the sample of households for the household survey was accomplished in three steps.

First, all 549 primary sampling units (PSUs) or clusters in Kagera region (most of which are villages) were categorized into eight strata based on four ecological zones and high/low adult mortality rates (AMR) calculated from the 1988 Census. A stratified random sample of 51 units were selected.[1] High mortality sampling units were over-sampled in each zone. Among the high AMR PSUs, 26 of 61 were selected compared to 25 of the 488 low AMR communities.

Next, all 26,416 households in these 51 communities were surveyed, resulting in enumeration of about 9% (135,683 individuals) of the total population of Kagera in about

[1] 54 PSUs were originally chosen but 3 were dropped due to insufficient resources.

9% of all communities. The enumeration survey was very simple, containing only four questions: 1. Name of head of household; 2. Number of people in the household 15 years and older, and 14 or younger; 3. The age and number of weeks any adults (15-50 years) in the household who where too ill to work (listing up to three adults); and, 4. The cause of death (illness, accident, childbirth or other) is recorded for up to three adult (15-50 years) deaths occurring in the household during in the preceding 12 months.

Finally, based on the enumeration survey, households were labeled as "sick" or "well". "Sick" households were ones in which there was an adult too sick to work or an adult death in the past 12 months. Only 7.2 percent of households (1913 households) were identified as "sick". The sick (well) households were randomly selected within village from the set of all sick (well) households. Sick households were over-sampled in each cluster comprising 14 out of every 16 households targeted. A total of 816 households were selected to be interviewed. By the first wave, 7-12 months after enumeration, 47 of the original 816 households were not interviewed for a variety of reasons (see Table A1.2). However, field researchers replaced these households with 69 more households from the enumeration sample. Thus, 838 households were interviewed in wave 1.

The second wave of interviews began in the Spring of 1992. Among other smaller differences between the wave 1 questionnaire and the questionnaire in waves 2-4, the reference period for recall questions is usually 12 months in the former and the period between interviews for the latter surveys. The average number of months between each survey is 6-7.

Characteristics of sample attrition across interviews are documented in Table A1.2. Attrition is an important issue because households experiencing a death may be more likely to drop out of the panel, for example, due to dissolution of the household unit following a death. Thus, the remaining sample of those households that experience a death and do not drop out of the panel may be least vulnerable to the shock of a prime-age death. One quarter of the households that drop during the course of the project (19 out of 81) had moved due to factors related to a death, though the majority of households that leave the panel do not leave for reasons related to a death. The analysis in the text does not restrict the sample to households that complete the panel.

Data Editing

The KHDS data used for this study were received completely unedited after their completion in the field. Each wave of the KHDS was fielded in two rounds about two weeks apart. This design allowed for some data checks and follow-up in the second round in the field on inconsistent data collected in the first round which covered about half of the sections of the household survey. For this study, editing of the KHDS data consisted of a multitude of verification and consistency checks, which were facilitated by the panel nature of the data.[2] Some observations (either on entire households or individuals) were ultimately eliminated, and in other cases, corrections to

---

[2] The unedited status of the KHDS extends to even the most basic data checks on variables such as sex, membership and consistency in identification numbers (for individuals and for households). These basic consistency checks were undertaken before preceding to other data checks. Overall, there were very few corrections of these sorts.

the data were made based on other information in the panel. More details pertaining to editing these data follow.

Originally 840 households were in the wave 1 sample. In the second and third passes of the panel, field researchers added 75 new households as replacements for households that dropped from the sample after wave 1. Since the criterion for the selection of these households is not documented, they are not used in this analysis.

Table A1.3 describes the number of individual observations dropped among the 13,528 cross-section of individuals between the ages of 7 and 65 residing in the 840 households. Two of the 840 households in wave 1 were excluded from the panel when it was discovered that these two households had the same household head with a different wife in each. According to supervisor manuals, they should have been considered one household, and, therefore, household-level sections of the survey should have been administered only once in each wave. Given the difficulty of combining certain sections of household level data (such as land and expenditure data) both households were discarded. All other observations that were excluded had missing values in either the explanatory or dependent variables.

A small number of corrections were made to particular variables. For example, for education, where no enrollment is reported in any wave (mainly adults) and highest grade is not constant, the most frequently reported level was chosen. For cases with four levels reported and no majority, the largest and smallest values are eliminated and the average of the remaining observations is calculated. For cases with three different levels reported, the middle value is used; with two levels reported, the average of the two levels is calculated. The new data for education are also used for education of resident parents and household heads. Likewise, these checks were made for the education reported for non-resident parents. For age, where inconsistently reported (e.g. people getting younger or aging by more than 1 year across back-to-back waves that are 6-7 months apart), all reported ages were back-dated to the first wave by length of time between waves. An average "first" age was then calculated from these data and ages for subsequent waves were recalculated by adding months between waves.

Some variables, such as orphan status, were expected to change in one direction only and were thoroughly checked for consistency. Corrections were made only when sufficient information allowed for ascertaining a presumably more accurate response. Otherwise, the data are considered missing. Data pertaining to land, income, or other measures that can vary in any direction across waves (as opposed to discrete status variables) were *not* imputed when missing.

Table A1.1: Sample of Households in the KHDS by Wave

Wave	Dates	Number of households (# dropped between waves)
1	Sept 1991 - May 1992	838
		(37)
2	May 1992 - Nov 1992	801
		(17)
3	Nov 1992 - May 1993	784
		(27)
4	June 1993 - Dec 1993	757
		(total dropped = 81)

Notes: Dropped households include some households that completed portions of the survey, but failed to complete the entire interview or any subsequent interviews.

Table A1.2: Sample Attrition in the KHDS

	Between enumeration and wave 1		Between waves of the household survey	
Overall rate of attrition (%)	5.8		9.7	
Reason for attrition	number	per cent	number	percent
Moved (not related to death)	18	38.3	46	56.8
Moved (related to death)	7	14.9	19	23.5
Head away [a]	9	19.1	2	2.5
Refused	4	8.5	13	16.0
Illness	2	4.3	1	1.2
Not found	1	2.1	0	0.0
Reason unknown	6	12.8	0	0.0
Total	47	100.0	81	100.0

Notes: The 47 households that dropped from the sample between enumeration and wave 1 were replaced by 69 households selected from a list of "replacement" households compiled from the enumeration survey. a. The absence of the household head was not a valid reason for dropping a household from the sample. This occurrence almost entirely ended after wave 1.

Table A1.3: Observations Dropped from KHDS Data

			Reason dropped			
Sample	Initial sample	Total dropped	Two households with same head	Missing hours	Missing land	Missing any parental characteristic
Children 7-14 years	4365	157	12	41	2	102
Females 15-19 years	1403	37	7	2	1	27
Males 15-19 years	1312	40	6	2	0	32
Females 20-50 years	2853	18	10	6	2	--
Males 20-50 years	2114	45	0	44	1	--
Adults 51-65 years	1481	19	8	11	0	--
Total	13528	316	43	106	6	161

Notes: Reasons for being dropped are not necessarily mutually exclusive, although in this table individuals are placed into only one category. Missing hours is predominantly hours in farming, but also includes home hours, and hours in wage and nonfarm self employment. Two households did not report land holdings in one wave each. The set of parental characteristics includes mother's and father's schooling, and orphan status.

APPENDIX 2

APPENDIX

APPENDIX 2

Table A2.1: Sample Statistics

	Children	Women	Men	Women	Men	Adults
Age	10.400	16.005	16.167	31.503	30.853	57.140
	(2.129)	(1.620)	(1.599)	(9.008)	(9.278)	(4.264)
Female (1 if female, else 0)	0.474	-	-	-	-	0.546
	(0.499)	-	-	-	-	(0.498)
Child of head (1 if child of household head, else 0)	0.688	0.627	0.653	-	-	-
	(0.463)	(0.484)	(0.476)	-	-	-
Mother's years of schooling	3.837	3.281	3.027	-	-	-
	(2.973)	(2.872)	(2.870)	-	-	-
Father's years of schooling	5.379	4.982	4.991	-	-	-
	(3.079)	(3.068)	(2.926)	-	-	-
Mother deceased (1 if mother deceased, else 0)	0.189	0.231	0.252	-	-	-
	(0.391)	(0.422)	(0.434)	-	-	-
Father deceased (1 if father deceased, else 0)	0.274	0.268	0.329	-	-	-
	(0.446)	(0.443)	(0.470)	-	-	-
Both parents deceased (1 if both parents deceased, else 0)	0.081	0.091	0.096	-	-	-
	(0.273)	(0.288)	(0.295)	-	-	-
No parent in household (1 if no parent in household, else 0)	0.250	0.313	0.277	-	-	-
	(0.433)	(0.464)	(0.447)	-	-	-
Schooling: 1-6 years (1 of completed >0 but less than 7 years, else 0)	-	-	-	0.253	0.267	0.484
	-	-	-	(0.435)	(0.443)	(0.500)
Schooling: 7 years (1 if completed 7 years, else 0)	-	-	-	0.452	0.560	0.081
	-	-	-	(0.498)	(0.497)	(0.273)
Schooling: 8+ years (1 if completed 8+ years, else 0)	-	-	-	0.047	0.093	0.032
	-	-	-	(0.212)	(0.291)	(0.175)
Head of household (1 if household head, else 0)	-	-	-	0.143	0.578	0.629
	-	-	-	(0.350)	(0.494)	(0.483)
Acres of land (acres of land inherited over all household members)	3.167	3.400	3.363	3.112	2.842	3.377
	(4.053)	(4.055)	(4.830)	(4.169)	(3.274)	(4.564)
Age of household head	49.730	51.382	50.001	46.160	43.996	57.542
	(14.643)	(15.944)	(15.270)	(14.935)	(15.743)	(10.543)
Years of schooling of head	4.267	4.364	4.297	4.665	4.969	3.668
	(3.094)	(3.006)	(3.015)	(3.115)	(3.281)	(2.810)
Female household head (1 if female head, else 0)	0.272	0.228	0.279	0.247	0.107	0.235
	(0.445)	(0.420)	(0.449)	(0.431)	(0.309)	(0.424)
Sample Size	3912	1254	1204	2596	1894	1393

Note: Standard deviations in parentheses.

Table A2.2a: Hours Equations

	Women 20-50				Men 20-50			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Age	-	1.875	-	0.611	-	-0.592	-	1.593
	-	(1.521)	-	(1.668)	-	(1.738)	-	(1.226)
Age squared	-	-0.045**	-	-0.010	-	0.020	-	-0.023
	-	(0.019)	-	(0.021)	-	(0.023)	-	(0.016)
Head of household	-	0.297	-	-5.744	-	-3.511	-	6.773**
	-	(4.110)	-	(4.507)	-	(4.115)	-	(2.903)
Acres of land	-	0.105	-	0.015	-	-0.117	-	-0.216
	-	(0.160)	-	(0.175)	-	(0.231)	-	(0.163)
Acres of land squared	-	-0.006	-	-0.004	-	0.008	-	0.007
	-	(0.005)	-	(0.005)	-	(0.011)	-	(0.008)
Age of household head	-	-0.275	-	0.520	-	0.339	-	-0.332
	-	(0.349)	-	(0.383)	-	(0.379)	-	(0.267)
Age of household head squared	-	0.003	-	-0.003	-	-0.005	-	0.004
	-	(0.004)	-	(0.004)	-	(0.004)	-	(0.003)
Years of schooling of head	-	-0.111	-	0.767	-	0.184	-	0.007
	-	(0.538)	-	(0.590)	-	(0.672)	-	(0.474)
Female household head	-	0.398	-	4.993	-	6.982	-	4.979
	-	(4.068)	-	(4.461)	-	(4.924)	-	(3.473)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.100	-	0.603	-	0.635	-	0.053
Household characteristics	-	0.872	-	0.126	-	0.187	-	0.231
Month and year dummies	0.000	0.006	0.002	0.070	0.000	0.021	0.000	0.021
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007
Sample Size	1851	2596	1851	2596	1344	1894	1344	1894

Notes: This table shows the estimates omitted from the output presented in Table 3. Standard errors are in parentheses and, for the OLS estimates, have been corrected for clustering at the individual level. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

Table A2.2b: Hours Equations

	Women 15-19				Men 15-19			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Age	-	-4.579	-	1.777	-	9.327*	-	14.067***
	-	(5.238)	-	(5.214)	-	(5.365)	-	(4.741)
Age squared	-	0.141	-	-0.028	-	-0.312*	-	-0.432***
	-	(0.162)	-	(0.161)	-	(0.164)	-	(0.145)
Child of head	-	-10.299*	-	-0.186	-	4.342	-	-1.857
	-	(5.856)	-	(5.829)	-	(6.357)	-	(5.618)
Mother deceased	-	1.600	-	6.302	-	-5.203	-	-5.108
	-	(4.222)	-	(4.203)	-	(4.844)	-	(4.281)
Father deceased	-	-0.237	-	-5.382	-	12.303**	-	5.894
	-	(5.785)	-	(5.759)	-	(6.086)	-	(5.379)
Both parents deceased	-	-3.292	-	-2.099	-	-4.673	-	0.843
	-	(5.679)	-	(5.653)	-	(6.404)	-	(5.659)
No parent in household	-	-8.025	-	5.047	-	0.301	-	1.390
	-	(6.307)	-	(6.278)	-	(4.408)	-	(3.895)
Acres of land	-	0.370	-	0.268	-	0.269	-	0.091
	-	(0.228)	-	(0.227)	-	(0.222)	-	(0.196)
Acres of land squared	-	-0.020***	-	-0.005	-	0.001	-	-0.003
	-	(0.008)	-	(0.008)	-	(0.005)	-	(0.005)
Age of household head	-	0.407	-	-0.355	-	-0.020	-	0.269
	-	(0.455)	-	(0.453)	-	(0.700)	-	(0.618)
Age of household head squared	-	-0.003	-	0.003	-	0.0002	-	-0.002
	-	(0.004)	-	(0.004)	-	(0.008)	-	(0.007)
Years of schooling of head	-	0.317	-	-0.171	-	-1.408**	-	-0.835
	-	(0.648)	-	(0.645)	-	(0.660)	-	(0.583)
Female household head	-	4.168	-	3.153	-	-6.525	-	-7.425
	-	(4.722)	-	(4.700)	-	(5.452)	-	(4.818)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.613	-	0.540	-	0.100	-	0.071
Household characteristics	-	0.075	-	0.912	-	0.078	-	0.584
Month and year dummies	0.023	0.580	0.000	0.000	0.000	0.098	0.000	0.043
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.012
Sample Size	874	1254	874	1254	854	1204	854	1204

Notes: See notes for Table A2.2a.

Table A2.2c Hours Equations

	Children 7-14				Adults 51-65			
	Farm		House		Farm		House	
	Δ hours	hours	Δ hours	hours	Δ hours	hours	Δ hours	hours
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Age	-	5.950***	-	2.847**	-	-0.603	-	0.196
	-	(1.149)	-	(1.205)	-	(7.084)	-	(5.710)
Age squared	-	-0.282***	-	-0.162***	-	-0.018	-	-0.0001
	-	(0.050)	-	(0.052)	-	(0.061)	-	(0.049)
Child of head	-	-3.740**	-	-1.454	-	-	-	-
	-	(1.745)	-	(1.830)	-	-	-	-
Mother deceased	-	-1.234	-	0.241	-	-	-	-
	-	(1.967)	-	(2.063)	-	-	-	-
Father deceased	-	-0.732	-	-1.121	-	-	-	-
	-	(1.761)	-	(1.847)	-	-	-	-
Both parents deceased	-	0.765	-	-1.314	-	-	-	-
	-	(2.193)	-	(2.300)	-	-	-	-
No parent in household	-	-1.941	-	0.906	-	-	-	-
	-	(1.587)	-	(1.664)	-	-	-	-
Head of household	-	-	-	-	-	-3.156	-	-9.517
	-	-	-	-	-	(7.803)	-	(6.289)
Acres of land	-	0.203**	-	0.186*	-	0.269	-	-0.180
	-	(0.092)	-	(0.097)	-	(0.237)	-	(0.191)
Acres of land squared	-	-0.003	-	-0.004	-	-0.006	-	0.007
	-	(0.003)	-	(0.003)	-	(0.006)	-	(0.005)
Age of household head	-	-0.160	-	-0.039	-	0.049	-	0.347
	-	(0.225)	-	(0.236)	-	(0.921)	-	(0.743)
Age of household head squared	-	0.002	-	0.001	-	0.001	-	0.001
	-	(0.002)	-	(0.002)	-	(0.009)	-	(0.008)
Years of schooling of head	-	0.558**	-	0.207	-	0.964	-	-0.618
	-	(0.267)	-	(0.280)	-	(1.279)	-	(1.031)
Female household head	-	1.823	-	-0.587	-	11.681	-	6.201
	-	(1.601)	-	(1.679)	-	(8.423)	-	(6.790)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.000	-	0.082	-	0.423	-	0.514
Household characteristics	-	0.107	-	0.569	-	0.709	-	0.000
Month and year dummies	0.000	0.179	0.000	0.002	0.000	0.492	0.042	0.016
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.023	0.000	0.125
Sample Size	2776	3912	2776	3912	1026	1393	1026	1393

Notes: See notes for Table A2.2a.

Table A2.3a: Hours Equations

	Women 20-50				Men 20-50			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Age	-	1.674	-	0.486)	-	-0.680	-	1.543
	-	(1.521)	-	(1.671)	-	(1.740)	-	(1.227)
Age squared	-	-0.044**	-	-0.010	-	0.021	-	-0.022
	-	(0.019)	-	(0.021)	-	(0.023)	-	(0.016)
Head of household	-	0.159	-	-5.644	-	-3.223	-	6.784**
	-	(4.109)	-	(4.513)	-	(4.128)	-	(2.910)
Acres of land	-	0.119	-	0.025	-	-0.120	-	-0.214
	-	(0.160)	-	(0.175)	-	(0.231)	-	(0.163)
Acres of land squared	-	-0.006	-	-0.004	-	0.008	-	0.007
	-	(0.005)	-	(0.005)	-	(0.011)	-	(0.008)
Age of household head	-	-0.279	-	0.539	-	0.322	-	-0.335
	-	(0.349)	-	(0.384)	-	(0.380)	-	(0.268)
Age of household head squared	-	0.003	-	-0.003	-	-0.005	-	0.004
	-	(0.004)	-	(0.004)	-	(0.004)	-	(0.003)
Years of schooling of head	-	-0.138	-	0.734	-	0.223	-	0.017
	-	(0.537)	-	(0.590)	-	(0.674)	-	(0.475)
Female household head	-	0.582	-	4.902	-	7.426	-	5.133
	-	(4.068)	-	(4.468)	-	(4.956)	-	(3.494)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.103	-	0.620	-	0.644	-	0.056
Household characteristics	-	0.857	-	0.131	-	0.186	-	0.254
Month and year dummies	0.000	0.006	0.002	0.060	0.000	0.018	0.000	0.025
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009
Sample Size	1851	2596	1851	2596	1344	1894	1344	1894

Notes: This table shows the estimates omitted from the output presented in Table 4. Standard errors are in parentheses and, for the OLS estimates, have been corrected for clustering at the individual level. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

Table A2.3b: Hours Equations

	Women 15-19				Men 15-19			
	Farm		House		Farm		House	
	Δ hours	hours	Δ hours	hours	Δ hours	hours	Δ hours	hours
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Age	-	-4.342	-	1.789	-	8.997*	-	14.589***
	-	(5.255)	-	(5.226)	-	(5.377)	-	(4.755)
Age squared	-	0.134	-	-0.029	-	-0.302*	-	-0.447***
	-	(0.163)	-	(0.162)	-	(0.164)	-	(0.145)
Child of head	-	-10.807*	-	-0.146	-	3.995	-	-2.625
	-	(5.887)	-	(5.855)	-	(6.380)	-	(5.643)
Mother deceased	-	1.325	-	5.961	-	-4.404	-	-5.017
	-	(4.233)	-	(4.210)	-	(4.854)	-	(4.293)
Father deceased	-	-0.851	-	-5.895	-	12.381**	-	5.166
	-	(5.826)	-	(5.973)	-	(6.116)	-	(5.409)
Both parents deceased	-	-2.832	-	-2.053	-	-4.783	-	1.421
	-	(5.722)	-	(5.690)	-	(6.429)	-	(5.686)
No parent in household	-	-7.991	-	5.785	-	0.729	-	1.813
	-	(6.361)	-	(6.326)	-	(4.416)	-	(3.906)
Acres of land	-	0.391*	-	0.283	-	0.258	-	0.063
	-	(0.229)	-	(0.228)	-	(0.222)	-	(0.197)
Acres of land squared	-	-0.021***	-	-0.006	-	0.001	-	-0.002
	-	(0.008)	-	(0.008)	-	(0.005)	-	(0.005)
Age of household head	-	0.426	-	-0.323	-	-0.060	-	0.298
	-	(0.456)	-	(0.453)	-	(0.701)	-	(0.620)
Age of household head squared	-	-0.003	-	0.003	-	0.001	-	-0.003
	-	(0.004)	-	(0.004)	-	(0.008)	-	(0.007)
Years of schooling of head	-	0.339	-	-0.148	-	-1.386**	-	-0.880
	-	(0.649)	-	(0.646)	-	(0.661)	-	(0.585)
Female household head	-	4.411	-	2.892	-	-6.248	-	-7.409
	-	(4.745)	-	(4.719)	-	(5.452)	-	(4.822)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.612	-	0.508	-	0.146	-	0.063
Household characteristics	-	0.064	-	0.825	-	0.082	-	0.612
Month and year dummies	0.009	0.657	0.000	0.000	0.000	0.154	0.000	0.056
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.010
Sample Size	874	1254	874	1254	854	1204	854	1204

Notes: See notes for Table A2.3a.

Table A2.3c Hours Equations

	Children 7-14				Adults 51-65			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Age	-	6.018***	-	2.858**	-	-0.575	-	0.151
	-	(1.147)	-	(1.207)	-	(7.105)	-	(5.710)
Age squared	-	-0.284***	-	-0.162***	-	-0.019	-	0.001
	-	(0.050)	-	(0.052)	-	(0.061)	-	(0.049)
Child of head	-	-3.665**	-	-1.381	-	-	-	-
	-	(1.749)	-	(1.840)	-	-	-	-
Mother deceased	-	-1.165	-	0.266	-	-	-	-
	-	(1.963)	-	(2.065)	-	-	-	-
Father deceased	-	-0.449	-	-1.076	-	-	-	-
	-	(1.762)	-	(1.854)	-	-	-	-
Both parents deceased	-	0.694	-	-1.286	-	-	-	-
	-	(2.194)	-	(2.308)	-	-	-	-
No parent in household	-	-1.830	-	0.860	-	-	-	-
	-	(1.586)	-	(1.669)	-	-	-	-
Head of household	-	-	-	-	-	-3.080	-	-9.360
	-	-	-	-	-	(7.810)	-	(6.276)
Acres of land	-	0.204**	-	0.185*	-	0.261	-	-0.172
	-	(0.092)	-	(0.097)	-	(0.238)	-	(0.191)
Acres of land squared	-	-0.003	-	-0.004	-	-0.005	-	0.007
	-	(0.003)	-	(0.003)	-	(0.006)	-	(0.005)
Age of household head	-	-0.128	-	-0.037	-	0.088	-	0.267
	-	(0.225)	-	(0.237)	-	(0.923)	-	(0.742)
Age of household head squared	-	0.002	-	0.0005	-	0.001	-	0.002
	-	(0.002)	-	(0.002)	-	(0.009)	-	(0.008)
Years of schooling of head	-	0.572**	-	0.210	-	1.009	-	-0.521
	-	(0.266)	-	(0.280)	-	(1.283)	-	(1.031)
Female household head	-	1.606	-	-0.560	-	11.587	-	6.244
	-	(1.600)	-	(1.683)	-	(8.429)	-	(6.774)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.000	-	0.088	-	0.393	-	0.522
Household characteristics	-	0.099	-	0.574	-	0.721	-	0.000
Month and year dummies	0.000	0.163	0.000	0.002	0.000	0.471	0.045	0.015
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.024	0.000	0.092
Sample Size	2776	3912	2776	3912	1026	1393	1026	1393

Notes: See notes for Table A2.3a

Table A2.4: Probability of an Adult Joining Household in Last 6 Months

	Male or female joiner		Female joiner		Male joiner	
Explanatory Variables	1	2	3	4	5	6
Acres of land	0.025	0.024	-0.001	-0.001	0.075***	0.075***
	(0.016)	(0.016)	(0.017)	(0.017)	(0.022)	(0.022)
	[0.006]	[0.006]	[-0.0002]	[-0.0003]	[0.012]	[0.012]
Acres of land squared	-0.0003	-0.0003	0.001	0.001	-0.003***	-0.003***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.001)	(0.001)
	[-0.0001]	[-0.0001]	[0.0001]	[0.0001]	[-0.0004]	[-0.0004]
Age of household head	0.031**	0.035***	0.028**	0.032**	0.025	0.028*
	(0.013)	(0.013)	(0.014)	(0.013)	(0.016)	(0.016)
	[0.007]	[0.008]	[0.005]	[0.006]	[0.004]	[0.004]
Age of household head squared / 100	-0.022*	-0.025**	-0.020	-0.023*	-0.013	-0.002
	(0.012)	(0.012)	(0.013)	(0.013)	(0.015)	(0.014)
	[-0.005]	[-0.006]	[-0.004]	[-0.004]	[-0.002]	[-0.003]
Years of schooling of head	0.051***	0.050***	0.045***	0.044***	0.036**	0.035*
	(0.013)	(0.013)	(0.015)	(0.015)	(0.018)	(0.018)
	[0.012]	[0.012]	[0.008]	[0.008]	[0.006]	[0.005]
Female household head	0.104	0.087	0.095	0.088	-0.055	-0.070
	(0.087)	(0.087)	(0.091)	(0.091)	(0.115)	(0.115)
	[0.025]	[0.021]	[0.018]	[0.017]	[-0.008]	[-0.011]
Past/future interview dummies	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes
P-value for joint significance:						
Household characteristics	0.000	0.000	0.000	0.000	0.000	0.000
Month and year dummies	0.000	0.000	0.000	0.000	0.000	0.000
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.000
Sample Size	2128		1912		1536	

Notes: This table shows the estimates omitted from the output presented in Table 5. Results are estimated using probit with standard errors in parentheses corrected for clustering at the household level; in brackets, coefficients have also been converted to change in probability (dp/dx) evaluated at the mean of all other regressors, which represents a discrete change for dummy variables from 0 to 1. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

Table A2.5: Hired Labor in Last 6 Months

	Any hired labor Probit		Number of mandays Household Fixed Effects		Total expenditure Household Fixed Effects	
Explanatory Variables	1	2	3	4	5	6
Acres of land	0.050***	0.050***	3.111	3.196	462.880	509.422
	(0.016)	(0.016)	(3.132)	(3.135)	(331.121)	(329.992)
	[0.018]	[0.018]	-	-	-	-
Acres of land squared	-0.001*	-0.001*	-0.159*	-0.161*	-3.488	-4.337
	(0.001)	(0.001)	(0.094)	(0.094)	(9.911)	(9.872)
	[-0.0003]	[-0.0003]	-	-	-	-
Age of household head	0.012	0.012	3.856	3.698	777.430	703.065
	(0.012)	(0.012)	(5.675)	(5.672)	(599.503)	(596.480)
	[0.004]	[0.004]	-	-	-	-
Age of household head squared / 100	-0.010	-0.007	-0.048	-0.046	-8.278	-7.313
	(0.010)	(0.012)	(0.063)	(0.063)	(6.615)	(6.583)
	[-0.002]	[-0.002]	-	-	-	-
Years of schooling of head	0.087***	0.087***	-1.774	-1.266	-962.449	-829.290
	(0.016)	(0.016)	(9.179)	(9.200)	(969.291)	(967.436)
	[0.031]	[0.031]	-	-	-	-
Female household head	0.122	0.122	-51.902	-51.453	-17303.550***	-17473.510***
	(0.094)	(0.094)	(48.538)	(48.575)	(5086.443)	(5068.953)
	[0.044]	[0.044]	-	-	-	-
Past/future interview dummies	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes
P-value for joint significance:						
Household characteristics	0.000	0.000	0.535	0.524	0.013	0.009
Month and year dummies	0.000	0.000	0.999	0.999	1.000	1.000
Village * wave dummies	0.000	0.000	0.009	0.008	0.901	0.881
Sample Size	2302		2312		2302	

Notes: This table shows the estimates omitted from the output presented in Table 7. Standard errors are in parentheses and for the probit estimates have been corrected for clustering at the household level; in brackets, for probit estimates, coefficients have also been converted to change in probability (dp/dx) evaluated at the mean of all other regressors, which represents a discrete change for dummy variables from 0 to 1. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

Table A2.6: Land Cultivated in Last 6 Months, Household Fixed Effects

Explanatory Variables	Area of land cultivated 1	2	Area of land cultivated per adult resident 3	4
Acres of land	0.573***	0.575***	0.199***	0.199***
	(0.038)	(0.038)	(0.018)	(0.018)
Acres of land squared	-0.003***	-0.003***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Age of household head	0.249***	0.230***	0.095***	0.089***
	(0.069)	(0.069)	(0.032)	(0.032)
Age of household head squared	-0.002***	-0.002***	-0.001***	-0.001***
	(0.001)	(0.001)	(0.0004)	(0.0004)
Years of schooling of head	-0.031	-0.025	-0.012	-0.011
	(0.111)	(0.111)	(0.052)	(0.052)
Female household head	-2.142***	-2.097***	-0.280	-0.257
	(0.583)	(0.584)	(0.271)	(0.272)
Past/future interview dummies	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes
P-value for joint significance:				
Household characteristics	0.000	0.000	0.000	0.000
Month and year dummies	0.456	0.478	0.215	0.233
Village * wave dummies	0.000	0.000	0.000	0.003
Sample Size	2323		2323	

Notes: This table shows the estimates omitted from the output presented in Table 8. Standard errors are in parentheses. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

Table A2.7: Crops Farmed by Any Household Member in Last 7 Days, Probit

Explanatory Variables	Coffee	Banana	Maize, Cassava or Beans
Acres of land	0.094***	0.072***	0.034**
	(0.015)	(0.015)	(0.014)
	[0.037]	[0.024]	[0.011]
Acres of land squared	-0.001***	-0.001***	-0.001*
	(0.0004)	(0.001)	(0.0005)
	-0.001]	[-0.0005]	[-0.0003]
Age of household head	[0.022**	0.013	0.026***
	(0.010)	(0.010)	(0.009)
	[0.009]	[0.004]	[0.009]
Age of household head squared	-0.0001	-0.0001	-0.0002***
	(0.0001)	(0.0001)	(0.0001)
	[-0.0001]	[-0.00003]	[-0.0001]
Years of schooling of head	0.0004	0.001	-0.003
	(0.013)	(0.012)	(0.012)
	[0.0002]	[0.0002]	[-0.001]
Female household head	-0.274***	-0.176**	-0.056
	(0.079)	(0.081)	(0.072)
	[-0.108]	[-0.061]	[-0.019]
Past/future interview dummies	yes	yes	yes
Month and year dummies	yes	yes	yes
Village * wave dummies	yes	yes	yes
P-value for joint significance:			
Household characteristics	0.000	0.000	0.000
Month and year dummies	0.000	0.000	0.000
Village * wave dummies	0.000	0.000	0.000
Sample Size	2323	2889	2893

Notes: This table shows the estimates omitted from the output presented in Table 9. Standard errors are in parentheses and have been corrected for clustering at the household level; in brackets coefficients have also been converted to change in probability (dp/dx) evaluated at the mean of all other regressors, which represents a discrete change for dummy variables from 0 to 1. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

Table A2.8: Wage Employment and Nonfarm Self-employment of Men (20-50)

Explanatory Variables	Wage Employment 1	2	Nonfarm Self-employment 3
Age	0.058	0.058	0.211***
	(0.044)	(0.044)	(0.049)
	[0.020]	[0.020]	[0.053]
Age squared	-0.001	-0.001	-0.003***
	(0.001)	(0.001)	(0.001)
	[-0.0003]	[-0.0003]	[-0.001]
Schooling: 1-6 years	-0.247	-0.250	-0.768***
	(0.209)	(0.208)	(0.246)
	[-0.083]	[-0.084]	[0.225]
Schooling: 7 years	-0.116	-0.117	0.868***
	(0.227)	(0.227)	(0.275)
	[-0.041]	[-0.041]	[0.208]
Schooling: 8+ years	-0.253	-0.255	0.540
	(0.287)	(0.287)	(0.351)
	[-0.083]	[-0.084]	[0.162]
Head of household	0.281	0.282	0.124
	(0.190)	(0.191)	(0.213)
	[0.097]	[0.097]	[0.031]
Acres of land	-0.064**	-0.064**	0.005
	(0.028)	(0.028)	(0.024)
	[-0.022]	[-0.022]	[0.001]
Acres of land squared	0.004*	0.004*	0.001
	(0.002)	(0.002)	(0.001)
	[0.001]	[0.001]	[0.00002]
Age of household head	-0.008	-0.008	0.010
	(0.020)	(0.020)	(0.021)
	[-0.003]	[-0.003]	[0.002]
Age of household head squared	0.0002	0.0002	-0.0002
	(0.0002)	(0.0002)	(0.0002)
	[0.00001]	[0.0001]	[-0.00004]
Years of schooling of head	0.084***	0.083***	-0.043
	(0.024)	(0.023)	(0.029)
	[0.029]	[0.029]	[-0.011]
Female household head	0.216	0.213	-0.034
	(0.181)	(0.180)	(0.220)
	[0.078]	[0.077]	[-0.008]
Past/future interview dummies	yes	yes	yes
Month and year dummies	yes	yes	yes
Village * wave dummies	yes	yes	yes
P-value for joint significance:			
Individual characteristics	0.077	0.073	0.000
Household characteristics	0.006	0.006	0.545
Month and year dummies	0.000	0.000	0.000
Village * wave dummies	0.000	0.000	0.000
Sample Size	1793		1622

Notes: This table shows the estimates omitted from the output presented in Table 10. Probabilities are estimated with standard errors in parentheses corrected for clustering at the household level; in brackets coefficients have also been converted to change in probability (dp/dx) evaluated at the mean of all other regressors, which represents a discrete change for dummy variables from 0 to 1. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

APPENDIX 3

APPENDIX 3

Table A3.1: Impact of Adult Household Member Deaths (15-50) on Farm Hours, Random Effects Estimates

Explanatory Variables	Women 20-50	Men 20-50	Women 15-19	Men 15-19	Children 7-14	Adults 51-65
Female death past 0-12 months	-1.779	0.558	-0.125	-0.533	-0.882	-0.363
	(1.258)	(1.621)	(1.383)	(1.781)	(0.683)	(1.871)
Female death future 0-12 months	-3.771**	-3.200	-2.822	-3.107	-1.197	-6.040**
	(1.809)	(2.006)	(2.058)	(2.012)	(0.892)	(2.914)
Male death past 0-12 months	-3.010**	0.627	-3.536	-2.234	-3.296***	-3.185
	(1.444)	(1.971)	(1.940)	(1.984)	(0.838)	(2.091)
Male death future 0-12 months	1.572	-0.134	-2.172	3.493	0.309	-1.972
	(2.021)	(2.932)	(2.607)	(2.658)	(1.042)	(2.880)
R^2	0.209	0.228	0.322	0.278	0.171	0.225
Breusch-Pagan test $\chi^2(1)$	49.57	139.80	22.23	82.98	110.18	73.16
p-value	0.000	0.000	0.000	0.000	0.000	0.000
Hausman test χ^2	136.59	100.79	43.06	135.24	108.66	167.38
p-value	0.993	1.000	1.000	0.995	1.000	0.741
Household-member death variables:						
Hausman test χ^2	2.228	0.365	33.481	2.775	3.630	3.604
p-value	0.694	0.985	0.481	0.596	0.458	0.462
P-value for joint significance:						
Female death past & future	0.050	0.219	0.390	0.302	0.203	0.117
Male death past & future	0.067	0.943	0.159	0.149	0.000	0.288
Sample Size	2596	1894	1254	1204	3912	1393

Notes: Standard errors are in parentheses. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Table A3.2 for additional regressors included but not reported here.

Table A3.2: Farm Hours Equations, Random Effects Estimates

Explanatory Variables	Women 20-50	Men 20-50	Women 15-19	Men 15-19	Children 7-14	Adults 51-65
Age	0.706**	-0.435*	2.919	8.712**	3.971***	-2.877
	(0.284)	(0.228)	(4.076)	(3.554)	(0.769)	(2.438)
Age squared	-0.013***	0.004	-0.078	-0.279**	-0.133***	0.022
	(0.004)	(0.003)	(0.126)	(0.109)	(0.037)	(0.021)
Female	-	-	-	-	2.582***	10.586***
	-	-	-	-	(0.359)	(1.551)
Child of head	-	-	-0.183	-0.569	-0.234	-
	-	-	(1.762)	(1.548)	(0.744)	-
Mother's years of schooling	-		-0.019	-0.228*	-0.024	-
	-	-	(0.152)	(0.136)	(0.074)	-
Father's years of schooling	-	-	-0.207	0.054	-0.047	-
	-	-	(0.151)	(0.132)	(0.079)	-
Mother deceased	-	-	1.243	0.319	0.566	-
	-	-	(1.130)	(0.938)	(0.611)	-
Father deceased	-	-	-3.063**	-1.277	-1.130*	-
	-	-	(1.248)	(1.106)	(0.600)	-
Both parents deceased	-	-	-0.259	1.942	-0.240	-
	-	-	(1.975)	(1.756)	(0.994)	-
No parent in household	-	-	0.236	0.912	1.247	-
	-	-	(1.774)	(1.596)	(0.804)	-
Schooling: 1-6 years	-0.649	-0.356	-	-	-	-2.408**
	(0.939)	(1.085)	-	-	-	(1.145)
Schooling: 7 years	-0.474	-1.147	-	-	-	-2.793
	(1.022)	(1.223)	-	-	-	(2.125)
Schooling: 8+ years	-2.114	-1.605	-	-	-	-4.134
	(1.832)	(1.618)	-	-	-	(3.092)
Head of household	1.863	1.925**	-	-	-	-0.052
	(1.443)	(0.961)	-	-	-	(1.404)
Acres of land	-0.279**	-0.183	0.299*	-0.264**	-0.028	-0.228
	(0.128)	(0.119)	(0.174)	(0.131)	(0.071)	(0.150)
Acres of land squared	0.004	0.010	-0.013**	0.005	0.001	0.007
	(0.004)	(0.006)	(0.006)	(0.004)	(0.002)	(0.004)
Age of household head	-0.115	0.051	-0.303**	-0.022	-0.056	0.049
	(0.123)	(0.093)	(0.149)	(0.139)	(0.077)	(0.201)
Age of household head squared	0.001	-0.0002	0.002	-0.0003	0.0003	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Years of schooling of head	-0.093	-0.279**	-0.207	-0.223	0.032	0.112
	(0.132)	(0.127)	(0.180)	(0.164)	(0.094)	(0.248)
Female household head	-2.989**	-1.750*	1.714	0.741	1.151**	0.216
	(1.190)	(0.927)	(1.263)	(1.179)	(0.608)	(1.580)
Past/future interview dummies	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes
P-value for joint significance:						
Individual characteristics	0.004	0.016	0.061	0.023	0.000	0.000
Household characteristics	0.017	0.018	0.023	0.041	0.176	0.000
Month and year dummies	0.017	0.011	0.435	0.048	0.126	0.812
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.000
Sample Size	2596	1894	1254	1204	3912	1393

Notes: This table shows the estimates omitted from the output presented in Table A3.1. Standard errors are in parentheses. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

Table A3.3: Impact of Adult Household Member Deaths (15-50) on Farm Hours, Random Effects Estimates

Explanatory Variables	Women 20-50	Men 20-50	Women 15-19	Men 15-19	Children 7-14	Adults 51-65
Female death past 0-6 months	-2.779*	-0.099	-0.869	-0.738	-1.468*	-0.960
	(1.538)	(1.959)	(1.775)	(1.991)	(0.822)	(2.390)
Female death past 7-12 months	-0.025	1.644	0.928	-0.975	0.110	0.543
	(1.959)	(2.415)	(2.043)	(2.833)	(1.050)	(2.607)
Female death future 0-6 months	-4.313**	-1.286	-3.499	0.820	0.418	-3.439
	(2.120)	(2.394)	(2.577)	(2.388)	(1.059)	(3.632)
Female death future 7-12 months	-2.752	-6.598**	-1.847	-6.528**	-4.437***	-9.834**
	(2.857)	(3.041)	(3.235)	(2.774)	(1.420)	(4.303)
Male death past 0-6 months	-3.396*	-0.114	-2.777	-2.190	-2.847***	-4.463*
	(1.785)	(2.327)	(2.440)	(2.352)	(1.038)	(2.602)
Male death past 7-12 months	-2.051	2.066	-4.743*	-0.954	-3.569***	-1.352
	(2.199)	(2.850)	(2.832)	(2.872)	(1.242)	(3.006)
Male death future 0-6 months	5.450**	-0.708	-2.567	4.700	1.843	-1.824
	(2.371)	(3.478)	(2.831)	(3.110)	(1.245)	(3.438)
Male death future 7-12 months	-7.573**	0.905	-0.296	-0.735	-2.627	-2.286
	(3.515)	(4.469)	(5.825)	(4.306)	(1.683)	(4.549)
R^2	0.214	0.229	0.322	0.284	0.177	0.227
Breusch-Pagan test $\chi^2(1)$	50.03	139.61	22.46	84.31	114.09	73.73
p-value	0.000	0.000	0.000	0.000	0.000	0.000
Hausman test χ^2	5783.61	123.10	2259.72	197.31	74.03	97.17
p-value	0.000	1.000	0.000	0.254	1.000	1.000
Household-member death variables:						
Hausman test χ^2	17.25	3.720	12.037	5.912	12.260	20.265
p-value	0.001	0.714	0.150	0.657	0.140	0.009
P-value for joint significance:						
Female death past	0.194	0.785	0.788	0.896	0.193	0.891
Female death future	0.081	0.093	0.351	0.053	0.006	0.058
Female death past & future	0.082	0.234	0.630	0.204	0.010	0.212
Male death past	0.122	0.753	0.155	0.642	0.001	0.224
Male death future	0.005	0.953	0.663	0.297	0.078	0.786
Male death past & future	0.004	0.955	0.374	0.381	0.000	0.533
Sample Size	2596	1894	1254	1204	3912	1393

Notes: Standard errors are in parentheses. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Table A3.4 for additional regressors included but not reported here.

Table A3.4: Farm Hours Equations, Random Effects Estimates

Explanatory Variables	Women 20-50	Men 20-50	Women 15-19	Men 15-19	Children 7-14	Adults 51-65
Age	0.311	-0.478	3.118	9.430**	4.013***	-0.052
	(0.243)	(0.355)	(3.951)	(4.466)	(0.703)	(2.903)
Age squared	-0.002	0.007	-0.064	-0.267*	-0.146***	0.001
	(0.004)	(0.005)	(0.122)	(0.137)	(0.034)	(0.025)
Female	-	-	-	-	-1.133***	1.346
	-	-	-	-	(0.312)	(1.841)
Child of head	-	-	-2.059	-0.912	-0.828	-
	-	-	(1.663)	(2.237)	(0.664)	-
Mother's years of schooling	-		-0.114	-0.025	0.160**	-
	-	-	(0.143)	(0.210)	(0.064)	-
Father's years of schooling	-	-	-0.084	0.308	-0.126*	-
	-	-	(0.1430	(0.202)	(0.069)	-
Mother deceased	-	-	1.715	-0.807	-0.412	-
	-	-	(1.068)	(1.431)	(0.537)	-
Father deceased	-	-	-2.143*	-0.640	-0.931*	-
	-	-	(1.177)	(1.661)	(0.529)	-
Both parents deceased	-	-	2.334	-0.624	1.140	-
	-	-	(1.870)	(2.590)	(0.881)	-
No parent in household	-	-	-2.632	0.526	-0.271	-
	-	-	(1.675)	(2.268)	(0.720)	-
Schooling: 1-6 years	-0.294	-2.925*	-	-	-	-1.075
	(0.800)	(1.704)	-	-	-	(1.351)
Schooling: 7 years	0.333	-3.474*	-	-	-	-1.947
	(0.873)	(1.911)	-	-	-	(2.509)
Schooling: 8+ years	-1.401	-8.495***	-	-	-	-2.243
	(1.568)	(2.514)	-	-	-	(3.653)
Head of household	1.606	1.007	-	-	-	2.732
	(1.242)	(1.479)	-	-	-	(1.670)
Acres of land	0.209*	-0.098	0.473***	0.357**	0.202***	0.444**
	(0.113)	(0.176)	(0.169)	(0.169)	(0.065)	(0.184)
Acres of land squared	-0.005	0.009	-0.017***	-0.001	-0.001	-0.008
	(0.004)	(0.009)	(0.006)	(0.005)	(0.002)	(0.005)
Age of household head	-0.088	0.113	-0.094	0.126	0.033	-0.355
	(0.106)	(0.143)	(0.141)	(0.208)	(0.038)	(0.239)
Age of household head squared	0.001	-0.001	0.0005	-0.001	-0.001	0.004
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
Years of schooling of head	-0.062	-0.014	0.002	-0.112	-0.047	0.265
	(0.113)	(0.197)	(0.170)	(0.242)	(0.083)	(0.293)
Female household head	-3.210***	0.663	1.102	-2.251	0.498	-0.560
	(1.024)	(1.436)	(1.195)	(1.739)	(0.539)	(1.879)
Past/future interview dummies	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes
P-value for joint significance:						
Individual characteristics	0.000	0.012	0.000	0.121	0.000	0.830
Household characteristics	0.008	0.714	0.053	0.019	0.000	0.053
Month and year dummies	0.015	0.013	0.500	0.206	0.108	0.826
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.000
Sample Size	2596	1894	1254	1204	3912	1393

Notes: This table shows the estimates omitted from the output presented in Table A3.3. Standard errors are in parentheses. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

APPENDIX 4

APPENDIX 4

Table A4.1: Impact of Adult Household Member Deaths (15-50) on House Hours, Random Effects Estimates

Explanatory Variables	Women 20-50	Men 20-50	Women 15-19	Men 15-19	Children 7-14	Adults 51-65
Female death past 0-12 months	-0.973	1.966*	-0.139	-1.781	-0.579	0.272
	(1.425)	(1.105)	(1.430)	(1.386)	(0.741)	(1.534)
Female death future 0-12 months	-3.766*	0.749	-0.688	-0.604	0.203	-1.621
	(2.042)	(1.368)	(2.123)	(1.585)	(0.965)	(2.387)
Male death past 0-12 months	-0.447	-0.208	0.759	-0.853	-1.164	-0.205
	(1.636)	(1.336)	(2.009)	(1.536)	(0.913)	(1.714)
Male death future 0-12 months	0.016	5.061**	-0.499	1.711	1.139	0.140
	(2.278)	(2.004)	(2.689)	(2.093)	(1.129)	(2.356)
R^2	0.126	0.181	0.287	0.234	0.123	0.201
Breusch-Pagan test $\chi^2(1)$	100.81	75.45	33.75	6.83	173.32	92.72
p-value	0.000	0.000	0.000	0.009	0.000	0.000
Hausman test χ^2	99.60	255.34	1051.18	106.85	954.26	42.70
p-value	1.000	0.000	0.000	1.000	0.000	1.000
Household-member death variables:						
Hausman test χ^2	13.653	6.687	7.484	3.212	2.006	6.608
p-value	0.008	0.153	0.112	0.523	0.735	0.158
P-value for joint significance:						
Female death past & future	0.124	0.199	0.946	0.399	0.700	0.764
Male death past & future	0.466	0.033	0.903	0.600	0.204	0.989
Sample Size	2596	1894	1254	1204	3912	1393

Notes: Standard errors are in parentheses. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Table A4.2 for additional regressors included but not reported here.

Table A4.2: House Hours Equations, Random Effects Estimates

Explanatory Variables	Women 20-50	Men 20-50	Women 15-19	Men 15-19	Children 7-14	Adults 51-65
Age	0.706**	-0.435*	2.919	8.712**	3.971***	-2.877
	(0.284)	(0.228)	(4.076)	(3.554)	(0.769)	(2.438)
Age squared	-0.013***	0.004	-0.078	-0.279**	-0.133***	0.022
	(0.004)	(0.003)	(0.126)	(0.109)	(0.037)	(0.021)
Female	-	-	-	-	2.582***	10.586***
	-	-	-	-	(0.359)	(1.551)
Child of head	-	-	-0.183	-0.569	-0.234	-
	-	-	(1.762)	(1.548)	(0.744)	-
Mother's years of schooling	-	-	-0.019	-0.228*	-0.024	-
	-	-	(0.152)	(0.136)	(0.074)	-
Father's years of schooling	-	-	-0.207	0.054	-0.047	-
	-	-	(0.151)	(0.132)	(0.079)	-
Mother deceased	-	-	1.243	0.319	0.566	-
	-	-	(1.130)	(0.938)	(0.611)	-
Father deceased	-	-	-3.063**	-1.277	-1.130*	-
	-	-	(1.248)	(1.106)	(0.600)	-
Both parents deceased	-	-	-0.259	1.942	-0.240	-
	-	-	(1.975)	(1.756)	(0.994)	-
No parent in household	-	-	0.236	0.912	1.247	-
	-	-	(1.774)	(1.596)	(0.804)	-
Schooling: 1-6 years	-0.649	-0.356	-	-	-	-2.408**
	(0.939)	(1.085)	-	-	-	(1.145)
Schooling: 7 years	-0.474	-1.147	-	-	-	-2.793
	(1.022)	(1.223)	-	-	-	(2.125)
Schooling: 8+ years	-2.114	-1.605	-	-	-	-4.134
	(1.832)	(1.618)	-	-	-	(3.092)
Head of household	1.863	1.925**	-	-	-	-0.052
	(1.443)	(0.961)	-	-	-	(1.404)
Acres of land	-0.279**	-0.183	0.299*	-0.264**	-0.028	-0.228
	(0.128)	(0.119)	(0.174)	(0.131)	(0.071)	(0.150)
Acres of land squared	0.004	0.010	-0.013**	0.005	0.001	0.007
	(0.004)	(0.006)	(0.006)	(0.004)	(0.002)	(0.004)
Age of household head	-0.115	0.051	-0.303**	-0.022	-0.056	0.049
	(0.123)	(0.093)	(0.149)	(0.139)	(0.077)	(0.201)
Age of household head squared	0.001	-0.0002	0.002	-0.0003	0.0003	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Years of schooling of head	-0.093	-0.279**	-0.207	-0.223	0.032	0.112
	(0.132)	(0.127)	(0.180)	(0.164)	(0.094)	(0.248)
Female household head	-2.989**	-1.750*	1.714	0.741	1.151**	0.216
	(1.190)	(0.927)	(1.263)	(1.179)	(0.608)	(1.580)
Past/future interview dummies	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes
P-value for joint significance:						
Individual characteristics	0.004	0.016	0.061	0.023	0.000	0.000
Household characteristics	0.017	0.018	0.023	0.041	0.176	0.000
Month and year dummies	0.020	0.019	0.002	0.001	0.006	0.002
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.031
Sample Size	2596	1894	1254	1204	3912	1393

Notes: This table shows the estimates omitted from the output presented in Table A4.1. Standard errors are in parentheses. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

Table A4.3: Impact of Adult Household Member Deaths (15-50) on House Hours, Random Effects Estimates

Explanatory Variables	Women 20-50	Men 20-50	Women 15-19	Men 15-19	Children 7-14	Adults 51-65
Female death past 0-6 months	-1.456	2.202	-1.121	-2.033	-0.494	-1.332
	(1.730)	(1.355)	(1.822)	(1.624)	(0.882)	(1.340)
Female death past 7-12 months	-0.425	1.613	1.221	-1.416	-0.809	2.260
	(2.201)	(1.677)	(2.094)	(2.312)	(1.122)	(2.111)
Female death future 0-6 months	-2.205	0.581	-1.088	0.123	0.517	-2.635
	(2.376)	(1.658)	(2.642)	(1.973)	(1.133)	(2.994)
Female death future 7-12 months	-5.547*	1.045	-0.423	-1.269	-0.425	-1.418
	(3.202)	(2.112)	(3.315)	(2.325)	(1.515)	(3.484)
Male death past 0-6 months	0.714	-0.541	0.525	-2.385	-0.663	-0.857
	(2.010)	(1.597)	(2.510)	(1.899)	(1.119)	(2.112)
Male death past 7-12 months	-1.728	0.134	0.967	1.881	-1.847	0.414
	(2.469)	(1.974)	(2.904)	(2.393)	(1.328)	(2.434)
Male death future 0-6 months	1.864	2.174	-1.773	1.507	1.551	-3.177
	(2.662)	(2.406)	(2.910)	(2.531)	(1.336)	(2.787)
Male death future 7-12 months	-4.132	10.067***	5.174	1.019	0.552	6.227*
	(3.942)	(3.110)	(5.975)	(3.599)	(1.797)	(3.684)
R^2	0.128	0.183	0.290	0.238	0.123	0.209
Breusch-Pagan test $\chi^2(1)$	101.95	75.72	34.31	7.19	172.69	94.93
p-value	0.000	0.000	0.000	0.007	0.000	0.000
Hausman test χ^2	415.49	65.08	1273.81	7422.35	404.55	34.58
p-value	0.000	1.000	0.000	0.000	0.000	1.000
Household-member death variables:						
Hausman test χ^2	22.272	19.029	30.447	16.537	8.477	10.373
p-value	0.004	0.015	0.000	0.035	0.388	0.240
P-value for joint significance:						
Female death past	0.698	0.193	0.676	0.393	0.695	0.389
Female death future	0.151	0.846	0.914	0.860	0.848	0.643
Female death past & future	0.371	0.495	0.915	0.707	0.892	0.601
Male death past	0.712	0.937	0.933	0.305	0.352	0.896
Male death future	0.426	0.005	0.546	0.809	0.503	0.094
Male death past & future	0.662	0.023	0.846	0.547	0.405	0.287
Sample Size	2596	1894	1254	1204	3912	1393

Notes: Standard errors are in parentheses. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Table A4.4 for additional regressors included but not reported here.

Table A4.4: House Hours Equations, Random Effects Estimates

Explanatory Variables	Women 20-50	Men 20-50	Women 15-19	Men 15-19	Children 7-14	Adults 51-65
Age	0.700**	-0.430*	3.032	8.774**	3.979***	-2.978
	(0.283)	(0.226)	(4.081)	(3.562)	(0.770)	(2.442)
Age squared	-0.013***	0.004	-0.082	-0.280**	-0.133***	0.022
	(0.004)	(0.003)	(0.126)	(0.110)	(0.037)	(0.021)
Female	-	-	-	-	2.578***	10.721***
	-	-	-	-	(0.359)	(1.555)
Child of head	-	-	-0.132	-0.463	-0.236	-
	-	-	(1.755)	(1.558)	(0.744)	-
Mother's years of schooling	-	-	-0.014	-0.226*	-0.023	-
	-	-	(0.151)	(0.137)	(0.074)	-
Father's years of schooling	-	-	-0.212	0.052	-0.048	-
	-	-	(0.151)	(0.133)	(0.079)	-
Mother deceased	-	-	1.267	0.347	0.561	-
	-	-	(1.126)	(0.945)	(0.611)	-
Father deceased	-	-	-3.026**	-1.311	-1.134*	-
	-	-	(1.244)	(1.113)	(0.600)	-
Both parents deceased	-	-	-0.261	1.898	-0.212	-
	-	-	(1.969)	(1.766)	(0.995)	-
No parent in household	-	-	0.278	0.988	1.233	-
	-	-	(1.767)	(1.605)	(0.805)	-
Schooling: 1-6 years	-0.656	-0.357	-	-	-	-2.448**
	(0.935)	(1.078)	-	-	-	(1.148)
Schooling: 7 years	-0.492	-1.189	-	-	-	-2.766
	(1.019)	(1.215)	-	-	-	(2.131)
Schooling: 8+ years	-2.103	-1.673	-	-	-	-3.988
	(1.826)	(1.608)	-	-	-	(3.099)
Head of household	1.920	1.941**	-	-	-	0.110
	(1.439)	(0.956)	-	-	-	(1.408)
Acres of land	-0.278**	-0.179	0.302*	-0.277**	-0.027	-0.225
	(0.128)	(0.119)	(0.175)	(0.132)	(0.071)	(0.150)
Acres of land squared	0.004	0.009	-0.013**	0.005	0.001	0.007
	(0.004)	(0.006)	(0.006)	(0.004)	(0.002)	(0.004)
Age of household head	-0.114	0.056	-0.301**	-0.034	-0.055	0.031
	(0.122)	(0.093)	(0.148)	(0.141)	(0.077)	(0.202)
Age of household head squared	0.001	-0.0003	0.002	-0.0002	0.0004	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Years of schooling of head	-0.093	-0.274**	-0.193	-0.224	0.035	0.120
	(0.132)	(0.126)	(0.180)	(0.165)	(0.094)	(0.248)
Female household head	-3.024**	-1.730*	1.736	0.814	1.531**	0.063
	(1.188)	(0.922)	(1.260)	(1.188)	(0.609)	(1.585)
Past/future interview dummies	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes
P-value for joint significance:						
Individual characteristics	0.004	0.014	0.063	0.024	0.000	0.000
Household characteristics	0.016	0.020	0.023	0.032	0.171	0.000
Month and year dummies	0.017	0.022	0.002	0.001	0.005	0.002
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.020
Sample Size	2596	1894	1254	1204	3912	1393

Notes: This table shows the estimates omitted from the output presented in Table A4.3. Standard errors are in parentheses. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

APPENDIX 5

APPENDIX 5

Table A5.1a: Impact of Adult Household Member Deaths (15-50) on Hours,
Sample of Households Below Median Expenditure per Capita

	Women 20-50				Men 20-50			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Female death past 0-12 months	2.297	-0.585	3.965	0.730	2.235	0.353	2.696	-1.861
	(2.455)	(3.073)	(3.566)	(3.461)	(3.163)	(3.944)	(1.790)	(2.495)
Female death future 0-12 months	1.073	-6.573	10.644***	1.754	1.974	-8.096*	-3.384	-5.272*
	(3.901)	(3.928)	(3.681)	(4.425)	(4.774)	(4.692)	(2.440)	(2.968)
Male death past 0-12 months	1.255	2.695	3.591	-6.305	1.021	-1.399	-1.869	-5.614*
	(3.345)	(4.165)	(2.257)	(4.692)	(2.409)	(5.252)	(1.257)	(3.322)
Male death future 0-12 months	6.939	11.526**	0.160	-6.079	-3.161	-0.995	2.478	2.317
	(4.874)	(5.407)	(3.786)	(6.091)	(6.054)	(6.531)	(2.525)	(4.131)
R^2	0.347	0.315	0.200	0.199	0.299	0.339	0.270	0.313
P-value for joint significance:								
Female death past & future	0.612	0.185	0.001	0.924	0.630	0.082	0.226	0.190
Male death past & future	0.178	0.093	0.274	0.377	0.836	0.965	0.224	0.022
Sample Size	954	1343	954	1343	714	1009	714	1009

Notes: Standard errors are in parentheses and, for the OLS estimates, have been corrected for clustering at the individual level. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Table A5.2a for additional regressors included but not reported here.

Table A5.1b: Impact of Adult Household Member Deaths (15-50) on Hours,
Sample of Households Below Median Expenditure per Capita

	Women 15-19				Men 15-19			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Female death past 0-12 months	2.458	4.680	-1.088	1.650	-0.246	4.093	1.460	-3.107
	(2.451)	(3.464)	(3.431)	(3.371)	(2.733)	(4.296)	(1.923)	(3.884)
Female death future 0-12 months	0.833	-0.503	-2.521	5.896	6.917	-1.115	-0.580	-2.793
	(3.295)	(4.713)	(5.360)	(4.587)	(5.493)	(4.503)	(2.874)	(4.071)
Male death past 0-12 months	-1.300	-9.509	0.636	2.581	-0.340	-6.159	0.810	-1.204
	(2.811)	(6.094)	(3.016)	(5.931)	(3.423)	(4.733)	(2.813)	(4.279)
Male death future 0-12 months	0.569	-7.704	-11.641**	0.374	2.413	0.982	1.289	0.341
	(3.613)	(7.803)	(5.672)	(7.594)	(5.204)	(6.711)	(2.635)	(6.068)
R^2	0.432	0.459	0.377	0.428	0.270	0.314	0.256	0.296
P-value for joint significance:								
Female death past & future	0.565	0.263	0.741	0.431	0.454	0.424	0.745	0.694
Male death past & future	0.856	0.296	0.107	0.861	0.893	0.261	0.724	0.933
Sample Size	515	739	515	739	519	724	519	724

Notes: See notes for Table A5.1a.

Table A5.1c: Impact of Adult Household Member Deaths (15-50) on Hours,
Sample of Households Below Median Expenditure per Capita

	Children 7-14				Adults 51-65			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Female death past 0-12 months	-0.041	-0.894	-2.490*	-0.487	-0.509	-1.885	4.267*	-4.309
	(0.816)	(1.469)	(1.280)	(1.528)	(3.418)	(4.164)	(2.579)	(3.569)
Female death future 0-12 months	1.001	-0.405	0.619	-0.169	2.244	-3.521	-8.372	-4.784
	(2.051)	(1.877)	(2.297)	(1.953)	(7.638)	(5.954)	(7.469)	(5.102)
Male death past 0-12 months	-1.260	-3.806	-2.062	-4.106**	-1.788	0.332	1.724	3.216
	(0.864)	(1.816)	(1.449)	(1.889)	(2.497)	(5.345)	(3.112)	(4.581)
Male death future 0-12 months	-1.923	-0.860	1.435	-0.532	3.247	-1.612	-2.562	0.556
	(1.820)	(2.395)	(2.746)	(2.491)	(5.209)	(6.315)	(8.806)	(5.412)
R^2	0.160	0.204	0.184	0.227	0.290	0.307	0.307	0.331
P-value for joint significance:								
Female death past & future	0.884	0.829	0.146	0.949	0.953	0.823	0.143	0.441
Male death past & future	0.201	0.077	0.364	0.052	0.653	0.935	0.848	0.725
Sample Size	1606	2260	1606	2260	538	729	538	729

Notes: See notes for Table A5.1a.

Table A5.2a: Hours Equations, Sample of Households Below Median Expenditure per Capita

	Women 20-50				Men 20-50			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Age	-	1.474	-	-0.561	-	-0.296	-	0.310
	-	(2.118)	-	(2.386)	-	(2.608)	-	(1.650)
Age squared	-	-0.035	-	-0.018	-	0.038	-	-0.009
	-	(0.026)	-	(0.029)	-	(0.032)	-	(0.020)
Head of household	-	3.226	-	2.013	-	-16.860	-	58.023***
	-	(5.703)	-	(6.425)	-	(30.626)	-	(19.374)
Acres of land	-	-0.131	-	0.091	-	0.042	-	-0.069
	-	(0.275)	-	(0.310)	-	(0.417)	-	(0.264)
Acres of land squared	-	-0.001	-	-0.011	-	-0.004	-	0.001
	-	(0.012)	-	(0.014)	-	(0.025)	-	(0.016)
Age of household head	-	-0.625	-	-0.163	-	0.071	-	2.927**
	-	(0.593)	-	(0.668)	-	(2.290)	-	(1.448)
Age of household head squared	-	0.008	-	0.002	-	-0.008	-	-0.018*
	-	(0.006)	-	(0.007)	-	(0.016)	-	(0.010)
Years of schooling of head	-	0.648	-	0.610	-	-2.451	-	-0.831
	-	(0.874)	-	(0.984)	-	(3.065)	-	(1.939)
Female household head	-	2.409	-	-2.954	-	21.685	-	4.982
	-	(6.456)	-	(7.273)	-	(21.512)	-	(13.609)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.512	-	0.685	-	0.451	-	0.023
Household characteristics	-	0.609	-	0.926	-	0.005	-	0.002
Month and year dummies	0.000	0.002	0.000	0.299	0.000	0.273	0.000	0.858
Village * wave dummies	0.000	0.000	0.000	0.094	0.000	0.002	0.000	0.030
Sample Size	954	1343	954	1343	714	1009	714	1009

Notes: This table shows the estimates omitted from the output presented in Table A5.1a. Standard errors are in parentheses and, for the OLS estimates, have been corrected for clustering at the individual level. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

Table A5.2b: Hours Equations, Sample of Households Below Median Expenditure per Capita

	Women 15-19				Men 15-19			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Age	-	7.582	-	11.251	-	11.671	-	7.035
	-	(7.347)	-	(7.151)	-	7.347	-	(6.642)
Age squared	-	-0.213	-	-0.302	-	-0.364	-	-0.251
	-	(0.228)	-	(0.222)	-	0.228	-	(0.201)
Child of head	-	-0.633	-	5.331	-	-5.063	-	-2.353
	-	(9.713)	-	(9.454)	-	5.605	-	(6.896)
Mother deceased	-	-0.684	-	4.004	-	1.652	-	-6.081
	-	(5.516)	-	(5.369)	-	12.280	-	(5.068)
Father deceased	-	-9.304	-	-5.244	-	0.023	-	6.851
	-	(10.057)	-	(9.788)	-	10.803	-	(11.102)
Both parents deceased	-	7.467	-	9.262	-	0.578	-	5.513
	-	(9.707)	-	(9.447)	-	6.665	-	(9.767)
No parent in household	-	1.884	-	8.144	-	0.578	-	5.225
	-	(9.865)	-	(9.601)	-	6.665	-	(6.026)
Acres of land	-	0.322	-	0.169	-	-1.148	-	0.279
	-	(0.405)	-	(0.394)	-	0.595	-	(0.538)
Acres of land squared	-	-0.030	-	0.006	-	0.111	-	-0.015
	-	(0.022)	-	(0.022)	-	0.045	-	(0.040)
Age of household head	-	0.754	-	-0.276	-	1.082	-	0.403
	-	(0.890)	-	(0.866)	-	0.991	-	(0.896)
Age of household head squared	-	-0.007	-	-0.001	-	-0.011	-	-0.002
	-	(0.010)	-	(0.010)	-	0.011	-	(0.010)
Years of schooling of head	-	0.360	-	-1.298	-	-0.700	-	-0.130
	-	(1.305)	-	(1.271)	-	1.001	-	(0.913)
Female household head	-	-4.175	-	-2.169	-	-2.525	-	-6.038
	-	(8.097)	-	(7.880)	-	10.006	-	(9.046)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.930	-	0.485	-	0.784	-	0.554
Household characteristics	-	0.743	-	0.451	-	0.192	-	0.943
Month and year dummies	0.000	0.941	0.000	0.000	0.000	0.145	0.000	0.691
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.345	0.000	0.596
Sample Size	515	739	515	739	519	724	519	724

Notes: See notes for Table A5.2a.

Table A5.2c Hours Equations, Sample of Households Below Median Expenditure per Capita

	Children 7-14				Adults 51-65			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Age	-	5.307***	-	4.147***	-	9.221	-	6.597
	-	(1.452)	-	(1.511)	-	(10.875)	-	(9.320)
Age squared	-	-0.269***	-	-0.202***	-	-0.104	-	-0.047
	-	(0.063)	-	(0.066)	-	(0.093)	-	(0.080)
Child of head	-	-1.007	-	0.955	-	-	-	-
	-	(2.247)	-	(2.337)	-	-	-	-
Mother deceased	-	-3.634	-	-1.206	-	-	-	-
	-	(2.586)	-	(2.690)	-	-	-	-
Father deceased	-	-0.205	-	1.121	-	-	-	-
	-	(2.525)	-	(2.626)	-	-	-	-
Both parents deceased	-	7.494**	-	-2.838	-	-	-	-
	-	(3.630)	-	(3.776)	-	-	-	-
No parent in household	-	-4.333**	-	4.174*	-	-	-	-
	-	(2.202)	-	(2.290)	-	-	-	-
Head of household	-	-	-	-	-	-0.333	-	-0.542
	-	-	-	-	-	(10.730)	-	(9.195)
Acres of land	-	0.124	-	0.244	-	-0.033	-	0.038
	-	(0.175)	-	(0.182)	-	(0.418)	-	(0.358)
Acres of land squared	-	-0.005	-	-0.009	-	0.013	-	-0.019
	-	(0.010)	-	(0.010)	-	(0.020)	-	(0.017)
Age of household head	-	0.059	-	0.118	-	0.351	-	-1.673
	-	(0.348)	-	(0.362)	-	(1.500)	-	(1.285)
Age of household head squared	-	0.000	-	-0.001	-	-0.001	-	0.020
	-	(0.003)	-	(0.003)	-	(0.015)	-	(0.013)
Years of schooling of head	-	0.566	-	0.582	-	2.864	-	-2.523
	-	(0.379)	-	(0.395)	-	(2.177)	-	(1.867)
Female household head	-	2.715	-	-3.185	-	12.783	-	1.934
	-	(2.512)	-	(2.613)	-	(13.966)	-	(11.968)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.001	-	0.054	-	0.462	-	0.872
Household characteristics	-	0.790	-	0.122	-	0.752	-	0.010
Month and year dummies	0.000	0.116	0.000	0.001	0.000	0.412	0.000	0.364
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.300	0.000	0.274
Sample Size	1606	2260	1606	2260	538	729	538	729

Notes: See notes for Table A5.2a

APPENDIX 6

APPENDIX 6

Table A6.1a: Impact of Adult Household Member Deaths (15-50) on Hours, Sample of Households Above Median Expenditure per Capita

	Women 20-50				Men 20-50			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Female death past 0-12 months	0.752	-0.486	4.712	5.626*	0.552	0.487	-1.839	3.727
	(1.672)	(2.738)	(3.678)	(2.969)	(3.289)	(3.206)	(1.692)	(2.539)
Female death future 0-12 months	1.029	2.528	2.714	-1.782	2.627	3.861	1.846	4.996*
	(3.088)	(3.584)	(4.584)	(3.888)	(2.462)	(3.740)	(2.988)	(2.962)
Male death past 0-12 months	-6.553***	-4.900*	-2.436	0.611	0.626	1.806	-0.147	-1.375
	(2.215)	(2.757)	(3.359)	(2.990)	(6.141)	(4.080)	(2.595)	(3.231)
Male death future 0-12 months	2.687	-0.414	-6.902**	-3.159	5.311**	1.433	-0.887	4.793
	(2.876)	(3.542)	(3.090)	(3.842)	(2.540)	(5.402)	(3.222)	(4.278)
R^2	0.244	0.295	0.222	0.242	0.360	0.413	0.304	0.371
P-value for joint significance:								
Female death past & future	0.858	0.686	0.404	0.068	0.564	0.544	0.509	0.184
Male death past & future	0.008	0.159	0.043	0.587	0.088	0.904	0.963	0.319
Sample Size	897	1253	897	1253	630	885	630	885

Notes: Standard errors are in parentheses and, for the OLS estimates, have been corrected for clustering at the individual level. * indicates statistical significance at 10%; ** at 5%; and *** at 1%. See Table A6.2a for additional regressors included but not reported here.

Table A6.1b: Impact of Adult Household Member Deaths (15-50) on Hours,
Sample of Households Above Median Expenditure per Capita

	Women 15-19				Men 15-19			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Female death past 0-12 months	2.308	-8.134**	2.528	-10.328***	-3.960	2.273	-1.422	0.655
	(3.731)	(3.279)	(4.147)	(3.337)	(2.604)	(3.881)	(2.534)	(3.557)
Female death future 0-12 months	-1.112	-8.467*	-8.721*	-8.630*	-4.888	4.410	-1.858	0.935
	(4.104)	(5.101)	(4.898)	(5.191)	(4.570)	(4.420)	(3.960)	(4.052)
Male death past 0-12 months	-2.020	-3.587	-0.355	-0.353	-1.018	3.867	1.529	-1.822
	(3.499)	(5.234)	(3.525)	(5.327)	(4.465)	(3.903)	(4.007)	(3.578)
Male death future 0-12 months	-0.494	-1.726	-3.671	0.524	6.074	6.365	2.616	1.975
	(4.517)	(6.383)	(5.333)	(6.496)	(4.421)	(4.675)	(3.689)	(4.286)
R^2	0.475	0.570	0.512	0.562	0.494	0.590	0.398	0.497
P-value for joint significance:								
Female death past & future	0.806	0.042	0.142	0.009	0.192	0.588	0.688	0.968
Male death past & future	0.836	0.771	0.767	0.985	0.332	0.371	0.697	0.632
Sample Size	359	515	359	515	335	480	335	480

Notes: See notes for Table A6.1a.

Table A6.1c: Impact of Adult Household Member Deaths (15-50) on Hours,
Sample of Households Above Median Expenditure per Capita

	Children 7-14				Adults 51-65			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Female death past 0-12 months	0.143	-1.299	-0.359	-0.929	0.424	4.929	4.852	-2.534
	(1.320)	(1.606)	(1.475)	(1.692)	(3.239)	(4.162)	(3.285)	(3.186)
Female death future 0-12 months	5.212**	-1.154	2.239	3.628	8.330	8.074	6.921	-6.357
	(2.071)	(2.199)	(1.585)	(2.317)	(5.452)	(6.315)	(5.238)	(4.834)
Male death past 0-12 months	-3.956**	-1.890	1.122	2.363	1.202	-0.959	5.295*	-0.149
	(1.629)	(2.136)	(2.013)	(2.250)	(2.999)	(3.745)	(2.877)	(2.868)
Male death future 0-12 months	4.201	4.205*	1.306	0.162	-0.455	5.274	-4.289	-0.287
	(2.174)	(2.411)	(2.197)	(2.540)	(3.632)	(5.641)	(4.489)	(4.318)
R^2	0.292	0.333	0.194	0.226	0.441	0.456	0.332	0.368
P-value for joint significance:								
Female death past & future	0.009	0.707	0.369	0.120	0.218	0.354	0.152	0.413
Male death past & future	0.031	0.024	0.480	0.489	0.918	0.504	0.127	0.997
Sample Size	1170	1652	1170	1652	488	664	488	664

Notes: See notes for Table A6.1a.

Table A6.2a: Hours Equations, Sample of Households Above Median Expenditure per Capita

	Women 20-50				Men 20-50			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Age	-	2.245	-	1.860	-	-0.064	-	0.963
	-	(2.363)	-	(2.563)	-	(2.637)	-	(2.089)
Age squared	-	-0.051*	-	-0.013	-	0.019	-	-0.022
	-	(0.031)	-	(0.034)	-	(0.035)	-	(0.028)
Head of household	-	1.125	-	-10.488	-	-7.251	-	6.916*
	-	(7.074)	-	(7.672)	-	(4.927)	-	(3.902)
Acres of land	-	0.375	-	-0.201	-	-0.606*	-	-0.451*
	-	(0.257)	-	(0.279)	-	(0.346)	-	(0.274)
Acres of land squared	-	-0.007	-	0.005	-	0.018	-	0.013
	-	(0.006)	-	(0.007)	-	(0.013)	-	(0.010)
Age of household head	-	0.308	-	1.217**	-	-0.531	-	-0.184
	-	(0.547)	-	(0.593)	-	(0.469)	-	(0.372)
Age of household head squared	-	-0.004	-	-0.010	-	0.004	-	0.001
	-	(0.006)	-	(0.006)	-	(0.005)	-	(0.004)
Years of schooling of head	-	-0.976	-	0.354	-	0.493	-	-0.128
	-	(0.887)	-	(0.962)	-	(0.801)	-	(0.634)
Female household head	-	-0.341	-	10.025	-	0.513	-	4.697
	-	(6.296)	-	(6.829)	-	(5.580)	-	(4.419)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.387	-	0.504	-	0.410	-	0.260
Household characteristics	-	0.679	-	0.019	-	0.286	-	0.643
Month and year dummies	0.000	0.346	0.289	0.080	0.000	0.007	0.000	0.036
Village * wave dummies	0.000	0.044	0.000	0.022	0.000	0.000	0.000	0.008
Sample Size	897	1253	897	1253	630	885	630	885

Notes: This table shows the estimates omitted from the output presented in Table A6.1a. Standard errors are in parentheses and, for the OLS estimates, have been corrected for clustering at the individual level. * indicates statistical significance at 10%; ** at 5%; and *** at 1%.

Table A6.2b: Hours Equations, Sample of Households Above Median Expenditure per Capita

	Women 15-19				Men 15-19			
	Farm		House		Farm		House	
	Δ hours	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*	*Δ hours*	*hours*
Explanatory Variables	OLS	F.E.	OLS	F.E.	OLS	F.E.	OLS	F.E.
Age	-	-8.184	-	6.678	-	7.956	-	22.804***
	-	(8.579)	-	(8.731)	-	(9.611)	-	(8.811)
Age squared	-	0.200	-	-0.216	-	-0.331	-	-0.597**
	-	(0.264)	-	(0.269)	-	(0.292)	-	(0.268)
Child of head	-	-21.020**	-	6.478	-	57.352	-	37.809
	-	(8.558)	-	(8.709)	-	(41.847)	-	(38.362)
Mother deceased	-	2.669	-	14.196*	-	-9.561	-	5.650
	-	(7.131)	-	(7.258)	-	(17.143)	-	(15.715)
Father deceased	-	-5.546	-	13.918	-	8.734	-	13.343
	-	(9.130)	-	(9.291)	-	(12.970)	-	(11.889)
Both parents deceased	-	-1.327	-	-20.710**	-	-4.207	-	-7.426
	-	(8.499)	-	(8.650)	-	(15.371)	-	(14.091)
No parent in household	-	-17.296*	-	18.638*	-	6.161	-	-2.993
	-	(9.969)	-	(10.145)	-	(7.884)	-	(7.227)
Acres of land	-	0.484	-	-0.258	-	0.358	-	-0.158
	-	(0.414)	-	(0.422)	-	(0.397)	-	(0.364)
Acres of land squared	-	-0.016	-	0.002	-	-0.001	-	0.005
	-	(0.010)	-	(0.011)	-	(0.008)	-	(0.007)
Age of household head	-	0.934	-	1.276	-	-5.502	-	-1.982
	-	(0.890)	-	(0.906)	-	(2.682)	-	(2.459)
Age of household head squared	-	-0.010	-	-0.013	-	0.050	-	0.016
	-	(0.009)	-	(0.009)	-	(0.026)	-	(0.024)
Years of schooling of head	-	-0.497	-	-2.560**	-	-0.180	-	-0.049
	-	(1.189)	-	(1.210)	-	(2.474)	-	(2.268)
Female household head	-	10.097	-	-10.681	-	-3.472	-	-3.084
	-	(8.043)	-	(8.185)	-	(11.309)	-	(10.367)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.255	-	0.131	-	0.287	-	0.094
Household characteristics	-	0.109	-	0.448	-	0.004	-	0.699
Month and year dummies	0.000	0.636	0.000	0.031	0.000	0.613	0.000	0.330
Village * wave dummies	0.000	0.022	0.000	0.001	0.000	0.000	0.000	0.368
Sample Size	359	515	359	515	335	480	335	480

Notes: See notes for Table A6.2a.

Table A6.2c Hours Equations, Sample of Households Above Median Expenditure per Capita

	Children 7-14				Adults 51-65			
	Farm		House		Farm		House	
Explanatory Variables	*Δ hours* OLS	*hours* F.E.	*Δ hours* OLS	*hours* F.E.	*Δ hours* OLS	*hours* F.E.	*Δ hours* OLS	*hours* F.E.
Age	-	6.354***	-	-0.022	-	3.058	-	-2.791
	-	(1.875)	-	(1.975)	-	(10.856)	-	(8.310)
Age squared	-	-0.275***	-	-0.057	-	-0.044	-	0.039
	-	(0.082)	-	(0.086)	-	(0.095)	-	(0.073)
Child of head	-	-9.490***	-	-5.370	-	-	-	-
	-	(3.270)	-	(3.445)	-	-	-	-
Mother deceased	-	4.591	-	3.946	-	-	-	-
	-	(3.399)	-	(3.581)	-	-	-	-
Father deceased	-	-3.206	-	-3.410	-	-	-	-
	-	(2.600)	-	(2.739)	-	-	-	-
Both parents deceased	-	-1.383	-	0.268	-	-	-	-
	-	(2.968)	-	(3.127)	-	-	-	-
No parent in household	-	-3.153	-	0.212	-	-	-	-
	-	(2.774)	-	(2.922)	-	-	-	-
Head of household	-	-	-	-	-	-16.132	-	-4.456
	-	-	-	-	-	(18.863)	-	(14.440)
Acres of land	-	0.353**	-	0.271	-	0.913*	-	0.021
	-	(0.164)	-	(0.173)	-	(0.469)	-	(0.359)
Acres of land squared	-	-0.006	-	-0.005	-	-0.016*	-	0.003
	-	(0.004)	-	(0.004)	-	(0.009)	-	(0.007)
Age of household head	-	-0.840*	-	0.180	-	-0.763	-	1.738
	-	(0.455)	-	(0.479)	-	(1.937)	-	(1.483)
Age of household head squared	-	0.010*	-	-0.0002	-	0.012	-	-0.010
	-	(0.005)	-	(0.005)	-	(0.021)	-	(0.016)
Years of schooling of head	-	1.384**	-	-0.991*	-	0.950	-	0.210
	-	(0.555)	-	(0.584)	-	(2.339)	-	(1.791)
Female household head	-	0.982	-	2.842	-	25.528	-	1.327
	-	(2.373)	-	(2.450)	-	(15.875)	-	(12.152)
Past/future interview dummies	yes	yes	yes	yes	yes	yes	yes	yes
Month and year dummies	yes	yes	yes	yes	yes	yes	yes	yes
Village * wave dummies	yes	yes	yes	yes	yes	yes	yes	yes
P-value for joint significance:								
Individual characteristics	-	0.004	-	0.219	-	0.743	-	0.797
Household characteristics	-	0.073	-	0.132	-	0.329	-	0.004
Month and year dummies	0.000	0.216	0.075	0.261	0.000	0.315	0.000	0.008
Village * wave dummies	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.226
Sample Size	1170	1652	1170	1652	488	664	488	664

Notes: See notes for Table A6.2a

LIST OF REFERENCES

LIST OF REFERENCES

Ainsworth, Martha, Susmita Ghosh and Innocent Semali. 1995. "The Impact of Adult Deaths on Household Composition in Kagera Region, Tanzania." draft, Policy Research Department, World Bank, Washington, D.C.

Ainsworth, Martha and Mead Over. 1994a. "AIDS and African Development." *World Bank Research Observer* 9(2): 203-240.

Ainsworth, Martha and Mead Over. 1994b. "The Economic Impact of AIDS in Africa." in M. Essex, S. Mboup, P. Kanki, M. Kalengayi, eds., *AIDS in Africa.* New York: Raven Press.

Ainsworth, Martha, Godlike Koda, George Lwihula, Phare Mujinja, Mead Over and Innocent Semali. 1992. "Measuring the Impact of fatal Adult Illness in Sub-Saharan Africa." Living Standards Measurement Study no. 90, World Bank, Washington, D.C.

Alderman, Harold and Christina Paxson. 1992. "Do the Poor Insure? A Synthesis of the Literature on Risk and Consumption in Developing Countries." WPS 1008, Agriculture and Rural Development Department, World Bank, Washington, D.C.

Barnett, Tony. 1994. *The Effects of HIV/AIDS on Farming Systems and Rural Livelihoods in Uganda, Tanzania and Zambia.* Final report to Food and Agricultural Organization. Norwich, UK: Overseas Development Group, University of East Anglia.

Barnett, Tony and Piers Blaikie. 1992. *AIDS in Africa: Its Present and Future Impact.* New York: Guilford Press.

Barnett, Tony, Joseph Tumushabe, Grace Bantebya, Ruth Ssebuliba, Juma Ngasongwa, David Kapinga, Monica Ndelike, Michael Drinkwater, Godfrey Mitti and Martina Haslwimmer. 1995. "Final Report: The Social and Economic Impact of HIV/AIDS on Farming Systems and Livelihoods in Rural Africa: Some Experience and Lessons from Uganda, Tanzania and Zambia." *Journal of International Development* 7(1): 163-176.

Becker, Gary. 1965. "A Theory of Time Allocation." *Economic Journal* 75: 496-517.

Bloom, David and Ajay Mahal. 1997. "Does the AIDS epidemic threaten economic growth?" *Journal of Econometrics* 77(1): 105-124.

Bongaarts, John. 1996. "Global Trends in AIDS Mortality." *Population and Development Review* 22(1): 21-45.

Brown, Lynn, Patrick Webb and Lawrence Haddad. 1994. "The Role of Labour in Household Food Security: Implications of AIDS in Africa." *Food Policy* 19(6): 568-573.

Chamberlain, Gary. 1980. "Analysis of Covariance with Qualitative Data." *Review of Economic Studies* 47(1): 225-238.

Cleave, John. 1974. *African farmers: Labor Use in the Development of Smallholder Agriculture*. New York: Praeger Publishers.

Cleveland, William. 1979. "Robust Locally Weighted Regression and Smoothing Scatterplots." *Journal of American Statistical Association* 74(368): 829-36.

Collier, Paul, Samuel Radwan and Samuel Wangwe. 1990. *Labour and Poverty in Rural Tanzania*. Oxford: Clarendon Press.

Cuddington, John. 1993a. "Modeling the Macroeconomic Effects of AIDS, with an Application to Tanzania." *World Bank Economic Review* 7(2): 173-189.

Cuddington, John. 1993b. "Further Results on the Macroeconomics Effects of AIDS: The Dualistic Labor Surplus Economy." *World Bank Economic Review* 7(3): 403-417.

Cuddington, John and John Hancock. 1994. "Assessing the Impact of AIDS on the Growth Path of the Malawian Economy." *Journal of Economic Development* 43(2): 363-368.

Deaton, Angus. 1997. *The Analysis of Household Surveys: Microeconometric Analysis for Development Policy*. Washington, D.C.: Johns Hopkins University Press.

Dercon, Stefan. 1996. "Risk, Crop Choice, and Savings: Evidence from Tanzania." *Economic Development and Cultural Change* 44(3): 485-513.

Evenson, Robert, Barry Popkin, and Elizabeth Quizon. 1980. "Nutrition, Work, and Demographic Behaviour in Rural Philippine Households." in H. Binswanger, R.E. Evenson, C.A. Florencio and B.N. White, eds., *Rural Households in Asia*. Singapore: Singapore University Press.

Fafchamps, Marcel. 1993. "Sequential Labor Market Decisions Under Uncertainly: An Estimable Household Model of West African Farmers." *Econometrica* 16(5): 1173-1197.

Gillespie, Stuart. 1989a. "Potential Impact of AIDS on farming systems." *Land Use Policy* 4: 301-312.

Gillespie, Stuart. 1989b. "The Potential Impact of AIDS on Food Production Systems in Central Africa." Food and Agriculture Organization, Rome, Italy.

Glomm, Gerhard and Michael Palumbo. 1993. "Optimal Intertemporal Consumption Decisions Under the Threat of Starvation." *Journal of Development Economics* 42(2): 271-291.

Greene, William. 1990. *Econometric Analysis*. New York: Macmillan Publishing Company.

Grossman, Michael. 1972. "On the Concept of Human Capital and the Demand for Health." *Journal of Political Economy* 80(2): 223-255.

Jacoby, Hanan. 1993. "Shadow Wages and Peasant Family Labor Supply: An Econometric Application to the Peruvian Sierra." *Review of Economic Studies* 60(4): 903-921.

Jacoby, Hanan and Emmanuel Skoufias. 1995. "Risk, Financial Markets, and Human Capital in a Developing Country." draft, Department of Economics, University of Rochester.

Juster, F. Thomas and Frank Stafford. 1991. "The Allocation of Time: Empirical Findings, Behavioral Models, and Problems of Measurement." *Journal of Economic Literature* 29(2): 471-522.

Kambou, Gerard, Shantayanan Devarajan, and Mead Over. 1992. "The Economic Impact of AIDS in an African Country with a Computable General Equilibrium Model of Cameroon." *Journal of African Economies* 1(1): 109-130.

Khandker, Shahidur. 1988. "Determinants of Women's Time Allocation in Rural Bangladesh." *Economic Development and Cultural Change* 37(1): 111-126.

Killewo, Japhet, Klinton Nyamuryekunge, Anita Sandstrom, Ulla Bredberg-Raden, Stig Wall, Fred Mhalu and Gunnel Biberfeld. 1990. "Prevalence of HIV-1 Infection in the Kagera Region of Tanzania: a Population-based Study." *AIDS* 4(11): 1081-1085.

Killewo, Japhet, L. Dahlgren and A. Sandstrom. 1994. "Socio-Geographical Patterns in HIV-1 Transmission in Kagera Region, Tanzania." *Social Science and Medicine* 38(10): 129-134.

Kochar, Anjini. 1995. "Explaining Household Vulnerability to Idiosyncratic Income Shocks." *American Economic Review Papers and Proceedings* 85(2): 159-164.

Kochar, Anjini. 1996. "Smoothing Consumption by Smoothing Income: Hours-of-Work Responses to Idiosyncratic Agricultural Shocks in Rural India." draft, Department of Economics, Stanford University.

Konde-Lule, J., R. Ssengonzir, R. McNamara, C. Li, M. Wawer, J. Edmundson, R. Kelly 1995. "HIV-Related Mortality and Household Economic Burden, Rakai, Uganda." IX International Conference on AIDS and STD in Africa, Kampala, Uganda.

Mukoyogo, Christian and Glen Williams. 1991. *AIDS Orphans: A Community Perspective From Tanzania*. London: ACTIONAID.

Mueller, Eva. 1984. "The Value and Allocation of Time in Rural Botswana." *Journal of Development Economics* 15(1-3): 329-360.

National Research Council. 1996. *Preventing and Mitigating AIDS in Sub-Saharan Africa*. Washington, D.C.: National Academy Press.

Newman, John and Paul Gertler. 1994. "Family Productivity, Labor Supply and Welfare in a Low Income Country." *Journal of Human Resources* 29(4):989-1027.

O'Dell, Michael, Helen Hubert, Deborah Lubeck, and Peter O'Driscoll. 1996. "Physical Disability in a Cohort of Persons with AIDS: Data from the AIDS Time-Oriented Health Outcome Study." *AIDS* 10(6): 667-673.

Over, Mead. 1992. "The Macroeconomic Impact of AIDS in Sub-Saharan Africa." African Technical Department, Technical Working Paper No. 3, World Bank, Washington, D.C.

Over, Mead and Daniel Dorsainvil. 1996. "The Impact of Adult Mortality on Income, Consumption and Assets," draft, Policy Research Department, World Bank, Washington, D.C.

Over, Mead and Peter Piot. 1993. "HIV Infection and Sexually Transmitted Diseases." in D. Jamison et al. *Disease Control Priorities in Developing Countries*. New York: Oxford University Press.

Philipson, Tomas and Richard Posner. 1995. "The Microeconomics of the AIDS epidemic in Africa." *Population and Development Review* 21(4): 835-848.

Pitt, Mark, Mark Rosenzweig and MD. Nazmul Hassan. 1990. "Productivity, Health, and Inequality in the Intrahousehold Distribution of Food in Low-Income Countries." *American Economic Review* 80(5): 1139-1156.

Pitt, Mark and Mark Rosenzweig. 1986. "Agricultural Prices, Food Consumption and the Health and Productivity of Farmers." in Inderjit Singh, Lynn Squire and John Strauss, eds., *Agricultural Household Models: Extensions and Applications*. Baltimore: Johns Hopkins Press.

Pitt, Mark and Mark Rosenzweig. 1990. "Estimating the Intrahousehold Incidence of Illness: Child Health and Gender-Inequality in the Allocation of Time." *International Economic Review* 31(4): 969-989.

Quisumbing, Agnes. 1996. "Modeling Household Behavior in Developing Countries: Discussion." *American Journal of Agricultural Economics* 78(5): 1346-1348.

Reardon, Thomas. 1997. "Using Evidence of Household Income Diversification to Inform Study of the Rural Nonfarm Labor Market in Africa." *World Development* 25(5): 735-747.

Rose, Elaina. 1995. "Ex Ante and Ex Post Labor Supply Responses to Risk in a Low-Income Area." draft, Department of Economics, University of Washington.

Rosenzweig, Mark. 1980. "Neoclassical Theory and the Optimizing Peasant: An Econometric Analysis of Market Family Labor Supply in a Developing Country." *Quarterly Journal of Economics* 94(1): 31-55.

Rosenzweig, Mark. 1988. "Risk, Implicit Contracts and the Family in Rural Areas of Low-Income Countries." *Economic Journal* 98(4): 1148-1170.

Rosenzweig, Mark and Kenneth Wolpin. 1985. "Specific Experience, Household Structure and Intergenerational Transfers: Farm Family Land and Labor Arrangements in Developing Countries." *Quarterly Journal of Economics* 100(5): Supplement, 961-987.

Ryder, Robert and Roy Mugerwa. 1994. "The Clinical Definition and Diagnosis of AIDS in African Adults." in M. Essex, S. Mboup, P. Kanki, M. Kalengayi, eds., *AIDS in Africa*. New York: Raven Press.

Sen, Amartya. 1966. "Peasants and Dualism with and without Surplus Labor." *Journal of Political Economy* 74: 425-450.

Singh, Inderjit, Lynn Squire and John Strauss. 1986. *Agricultural Household Models: Extensions and Applications*. Baltimore: Johns Hopkins Press.

Skoufias, Emmanuel. 1993. "Labor Market Opportunities and Intrafamily Time Allocation in Rural Households in South Asia." *Journal of Development Economics* 40(2): 277-310.

Strauss, John and Duncan Thomas. 1995. "Human Resources: Empirical Modeling of Household and Family Decisions." in H. Chenery and T.N. Srinivasan, eds., *Handbook of Development Economics*, Volume 3. Amsterdam: North Holland.

Tibaijuka, Anna. 1984. *An Economic Analysis of Smallholder Banana-Coffee Farms in the Kagera Region, Tanzania: Causes of the Decline in Productivity and Strategies for*

Revitalization. Published Ph.D. dissertation, Swedish University of Agricultural Sciences, Department of Economics and Statistics, Uppsala.

Tibaijuka, Anna. 1997. "AIDS and Economic Welfare in Peasant Agriculture: Case Studies from Kagabiro Village, Kagera Region, Tanzania." *World Development* 25(6): 963-975.

Townsend, Robert. 1994. "Risk and Insurance in Village India." *Econometrica* 62(3): 539-591.

Wooldridge, Jeffrey. 1997. "Asymptotic Properties of Weighted M-Estimators for Variable Probability Samples." Econometrics and Economic Theory Paper No. 9604, Department of Economics, Michigan State University.

World Bank. 1992. *Tanzania AIDS Assessment and Planning Study*. World Bank, Washington, D.C.

World Bank. 1993. "Report of a Workshop on: the Economic Impact of Fatal Illness in Sub-Saharan Africa." World Bank, Washington, D.C. and the University of Dar es Salaam.

World Health Organization. 1995. Unpublished data compiled by the Global Programme on AIDS and cited in John Bongaarts. 1996. "Global Trends in AIDS Mortality." *Population and Development Review* 22(1): 21-45.

Chapter 2

EXAMINING REPORTING ERRORS IN RETROSPECTIVE MORTALITY DATA

I. Introduction

Empirical analysis of many aspects of household and individual behavior typically relies on retrospective data as reported by individuals. Even with the development of panel surveys to collect household survey data, at least in the initial interview, retrospective information will be counted on for identification of past events. Researchers field surveys and utilize recall data pertaining to a wide range of topics from retrospective life histories (e.g. marriages and births) to consumption expenditures in the recent past.

The quality of retrospective data is, however, often difficult to discern. Some experimental studies have been designed and implemented to explore the extent to which different types of recall errors plague retrospective data. These sorts of analysis can hopefully improve methods of collecting retrospective data and minimizing recall errors. For example, Scott and Amenuvegbe (1990) examine how varying duration of recall periods is associated with errors in recalling expenditures. Loftus and Marburger (1983) assess the improvement in accuracy of retrospective accounts when surveys use a highly salient landmark event (the eruption of Mt. St. Helens) to mark the beginning of the reference period. Van Der Vaart et al. (1995) explore possible reductions in recall bias when surveys provide a checklist to respondents.

Because we anticipate that the nature of recall bias will vary with the type of retrospective data collected, it is difficult to make generalized statements about appropriate survey techniques, let alone accuracy. Unfortunately, researchers are often limited in their ability to assess the quality of retrospective data in a specific data set. Auxiliary sources, such as marriage or birth certificates or receipts for expenditures, are usually not available to validate retrospective data. For some types of recall error, researchers can look for indicators of quality within a data set. For example, pronounced spiking or heaping of variables such as age, job tenure or duration of unemployment may suggest rounding on the part of respondents. Even in this case, though, without further information it is not possible to distinguish rounding from a true heaping process. When available, panel data can present an alternative means of assessing the quality of retrospective data by comparison of retrospective reporting in reinterviews with that in the original interview when recall periods overlap.

Using the Kagera Health and Development Survey (KHDS), this paper attempts to assess the quality of the reporting of deaths of household members in two ways. First, the pattern of incidence of deaths over the 2-year recall period in the first household interview is examined. Second, the data collected in the first full interview of the KHDS are compared with information reported in the enumeration (baseline) survey that preceded it. Although the enumeration survey does not use the same survey instrument as the full KHDS questionnaire, basic event reporting can be compared across surveys.

This analysis is useful for several reasons. In general, we expect the reporting of death, a major event, to be less prone to event recall as compared to retrospective data on minor events such as incidental expenditures. The degree to which deaths are inconsistently reported may underscore the need to pursue longitudinal studies that collect data over shorter retrospective periods and later can be used to piece together more reliable event histories.

Within the more narrow context of this specific data set, this analysis may be insightful to researchers anticipating utilizing the KHDS with its extensive and rich data. The expressed objective of this survey was to examine the impact of deaths on households and communities; thus, the quality of this component of the KHDS is especially important. As a consequence of the following analysis, data for the retrospective period reported in the first household interview is truncated when used in Chapter 1 analysis.

This paper is organized as follows. Section II discusses the various aspects of recall error. Section III describes the KHDS data and the degree to which the enumeration survey can be compared with the first interview of the panel. The incidence of deaths reported in the KHDS is presented in Section IV. Section V covers the comparison across the enumeration survey and the first KHDS full interview. Section VI concludes.

II. Recall Error

There is a large body of work in survey literature about reporting errors in survey data; Sudman and Bradburn (1974) summarize the extensive work in this area from the 1950s and 1960s. Retrospective data, in particular, introduces various data quality issues linked to recall errors. Over time, respondents may forget that some event occurred, and thus underreport events. Remembrance of events will depend not only on the duration of the recall period, but also on the nature of event being reported. For example, with respect to expenditures and income, Deaton (1997) notes that a longer recall period may be plagued with greater measurement error because respondents have difficulty recalling expenditure for minor items several months later. This suggests that estimates of these variables, expenditures or income, fall as the recall period is lengthened. It also suggests that less meaningful events are more likely to be forgotten. That is, important life events may be associated with improved recall. As well, events linked to other events may improve reporting accuracy, particularly if the other event is a salient one. For example, migrations tied to marriage may be more accurately reported than other, less significant moves. Smith and Thomas (1997) explore these issues and others relating to recall error in reporting migration histories in the first and second Malaysian Family Life Surveys conducted 12 years apart. They find that salient moves linked with meaningful events or moves that last a long time are more accurately reported.

Aside from errors in the recollection of an event, the quality of retrospective data depends on the remembrance of the details of the event. Recall bias will, no doubt, depend on the nature of the event being recalled. Blane (1996) asserts that details of emotional laden events are more likely to be recalled inaccurately while everyday activities are recalled more accurately.[1]

A pivotal detail of retrospective reporting is the dating of the event. *Forward telescoping*, for example, is the reporting of an event more recently that it actually occurred, thus downward biasing time from the survey to the event. Forward telescoping may even be deliberate on the part of the respondent. Shorter recall periods may be subject to a "`boundary' or `start-up' problem, whereby respondents report items just before the reporting period, in an effort to be helpful and to ensure that the enumerator does not miss events that he or she would `surely' want to know about (Deaton, 1997)." Landmark events that clearly mark the beginning of the reference period may reduce the incidence of unintentional forward telescoping (Loftus and Marburger, 1983). Along this same line, Blane (1996) discusses the concept of a "Life Grid" whereby all dates of any changes in areas of interest are cross-referenced. These events can include events external to the households such as wars and earthquakes.

Heaping is one possible type of recall error in which we observe an unusual concentration of responses at certain durations with respect to prior expectations about the frequency distribution.[2] The problem of heaping has a range of applications from reporting of duration of breastfeeding (Klerman, 1993) to unemployment duration (Torelli and Trivellato, 1993). Ureta (1992) finds pronounced spiking at five-year intervals in reported job tenure from several Current Population Surveys; furthermore,

---

[1] Blane (1996) goes on to describe these everyday events as the hum-drum details of life that include "barely noticed background routines of life" which would seemingly make them less accurately recalled.

[2] Evidence that KHDS households may approximate dates can be drawn from the sample of children under 60 months of age (not reported here); the distribution of children by reported age displayed very distinct heaping at 6-month intervals.

she finds that the probability of rounding increases with tenure. Respondents may heap as an approximation of duration, such a rounding to the nearest year. Researchers have implemented methods to smooth data as a correction for reported tenure (see, for example, Ureta (1992) and Diebold et al. (1997) with respect to tenure distributions in the Current Population Surveys). Such corrections are typically based on the presumption that the heaping is an artifact of rounding by respondents which may not be the case. Klerman (1993) tests the presumption that heaping moves answers to the closest heaping point (e.g. year or half-year) with respect to breastfeeding durations in Malaysia and finds that in most cases the heaped data is not pulled from adjacent responses.

Errors in recalling the date or other characteristics of events may be noisy but not necessarily associated with a pattern like telescoping or heaping. With respect to birth histories, women may recall all births but year-of-birth may be reported with noise, particular in settings where women have a large number of births, and low levels of schooling/literacy.

III. Data

The data for this study are drawn from a research project conducted by the World Bank and the University of Dar es Salaam in the region of Kagera in Northwest Tanzania.[3] The explicit objectives of the project were to measure the economic impact of prime-age (15-50) adult fatal illness in the region and to propose cost-effective strategies

---

[3] For further description of the project and data see Ainsworth et al. (1992) and World Bank (1993).

to help survivors. Kagera is estimated to be one of the regions in Tanzania most affected by the HIV/AIDS epidemic (World Bank, 1992). The issue of the quality of the retrospective data about incidence and characteristics of deaths in the KHDS is important because the objectives of the survey rely not only on the reporting of deaths, but also on the characteristics of the event (i.e. date and classification of deaths with respect to household membership and age).

Begun in 1991, the KHDS is a panel survey that consists of four lengthy interviews, referred to as "waves", approximately 6-7 months apart on average. The KHDS included 838 households in the first wave; 757 households complete all four waves. In the first wave of the KHDS, households were asked to report deaths in the 24-month period preceding the interview. In the following waves, the reference period is the last 6 months (or the time since the last interview). Information on deaths was fielded in two survey modules. The first (section 20a) is designed for the deaths of members of the household (not necessarily related to the respondent) and the second (section 20b) captures the deaths of any non-household member (i.e. non-coresident) relatives. The deaths reported in these sections of the household survey should be recorded only once. Thus, there is no overlap in the recall periods of the four waves of data and sections 20a and 20b are mutually exclusive.

The initial 838 households were selected on the basis of a baseline survey (referred to as the enumeration survey) fielded to *all* households in the 51 survey villages less than a year before the start of the KHDS panel. The enumeration survey asks about presence of adults in the household who are too sick to work and about deaths of household members in the last 12 months. Thus, the retrospective period covered in the enumeration survey lies within the 24-month recall period of the first wave.[4] The consistency of the reporting of household member deaths can therefore be examined by linking the enumeration data with that of the first wave. While very similar, the survey instruments are not, however, the same. Inconsistencies across the two surveys can not necessarily be attributed to recall bias as opposed to the differences in the survey instruments.

IV. Incidence of Death in Kagera Households

A priori, in any *random* sample of households we expect to observe a (fairly) smooth distribution in the percentage of households reporting a prime-age death over each month in a 24 month period. An exception to this uniform distribution would be the occurrence of deaths due to a contagion (in the community or the household), in which case the proportion of households reporting death may *increase* as dates approach the interview date. Another exception would be in the event of seasonal patterns in the incidence of deaths; certain months may be associated with higher mortality. This would be the case if, for example, certain seasons are related to higher morbidity or disease rates for environmental or economic reasons. Examination of the timing of reported deaths confirms that death rates, in general, are highest in the

[4] For households in 2 villages (out of 51), the start date of the wave 1 recall period follows that of the recall period for the enumeration. In one of these cases, the difference is only a few days in the same month. In the other village (with 17 households), the wave 1 recall period starts 2 months after the start of the enumeration recall period. For other households in which the entire enumeration recall period lies within the wave 1 recall period, the length between the start of the wave 1 recall and the start of the enumeration survey recall varies by household.

months of April, August and July. July and August are the driest months of the year -- part of the "kiangazi" season. The month of April in the "masika" rainy season is one of the rainiest months of the year. However, this is not likely to be an issue in the KHDS where the sample of households interviewed span a seven-month period.

If we examine the reporting of prime-age adult household member deaths among the sample of all 837 households interviewed in the first wave of the KHDS, we notice two important features consistent with the sampling strategy employed (Figure 1).[5] Despite the seemingly low levels of adult mortality in Figure 1, the levels of mortality in this sample of households are actually *much* higher than would be predicted for the average household from the 1988 census. Using the census data, Over (1995) estimates the risk of an adult death in the average Kagera households to be about 1.88 percent per year. By his calculations, we observe more than four times the expected number of households experiencing at least 1 prime-age death. This outcome is directly attributed to the stratified choice based sample employed which was based on a short enumeration survey collected, on average, 8-9 months earlier.

The second feature of Figure 1 is the increase in the proportion of households reporting a death after about 7-8 months in the past. This is also consistent with the sampling strategy employed. The objective of the sampling procedure was to increase the project's chances of observing serious illness or death in the sampled households.

[5] The xth month refers to deaths reported anywhere from exactly x months in the past to just under $(x+1)$ months. Multiple deaths are accounted for in the event that the deaths occurred in different months in the past. Only a few households reported 2 deaths in the same month; these cases of multiple deaths are not taken into account here. Households report only the month and year of death; day of death has been set to the 15th of the month. One household is dropped from all analysis due to inability to link the household with its respective enumeration data.

One part of the criterion for those households over-sampled was the reporting of an adult death within the 12 months preceding the enumeration survey, which predates the wave 1 interview by 7 months, on average.

To account for the sample strategy, the data are weighted using sample weights defined as:

$$Q(j)/H(j)$$

where Q(j) is the population fraction of some outcome j and H(j) is the sample fraction of the same outcome (see Manski and Lerman, 1977). In a simple random sample we expect to observe Q(j)= H(j). In this analysis case j is either "sick" or "well", where "sick" households were oversampled in every community. "Sick" households are those that report either a prime-age adult too sick to work or a prime-age adult death in the preceding 12 months at enumeration. Weights are calculated for both groups within each of 51 clusters (or villages); thus there are 102 distinct sample weights. This formula does not account for first stage sampling, which involved the selection of the 51 clusters among all 529 primary sampling units in the region. Therefore, these weights cannot be used to infer regional statistics.

The enumeration data, collected over all household within the cluster, is used to calculate the population proportions that are "sick" and "well". For most clusters in our sample, where j="sick", H(j) is 14/16; conversely, H(j) is 2/16 where j is "well". Population proportions of "well" households are considerable higher than the "sick" households; the mean and median percent of the population "sick" is 8 percent.

The weighted probability of observing a death in any month over the 24 month period is substantially lower (Figure 2). The bumps in this distribution, in particular at 19 months, are driven by a few deaths in "well" households which get considerable weights as noted above.

V. Consistency in Reporting of Deaths

Although the KHDS was not designed to assess the consistency of reporting of deaths, we can glean some information from comparison of the first wave with the enumeration data. As aforementioned, the 12 month retrospective period covered at enumeration is within the 24 month recall period covered in wave 1. Unfortunately, the survey modules used at enumeration and wave 1 are not the same. Specifically, at enumeration, households identified the age and cause of death (illness, accident, childbirth, or other) in response to the question: "Has any adult in this household died in the past 12 months?" In wave 1, households are asked: "Has any member of your household who was residing with you died in the past 24 months?". For non-household members, households were asked: "Do you have any relatives who were living away from your household and who died in the last 24 months?" Detailed information is collected about each death reported in wave 1, including the age of the deceased, cause of death, and the date of the death.[6]

[6] For the enumeration survey, only adult deaths due to illness are considered. The adult deaths reported in wave 1 are almost all reported as caused by illness, but some are due to other causes. Because deaths due to non-illness causes are included in the wave 1 reported deaths, this favors fewer inconsistencies in underreporting among households that report a death at enumeration and potentially results in more inconsistencies among those reporting no death due to illness at enumeration.

Because of the lack of details for deaths reported at enumeration, confirmation of re-reporting of a *specific* person can not be done.[7] Rather, a more rudimentary comparison can be done be assessing the reporting of at least one prime-age adult death (15-50) in only one or both surveys. Since specific deaths are not matched in the two surveys, the match rates for reporting of a prime-age death in both surveys may understate misreporting if some matches for reporting a prime-age death in this analysis do not capture the same person.

Comparison of the Two Surveys

Comparison of these data reveals marked inconsistency in reporting. Table 1 reports the cross-tabulation of the reporting of deaths by households at enumeration to subsequent reporting in wave 1. From the enumeration survey, households can fall into one of two categories based on the reporting of any death in the recall period. From the wave 1 survey, households are divided into four groups depending on any reported death over the preceding 24 months and the timing of the reported death with respect to the enumeration recall period.

Among the 837 households surveyed at enumeration, 369 reported a death due to illness of at least one adult 15-50 years during the 12-months preceding enumeration. *Less than half* of the households that identified a death during the enumeration survey (159 of 369) also identified a prime-age adult death of household members occurring in the enumeration recall period when re-surveyed in wave 1 (Table 1, Panel A). On the

[7] Although collected at enumeration, the data available at this time do not consist of the specific age reported but rather the age as under 15, 15-50 and 51-65.

other hand, 155 households reported a death at enumeration in the 12 months preceding enumeration and, subsequently reported *no* death over the entire 24 month recall period at wave 1. Another 55 households reported a death at enumeration, but the death(s) reported at wave 1 occurred outside of the 12 month enumeration recall period. Among households reporting no death in the last 12 months at enumeration (n=468), we observe 16 households reporting at least one death over the same period in the subsequent wave 1 interview. Thus, in most cases, the inconsistency in reporting surrounds the under-reporting of deaths in the subsequent survey.

There are several possible explanations for these apparent inconsistencies: changes in classification of membership of deceased, recall errors in age of deceased and errors in dating of deaths. These explanations assume that households do not forget about the event altogether, which, given the nature of the event, seems unlikely. With the exception of errors in dating of deaths which places them out of the range of the recall period, these explanations assume that in some fashion, all deaths were rereported. That is, the mismatch arises from the category that deaths at reinterview were considered (15-50 year-old household members). An additional possibility for inconsistencies between these data is that the respondents supplying this information for the households change from the enumeration survey to the wave 1 interview. In both cases, the respondent should have been the household head. However, in some instances the household head is not in the household at the time of the survey or headship changed from enumeration to wave 1. For both surveys, we do not have information on who is responding for the household, although it presumed to be the head when present. We do, however, know if headship changed from enumeration to wave 1 and this information will be used below. The maintained, yet untested, hypothesis is that the deaths reported at enumeration actually occurred.

Some deaths may be systematically re-classified by households as non-household members. This would occur if, for example, a fraction of these deaths are not long-term members but rather individuals who returned to the household shortly before dying, perhaps returning in light of a fatal illness. About 30 percent of all prime-age deaths observed during the panel (deaths occurring between wave 1 and wave 4) are individuals who moved into the household *between* waves. Thus, these individuals resided in the household for less than 7 months before they died. Households may be re-classifying such short-term member deaths over time into the category of non-coresident. Other research has suggested that AIDS-related deaths may be associated with afflicted adults returning to their native areas shortly before dying (National Research Council, 1996). Among other reasons, this may be to seek terminal care and to save the family the cost of shipping the body.

The structure and sequence of the household survey offers a second explanation for the potential reclassification of deaths. Respondents in wave 1 may have a more narrow or restrictive sense of membership when reporting deaths in the final survey module after completing the full household survey. The in-depth coverage of the household elicited in wave 1 may lead respondents to be more discriminating in classifying deceased persons as former household members as opposed to the very short enumeration survey.[8]

Taking into account the re-classification of deaths and the possibility of errors in age-reporting, the data are re-examined in two ways. Because the date of deaths was not collected in the enumeration survey, we are not able to assess the extent to which dating errors are driving these observed inconsistencies. Table 1, Panel B considers death of individuals 15-65 who are reported in wave 1 as either household members or non-member relatives who died in the same village. Table 1, Panel C broadens this to include all adult deaths aged 15-65 (reported as either member or non-member) reported in wave 1. Under this broader definition, a substantial number of inconsistencies observed in Panel A are removed. In fact, about half of all households reporting no member deaths in wave 1 despite reporting such death at enumeration do report a death during the enumeration recall period if we expand deaths to cover non-member relatives who died in the same village. Nevertheless, even with the broadest description in Panel C, we still find that about one-third of households reporting a death in the 12-month recall period from enumeration fail to report a death in this same period at wave 1 (127 of 369). These broader set of characteristics of deaths reported in wave 1 also introduce numerous inconsistencies for households reporting no death at enumeration.

[8] Another possibility is that at enumeration households were motivated to classify deceased non-member relatives as household members if they perceived that the enumeration survey was tied to some sort of social welfare or assistance program.

Probability of Underreporting in Wave 1

The interesting question posed by these inconsistencies is to what extent can we identify whether certain households are more likely to report contrary information or which household characteristics are linked to misreporting across these two surveys. Table 2 presents results from probit estimation of the probability of reporting no deaths in wave 1 among the subsample of 369 households that reported at least one death 15-50 at enumeration.[9] By this classification, households that rereported a death *outside* the enumeration recall period are not considered to be inconsistent. Thus, this narrows the focus to the subset of households that reported a death at enumeration and do not rereport at *any time* during the 24 month period at wave 1. The dependent variable is 0 for households reporting any adult 15-50 member death in the 24 month wave 1 recall period and 1 for households reporting no death. The explanatory variables include characteristics of the household head (age, age squared, and dummy variables for highest level of education completed and sex) in wave 1, log per capita expenditure reported in wave 1 (in Tanzanian shillings), and a dummy variable indicating whether headship changed between enumeration and wave 1.

The set of characteristics of the household head, individually and jointly, do not significantly influence the probability of misreporting. Jointly, the education of the head is significant, although the interpretation of the coefficients is not clear.

---

[9] We could expand our coverage of deaths reported at enumeration to include deaths 15-65. This, however, adds only 2 more households and does not qualitatively change the results of this analysis. Standard errors have been corrected for clustering at the household level.

Per capita expenditure (logged) is positively associated with misreporting, although the effect is quite small.[10] This suggests that among households with a death in the distant past, wealthy households, for whom the death may be smaller economic crisis for the household, are more likely to report the event inconsistently. If these inconsistencies are driven by re-classification of deaths, then deaths in wealthier households are more likely to be re-classified from members to non-members than deaths in less wealthy households. Additional support of this supposition is drawn from the deaths reported in waves 2-4. Households reporting an adult 15-50 death of a household member who joined the household between waves (individuals who join the household and die within 7 months) have, on average, higher levels of per capita expenditure. This may indicate that wealth is identifying those households in which the deceased where short-term members and, thus, are more likely to be re-classified as non-household members.

A change in headship between enumeration and wave 1 is associated with more errors in reporting. Probability of misreporting is 20 percentage points lower in households where the head did not change from the enumeration survey to wave 1. This is almost half of the mean probability of misreporting in the sample (.42).

VI. Conclusions

In a wide range of social science research, retrospective questions are used to inform researchers about past behaviors and events that are otherwise unobtainable.

---

[10] The probability of misreporting increases by 1 percent for a 14 percent increase in expenditure per capita (10,000 Tanzania shillings), evaluated at the mean level of expenditure per capita.

The quality of these data, no doubt, depend on the nature of the event being recalled and the survey design. Additionally, the accuracy may depend on the characteristics of the respondents themselves.

This study has explored the consistency of recall of prime-age adult deaths as reported by surviving household members. This was undertaken in two ways. First, the reporting of prime-age deaths by month over the 24 month recall in the first full household interview was examined. Incidence of deaths did not appear to be heaped and, when weighted, gave the low probabilities that would otherwise be expected from regional census data. Second, reporting in an initial interview was compared with a subsequent, and more detailed reinterview. More specific analysis was confounded due to the limited amount of data collected in the initial contact. Nevertheless, comparison of households reporting any death in past 12 months at first interview with reporting of any adult death in past 24 months at the reinterview 7-8 months later revealed stark underreporting in the second survey. Several alternative interpretations could explain these results, but lack of data prohibit exploring many of these. One outstanding caveat to these results is the possibility that differences in the survey instruments rather than recall errors can explain inconsistencies across surveys. Further analysis found that some characteristics of the household, in particular per capita wealth and change in household head between interviews, were associated with a higher probability of underreporting among those households reporting a death in the first survey.

Even if a sizable number of these inconsistencies were driven by changes in headship and differences in survey modules, the discrepancies are large enough to be surprising given the landmark nature of a prime-age death in households. They suggests that even for major lifetime events, details surrounding them are variable at least among the set of characteristics including date, age and household membership. In terms of informing methodology in the specific area of incidence of deaths, researchers may need to emphasize shorter recall periods or at least not emphasize in analysis those deaths reported in the more distant past.[11]

With respect to the analysis undertaken in Chapter 1, the retrospective data on deaths reported in the first household interview is truncated so that only the information within 6 months of the household interview is used. Without further information, it is not possible to assess what portion of the recall period in wave 1 is reliable. By truncating these data at 6 months past, however, the recall period for *all* waves is approximately 6 month.

[11] For example, Tibaijuka (1997) collects data on adult (over 14 years) deaths in households over the period 1980-1989 which may suffer substantial recall errors.

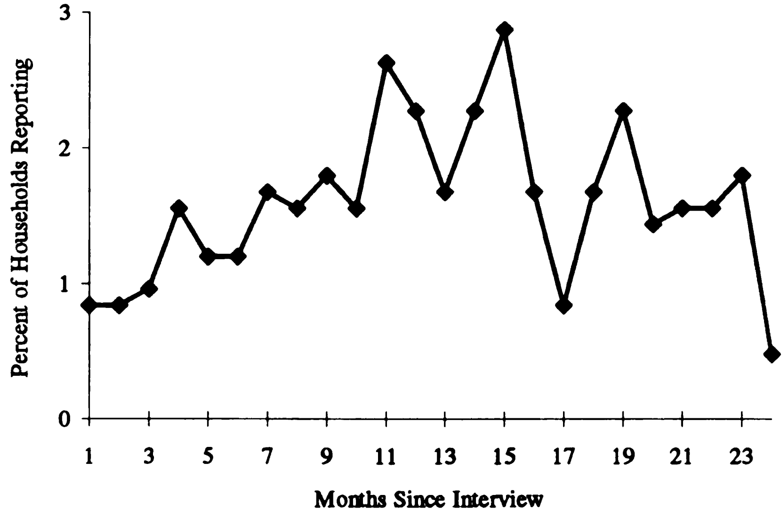


Figure 1: Households Reporting a Prime-Age Death, Unweighted (n=837)

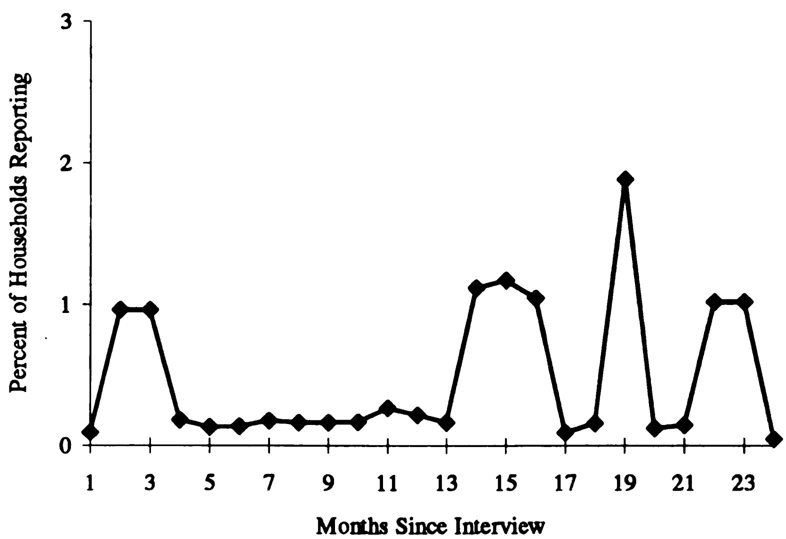


Figure 2: Households Reporting a Prime-Age Death, Weighted (n=837)

Table 1: Reporting of Deaths During Enumeration and at Wave 1 Interview, Percent of Households (n=837)

PANEL A				
Enumeration: Reporting of death 15-50 in 12 months preceding enumeration	*Wave 1*: Reporting of death of adult 15-50 (household member) in 24 months preceding wave 1			
	None	After enumeration & before wave 1	Enumeration recall period	More than 12 months before enumeration
None (n=468)	401	48	16	3
At least 1 death (n=369)	155	20	159	35
PANEL B				
Enumeration: Reporting of death 15-50 in 12 months preceding enumeration	*Wave 1*: Reporting of death of adult 15-65 (members & non-members in same village) in 24 months preceding wave 1			
	None	After enumeration & before wave 1	Enumeration recall period	More than 12 months before enumeration
None (n=468)	296	90	62	20
At least 1 death (n=369)	88	41	201	39
PANEL C				
Enumeration: Reporting of death 15-50 in 12 months preceding enumeration	*Wave 1*: Reporting of death of adult 15-65 (members and non-members) in 24 months preceding wave 1			
	None	After enumeration & before wave 1	Enumeration recall period	More than 12 months before enumeration
None (n=468)	173	119	142	34
At least 1 death (n=369)	43	41	242	43

Note: Deaths reported at enumeration consist of only those due to illness. Deaths reported at wave 1 are those due to any cause. The cause of death reported in the vast majority of cases for both surveys was illness. Households with multiple deaths over the 24-month recall period, including at least one during the 12 months before enumeration, are assigned to the category "12 months before enumeration" ; households with multiple deaths after enumeration and before the 12 month recall are assigned to the last category "more than 12 months before enumeration".

Table 2: Probability of Reporting no Adult Deaths in Past 24 Months at Wave 1, Among Households Reporting an Adult Death in Last 12 Months at Enumeration (n=369)

	Mean	
Dependent variable	0.420	
Explanatory variables		
Age of household head	50.280	0.003
		(0.022)
		[0.001]
Age of head squared (/100)		-0.004
		(0.020)
		[-0.002]
Education of head 1-6 years♦	0.439	0.281
		(0.184)
		[0.110]
Education of head 7+ years♦	0.304	-0.113
		(0.223)
		[-0.044]
Female head	0.317	-0.215
		(0.162)
		[-0.083]
Log expenditure per capita	11.171	0.184*
		(0.101)
		[0.072]
No change in household head	0.938	-0.519*
		(0.274)
		[-0.205]
Constant		-1.845
		(1.152)
Pseudo R^2		0.028

Note: β are estimated using probit estimation with standard errors in parentheses corrected for clustering at the household level. In brackets, coefficients have been converted to change in probability evaluated at the mean of other regressors. The dependent variable is equal to 1 for households reporting no household member 15-50 death over the 24-month recall period, and equal to 0 for households reporting any such death(s) in the 24-month, regardless of the date reported. Log expenditure per capita is expenditure in last 12 months (in Tanzanian shillings) reported in wave 1 measured per capita, replacing actual number of members in household with a calculation of the number of residency-adjusted adults. ♦ education variables are jointly significant at 5%. * indicates statistical significance at 10%.

LIST OF REFERENCES

LIST OF REFERENCES

Ainsworth, Martha, Godlike Koda, George Lwihula, Phare Mujinja, Mead Over and Innocent Semali. 1992. "Measuring the Impact of fatal Adult Illness in Sub-Saharan Africa." Living Standards Measurement Study no. 90, World Bank, Washington, D.C.

Blane, D.B. 1996. "Collecting Retrospective Data: Development of a Reliable Method and a Pilot Study of Its Use." *Social Science and Medicine* 42(5): 751-757.

Deaton, Angus. 1997. *The Analysis of Household Surveys: Microeconometric Analysis for Development Policy*. Washington, D.C.: Johns Hopkins University Press.

Diebold, Francis, David Neumark, Daniel Polsky. 1997. "Job Stability in the United States." *Journal of Labor Economics* 15(2): 206-233.

Klerman, Jacob. 1993. "Heaping in Retrospective Data: Insights from the Malaysian Family Life Surveys' Breastfeeding Data." RAND, Santa Monica, California

Loftus, Elizabeth and Wesley Marburger. 1983. "Since the Eruption of Mt. St. Helens, Has Anyone Beaten You Up? Improving Accuracy of Retrospective Reports with Landmark Events." *Memory and Cognition* 11(2): 114-120.

Manski, Charles and Steven Lerman. 1977. "The Estimation of Choice Probabilities from Choice-based Samples." *Econometrica* 45(8): 1977-1988.

National Research Council. 1996. *Preventing and Mitigating AIDS in Sub-Saharan Africa*. Washington, D.C.: National Academy Press.

Over, Mead. 1995. "Adults Deaths in the Sample of Households: Survey Methods and Results." draft, Policy Research Department, World Bank, Washington, D.C.

Scott, Chris and Ben Amenuvegbe. 1990. "Effect of Recall Durations on Reporting of Household Expenditures." Social Dimensions of Adjustment in Sub-Saharan Africa, Working Paper 6, World Bank, Washington, D.C.

Smith, James and Duncan Thomas. 1997. "Migration in Retrospect: Remembrances of Things Past." RAND, Santa Monica, California.

Sudman, Seymour, and Norman Bradburn. 1974. *Response Effects in Surveys: A Review and Synthesis*. Chicago, Il: Adline.

Tibaijuka, Anna. 1997. "AIDS and Economic Welfare in Peasant Agriculture: Case Studies from Kagabiro Village, Kagera Region, Tanzania." *World Development* 25(6): 963-975.

Torelli and Trivellato. 1993. "Modeling Inaccuracies in Job-search Duration Data." *Journal of Econometrics* 59: 187-211.

Ureta, Manuelita. 1992. "The Importance of Lifetime Jobs in the U.S. Economy, Revisited." *American Economic Review* 82(1): 322-335.

Van Der Vaart, Wander, Johannes Van Der Zouwen and Wil Dijkstra. 1995. "Retrospective Questions: Data Quality, Task Difficulty, and the Use of a Checklist." *Quality and Quantity* 29: 299-315.

World Bank. 1992. *Tanzania AIDS Assessment and Planning Study*. World Bank, Washington, D.C.

World Bank. 1993. "Report of a Workshop on: the Economic Impact of Fatal Illness in Sub-Saharan Africa." World Bank, Washington, D.C. and the University of Dar es Salaam.