FASID
Discussion Paper Series on International Development Strategies
No. 2003-006

WORKING-AGE ADULT MORTALITY AND PRIMARY SCHOOL ATTENDANCE IN RURAL KENYA

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November 2003

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Abstract

The rapid increase in adult mortality due to the AIDS epidemic in sub-Saharan Africa raises great concern about its impact on child welfare. This article estimates the impact of AIDS-related adult mortality on primary school attendance in rural Kenya using a panel of 1,266 households surveyed in 1997, 2000, and 2002. We find a strong correlation between working-age adult mortality and lagged HIV-prevalence rates at nearby sentinel survey sites. School attendance, especially for children in relatively poor households, is negatively correlated with lagged provincial HIV-prevalence rates. Children, especially girls in relatively poor households, are less likely to be in school directly prior to the death of an adult member than children in unafflicted households. By contrast, boys in relatively poor households are less likely to be in school after an adult death. The evidence indicates that rising adult mortality in rural Kenya is adversely affecting primary school attendance especially among the poor. However, these results measure only short-term impacts. Over the longer run, whether school attendance in afflicted household rebounds or deteriorates further is unknown.

JEL classification: O12, O15, J10, Q12

Keywords: HIV/AIDS, Education, Kenya

1. INTRODUCTION

Education contributes to economic growth (Barro, 1991; Mankiew, Romer, and Weil, 1992). Rising education of the labor force has been identified as a primary ingredient in processes of structural transformation and economic development (Johnston and Kilby, 1975; Gabre-Madhin and Johnston, 2002). Education is a primary investment that the poor can make to escape from poverty over the long run. Recognizing this, many governments and international organizations put a high priority on education in their development agendas, such as the Millennium Development Goals (United Nations, 2000).

The onset of the AIDS epidemic in the past two decades raises serious questions about long term human capital development, including education, and the future quality of the workforce in areas where the disease is particularly acute, such as in many countries of Africa. There is growing concern over the effect of high AIDS-related adult mortality and illness on child welfare and the disease's effects on their potential over the long run to support themselves as adults and to contribute to their countries' development (UNICEF, 1999; Bell, Devarajan, and Gersbach, 2003).

Available empirical evidence indicates that school enrollment rates are lower among AIDS orphans compared with non-orphans (World Bank, 1999; Ainsworth, Beegle, and Koda, 2002; Case, Paxson, and Ableidinger, 2002). A long list of anecdotal case studies also supports this evidence (Gachuhi, 1999; Nyambedha, et al., 2001; Guest, 2001; USAID, 2002). However, using 39 nationally representative data sets collected in the 1990s from 28 countries, mostly in Sub-Saharan Africa, Ainsworth and Filmer (2002) show that the difference in enrollment rates between orphaned and non-orphaned children varies greatly across countries and wealth levels within a country. There are likely to be important conditioning factors affecting the relationship between parent mortality and child schooling.

A major difficulty in measuring the impact of adult mortality, especially mortality attributable to AIDS, is that it is caused by behavioral choices rather than by random events. Individuals and households incurring adult mortality are more likely to display certain characteristics. For example, especially in the early years of the epidemic in sub-Saharan Africa, evidence suggests that men and women with higher education and income were more likely to contract HIV than others because they were more able to attract potential sexual partners (Ainsworth and Semali, 1998; Gregson, Waddell, and Chandiwana, 2001).[1] If prime-age mortality remains correlated with individual and household characteristics such as social status, wealth, and mobility – which are also important determinants of school enrollment – failure to control for these characteristics may generate biased estimates of the impact of adult mortality on school attendance. However, it is possible to overcome this problem by estimating the effect of adult mortality on school attendance of the same children over time, using child fixed-effects models. To our knowledge, no study has yet applied child fixed-effects models to overcome this problem.

The purpose of this paper, therefore, is to identify the effect of adult mortality on school attendance among primary-school age children (7 to 14 years) in rural Kenya. To address this question, we first identify potential pathways by which adult mortality may affect child school attendance and the timing of each pathway. Then, we estimate the impacts of adult mortality on child school attendance in rural Kenya after stratifying sampled households and their children by

1 As information about HIV transmission spreads, however, it is believed that educated people are more likely to change their behavior in ways that reduce their vulnerability to the disease compared to less educated people.

wealth and gender. Kenya is one of the most heavily HIV-infected countries in the world: 13.5 percent of adults aged 15 to 49 are estimated to be living with HIV in June 2000 (NASCOP, 2001).

Two sources of data are used: a three-year nationwide panel data set of 1,422 rural households, collected in 1997, 2000, and 2002, and secondary data on HIV-prevalence rates from 13 sentinel surveillance sites, collected annually between 1990 and 1999 by the National AIDS and STDs Control Programme (NASCOP). The data are used to estimate the effect of working-age adult mortality since the first survey on school attendance of children aged 7 to 14 in the second and third surveys.

The study highlights three major findings: First, children's school attendance is adversely affected by the death of working-age adults among the bottom half of sample households ranked by initial asset levels in 1997, but no significant effects are detected among households in the top half of the asset distribution. Second, working-age adult mortality negatively affects school attendance even before the death in poor households. The negative impact is larger among girls than boys. This suggests that children, especially girls, are sharing the burden of caring for sick working-age adults and/or that school fees tend to be among the first expenditures curtailed in relatively poor households after one of their prime-age members becomes chronically ill. By contrast, school attendance among boys in relatively poor households drops more sharply after the adult member dies. Third, school attendance among the poor is negatively correlated with lagged provincial HIV-prevalence rates, even after controlling for child fixed-effects. This result suggests that AIDS is indirectly affecting child school attendance in ways other than through the death of household members, or that unobserved time varying factors correlated with changes in HIV-prevalence rates are impeding school attendance.

The next section of the paper describes the sample and panel data used in the analysis. Section 3 presents the conceptual framework and some descriptive analyses. Estimation strategies and variables are discussed in Section 4. Estimation results are in Section 5, followed by conclusions in Section 6.

2. DATA

2.1. Working-age Adult Mortality

The study uses a three-year panel of rural household surveys in 1997, 2000, and 2002. In April 1997, a total of 1,578 households were randomly selected from 24 districts within the eight agriculturally-oriented provinces of the country. The sampling frame for the surveys was prepared in consultation with the Central Bureau of Statistics and implemented by the Tegemeo Institute of Egerton University. We exclude two pastoral districts (40 households) that differ substantially from other zones and had high rates of attrition. Thirty-eight households having farm sizes greater than 20 acres were also excluded, to maintain the study's focus on small-scale households. Of the 1,500 remaining households, 1,422 households were able to be re-interviewed in 2000, and of those, 1,266 households were re-interviewed in 2002 (Table 1).2

When enumerators re-visited the 1997 sampled households in 2000 and 2002, they asked the whereabouts of each individual in the demographic roster of the 1997 survey. If the household contained new members not listed in the 1997 survey, the enumerators added the new members' names in the demographic roster, obtained socio-demographic information on these individuals,

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2 Please see Yamano and Jayne (2003) for detailed discussions on the sample and analyses on the impacts of adult mortality on household composition, farm production, and assets.

and included them in the roster for subsequent surveys. Similar information was recorded for members in 1997 who were no longer residents of the household in 2000 or 2002. Through this process, information was obtained on individuals who had passed away since the preceding survey.

Our analysis focuses on adults between the years of 15 to 54 for men and 15 to 49 for women because these correspond to the age ranges reported by the World Health Organization for HIV prevalence, and are the age ranges hardest hit by the disease (NASCOP, 2001). Between the 1997 and 2000 surveys, 84 adults in these age ranges (which we hereafter refer to as "working-age" adults for shorthand) passed away among the 1,422 sampled households. In the 2002 survey, we found 42 additional cases of mortality in these age ranges among the 1,266 households since the 2000 survey. Thus, the total number of deceased working-age adult members is 126. Of those, about 36 percent were found in Nyanza province, where only 12 percent of the sampled households reside.

In Nyanza province, the survey covered three districts: Kisumu, Siaya, and Kisii districts. In Kisumu and Siaya districts, 23.7 percent of the sampled households experienced at least one working-age adult death since the 1997 survey. In Kisii district, which is farther away from the main highways, more rural, and culturally different from the Luo dominated areas of Kisumu and Siaya, only 4.7 percent of sampled households had experienced at least one working-age death since the 1997 survey (Table 1, column C). These differences in death rates across districts are broadly consistent with the differences in HIV-prevalence among pregnant women testing HIV-positive at urban sentinel surveillance sites in these district (Table 1, column F).

In Kisumu city, the third largest city in Kenya and the capital of Nyanza province, about 22 percent of pregnant women tested HIV positive at a sentinel-surveillance site from 1990-94. The five-year period of 1990-94 is matched with the survey data over the 1997-2002 period to reflect the 6-10 year average survival time after HIV sero-conversion as noted by epidemiological studies in the region (Whitworth et al., 2003; Todd, 2003).

Kisumu and Siaya districts are well connected to Kisumu city with busy highways that also connect Kisumu with Nairobi to the east and with Kampala, Uganda, to the west. Along highways in Kenya, especially the Trans-Africa Highway that connects Mombasa with Kampala via Nairobi, high HIV-seroprevalence rates have been found among high-risk people, e.g., truck drivers and commercial sex workers (Carswell, Lloyd, and Howells, 1985; Mbugua et al., 1995). HIV appears to spread into rural communities from truck stops via interactions between high-risk people and local people, including adolescents who interact with high-risk people (Nzyuko, et al., 1997). Siaya district is also connected with Busia, a border city with Uganda, where about 20 percent of pregnant women were found to be HIV positive at a sentinel surveillance site during 1990-94 (NASCOP, 2001).

Additional factors are believed to have contributed to a high HIV prevalence rate in Kisumu and Siaya districts. Such factors include the relative importance of polygamous households (which increases HIV transmission between a husband and wives), Luo peoples' traditional practices, such as widow inheritance (which increases HIV transmission from a widow to a new husband) and customs associated with fish trading (where sexual favors are common among fishermen and women traders), and male non-circumcision (which increases men's risk of HIV infection per sexual contact).

By contrast, the district town of Kisii, which is further from the Trans-Africa Highway and home to the Kisii ethnic group, only 3.6 percent of pregnant women tested HIV positive at a sentinel surveillance site from 1990 to 1994 (NASCOP, 2001). Thus, the difference in the numbers of working-age adult deaths between Kisumu/Siaya districts and Kisii district is consistent with the difference between the HIV prevalence rates between districts. To examine this point further, we estimate the association between lagged HIV-prevalence rate at the nearest urban-sentinel-surveillance site and the probability of experiencing working-age adult death in Section 5.

2.2. Primary School-Age Children Included in the Analyses

In the 2002 survey, respondents were asked about each household member's schooling, including the number of years spent in school prior to the survey and whether each child was currently attending school. The results on school attendance in columns D and E of Table 1 are taken from 2,565 and 2,107 children aged 7 to 14, who had yet to complete their primary school education by the time of the 2000 and 2002 surveys, respectively. This sample includes children who had left the sampled households since the 1997 survey. Excluding them from the final sample may cause an under-estimation of the negative impact of adult mortality on school attendance because it is more likely that children who left (or were sent away from) their households after experiencing adult mortality were less likely to be attending school than those who remained in the sampled households. In the 2000 and 2002 survey, enumerators asked about the schooling of children listed on the 1997 survey even when the children had left the sampled households. Among the 2,565 and 2,107 children in the 2000 and 2002 sample, 8.3 and 11.8 percent of children left their households (either permanently or temporarily) since the 1997 survey, respectively.

Second, despite our efforts to keep track of all of the sampled households and individuals, we lost some children in the final samples due to attrition. For instance, between the 2000 and 2002 surveys, we lost track of 345 children aged 7 to 14 years old. Out of the 345 children, 259 children are in the 156 households that could not be re-interviewed in 2002. If these households suffered a higher incidence of working-age mortality between 1997 and 2002, we would have sample selection bias when estimating the impact of working-age adult mortality on child schooling. To examine this attrition bias, we include an attrition dummy variable in the estimation models.

Finally, to maintain our focus on primary school enrollment, we exclude from the final sample 28 and 96 children who were between 7 and 14 years old in 2000 and 2002, respectively, because respondents indicated that they had already completed primary school prior to the surveys.

3. Impact of Prime-age Adult Mortality on Schooling

3.1. Conceptual Framework

How does working-age mortality reduce child schooling? There are three main economic factors influencing child school enrollment: (a) the financial costs of schooling, such as school fees and books, relative to households' resources; (b) the opportunity costs of children' time; and (c) the expected returns from school. The potential effects of working-age mortality on child schooling depends on how working-age mortality affects these factors (World Bank, 1999).

First, medical expenditure associated with prolonged illness and eventual funeral costs reduce the financial resources of the household (Barnett and Blaikie, 1992; Lundberg, Over, and Mujinga, 2000). Depending on the household's initial income and wealth and impact of death on these variables, the household may withdraw children from school. Because afflicted households' financial situation may not recover quickly after the death of the sick member, children's school attendance may be affected long after the death occurs.

Second, AIDS-related adult mortality is likely to negatively affect child schooling by increasing the opportunity costs of children's time. As one family member becomes chronically ill, another household member (usually a female member and often an older girl) must devote more time to care giving.[3] As a result, a care-giving female member may need to reduce time devoted to her usual activities. If a girl is expected to help care for the sick, she may stay home instead of going to school. The increased demand for care-giving labor, however, will disappear if the sick adult passes away.

The household also experiences an increased demand for labor previously provided by the sick member. The way in which households adjust to internal labor supply shocks varies according to the resources of the households. For example, households with sufficient income may hire additional workers to meet residual labor needs. Some afflicted households are able to attract additional members to at partially offset the loss of another member (Beegle, 2003; Ainsworth, Ghosh, and Semali, 1995). Households that are poor and/or face high opportunity costs on their scarce resources may be most vulnerable to calling upon their children to discontinue school to provide labor to the household after an adult passes away. An increased demand for labor among non-sick members will not disappear even after the death of the sick member.

Third, because of its effect on life expectancy, HIV/AIDS in high-prevalence countries may alter individuals' time preference for money (McPherson, 2001). Life expectancy in Kenya

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3 For instance, Ainsworth and Dayton (2003) found a decline in Body Mass Index among elderly in non-poor households after an adult death. They suggested that the decline could be explained by a diversion of household resources to the medical care and/or increased demands on the time of elderly to care for sick AIDS patients in non-poor households.

in 1999, for instance, is 48 years, compared to 58 years in 1993 (World Bank, 1995; 2002). Part of the decline in life expectancy is due to increased infant mortality caused by mother-to-child HIV infection, yet there is still a considerable decline in the expected years of work among young adults. The decline in the expected years of work is expected to change parents' expectations about the lifetime return from their children's education both to themselves (e.g., intergenerational transfers from children to parents in their old age) and to their children.

We lack suitable instruments to empirically distinguish the impacts of one factor from the others. However, this conceptual framework provides some insight into the potential pathways by which adult mortality may affect child schooling. We consider two hypotheses in particular. The first hypothesis is that children in poor households are more vulnerable to working-age adult mortality because of the first and second factors. To test this hypothesis we stratify the sample into two groups based on households' initial asset levels and compare model results for both groups. According to this hypothesis, we expect to find larger impacts of working-age adult mortality among the relatively poor half of the sample than the less-poor half.

The second hypothesis is that adult mortality affects boys and girls differently. In Kenya, as in most parts of eastern and Southern Africa, girls tend to assume more care giving responsibilities than boys (Opiyo, 2001). Thus, if the second pathway is important, we expect to find a larger negative impact on girls' schooling than that of boys prior to adult mortality. Thus, we also stratify the sample by gender.

AIDS may affect child schooling not only through direct impacts on afflicted households but also through community effects. For instance, areas with high HIV prevalence rates suffer reduced profitability of businesses such as commercial farms, outgrower schemes, and non-farm businesses relying on wage labor (e.g., Fox et al., 2003; Rugalema, 1999). Reduced economic profitability may translate into wage job contraction, fewer economic opportunities, and lower household incomes in such areas, which may indirectly affect children's school attendance. For these reasons, studies measuring the effects of AIDS on child schooling only through the pathway of how afflicted households themselves respond may underestimate the actual impact of the disease.

3.2. Descriptive Analysis

Based on data collected from the 2000 and 2002 surveys, we categorize children in the sample according to whether they incurred the death of a working age adult in their household in either of the two survey intervals: September 1997- May 2000 and May 2000 – May 2002. In the following discussion, we call the interval between the 1997 and 2000 surveys as the first period and the interval between the 2000 and 2002 surveys as the second period.

In Table 2, we group children by whether they suffered the death of a working-age adult in their household in either the first or second period. Among these different groups of children, Table 2 shows differences in school attendance rates, years of schooling, age, and numbers of sample children in each category.

Overall mean attendance rates[4] are 89.7 and 88.3 percent in 2000 and 2002, respectively. But among children who experienced working-age adult mortality in the first period (Table 2, column C and D), the mean attendance rate declines from 91.1 percent in 2000 to 81.6 percent in 2002. Thus, we find a larger decline in enrollment rates among children who experienced the

4 Throughout this paper, we use the “attendance” to signify whether the child was actually in school, as opposed to “enrollment,” which does not necessarily imply regular presence in school.

mortality than children who did not. This suggests that children are dropping out of school, after experiencing adult mortality in their households. When we stratify the sample into two groups ranked by initial value of productive assets – hereafter, poor and non-poor -- we find a larger decline in enrollment among the poor (from 86.4 to 72.1) than non-poor (from 94.5 to 86.6).

On the other hand, children who experienced working-age adult mortality in the second period (between 2000 and 2002) were less likely to be in school in 2000 (i.e., before the death occurred) than in 2002 (Table 2, column E and F). The average attendance rate jumps from 70.0 percent in 2000 to 89.6 percent in 2002, after experiencing the adult mortality. This increase in attendance is much more drastic among the poor than non-poor. Low attendance rates in 2000 may reflect a combination of the added burden on children to care for the ill member in the first period, prior to the adult mortality, and/or to provide labor activities formerly performed by the ill member.

Comparing the years of schooling completed by children, we note that children in poor households who incurred a working-age adult mortality during the second period have significantly less schooling, 1.90 years, in 2002 (Column F) than children who did not experience any working-age adult mortality, 2.66 years, (Column B), although their average ages are very similar. This suggests that children who experienced working-age mortality in the second period had delayed enrollment or dropped out temporarily from school, possibly to take care of ill members. This could explain why we find a relatively low attendance rate in 2000 but a high attendance rate in 2002 among children who experienced working-age mortality in between 2000 and 2002 (the second period).

The findings in Table 2 suggest a process described in Figure 1. When an adult starts to become ill from AIDS, the probability drops that a school-age child will attend school. Because medical expenses tend to rise at the same time that earnings from the sick member declines, we expect that adjustments in school enrollment will be greater for relatively poor households. After the death of the sick member, the child's likelihood of being in school rises because care giving needs have subsided. However, depending on whether the household has been able to attract additional labor to take over tasks formerly handled by the deceased, the opportunity cost of children's labor may still be perceived to be too high to warrant an immediate return to school. Relatively poor afflicted households may also be less able to continue incurring school fees. By contrast, children in better-off households are less subject to a dramatic "down-up-down" movement, because of their households' greater ability to draw upon savings and assets to maintain desired expenditures in the face of economic shocks.

The picture emerging from Table 2 and Figure 1 are only bivariate associations, which may be spuriously driven by regional differences or household characteristics. Thus, to measure the differences in enrollment rates due to adult mortality, holding other factors constant, we need to employ multivariate techniques. In addition, because HIV infection is influenced by behavioral choices of household members, the possible correlation between working-age adult mortality and unobserved factors in schooling also needs to be controlled for.

4. Estimation Strategies and Variables

Our estimation procedure followed four steps described below. We first develop a working-age mortality model to identify factors associated with children experiencing the death of a working-age member in their household over the entire survey period. Next, we estimate primary school attendance models to examine the effects of mortality on schooling both before and after the timing of the death. Lastly, to examine the robustness of the findings after controlling for time-invariant unobserved effects, we estimate household- and child- fixed effects conditional logit models of child school attendance.

4.1. Estimation Strategies

The Working-Age Adult Mortality Model

Before estimating the impact of working-age adult mortality on schooling, we first estimate the determinants of children's experience of working-age adult mortality in the first period (1997-2000). We focus on the first period because the sample in the first period has a less severe attrition problem than the second period. To examine a relationship between the lagged-HIV prevalence rate and sample attrition, we include a dummy variable for attrition, A_{it}. The attrition variable, A_{it}, equals one for children whose information is not available in 2002. Thus, the working-age adult mortality model is

$$D_{i1997\text{-}2000} = \phi_{HIV}\, HIV_{j\ 1990\text{-}94} + \phi_A\, A_{it} + \phi_X\, X_{it} + e_{it} \qquad (1)$$

where $D_{i1997\text{-}2000}$ is a dummy variable that takes one if child i experienced working-age adult morality in 1997-2000; $HIV_{j\ 1990\text{-}94}$ is the average lagged-HIV-prevalence rate in at the nearest surveillance site in 1990-94; and X_{it} is a vector of child, household, and regional characteristics. We estimate this model with Probit. Because of a long asymptomatic period, we include the lagged-HIV prevalence information from the period of 1990-1994. By estimating ϕ_{HIV} and establishing the relationship between working-age adult mortality and the lagged HIV-prevalence rate, we can examine the extent to which working-age mortality found in the panel data are influenced by HIV/AIDS.

The Primary-School Enrollment Model

The economic theory and estimation models on schooling have been discussed in numerous papers (Strauss and Thomas, 1995; Glewwe, 2002). Following previous studies, we write a simple equation of a school enrollment model as:

$$S_{it} = \beta_{HIV} HIV_{jt-K} + \beta_D D_{it} + \beta_X X_{it} + u_{it} \quad (2)$$

where S_{it} is a dummy which takes one if child i is enrolled in school at time t; other variables are as defined as before. The lagged-HIV prevalence rate at the nearest surveillance site is expected to pick up broader community effects of the AIDS epidemic on child school attendance (separate from the direct effect via afflicted households). However, the lagged HIV-prevalence rate could be correlated with many regional characteristics. For instance, we know from previous studies that HIV prevalence rates tend to be high in areas with major trunk roads where there is a steady influx of outsiders. Thus, we should be cautious when we interpret the results on this variable. We match the lagged mean HIV-prevalence information from 1990-1994 (1992-1996) with the observations of the 2000 (2002) survey because of the 6-10 year average survival time after HIV sero-conversion (Whitworth et al., 2003; Todd, 2003).

Before proceeding, we clarify the notation for survey periods. In the first period (1997 to 2000), which we call $t=1$, the schooling dummy (S_{i1}) indicates whether child i is in school at the time of the 2000 survey. Analogously, S_{i2} indicates whether child i is in school at the time of the 2002 survey. The working-age adult mortality dummy, D_{i1} (D_{i2}) indicates whether child i resides in a household experiencing at least one working-age death in the period between the 1997 and 2000 (2000 and 2002) surveys.

We also want to ascertain whether children's school attendance is affected prior to and/or after the occurrence of a death. This is because the impact of the adult mortality may manifest long before the member actually dies, as discussed in Section 2. We therefore include two categorical variables in the models to account for time of death relative to the observations on child schooling. The post-mortality variable (D_{it-1}), indicates that child *i's* household experiences a working-age death in the period prior to the observation on schooling. For instance, if a child experiences a working-age death in the household in the first period, the post mortality variable (D_{it-1}) takes a value of one in the second period and zero in the first period. The pre-mortality dummy variable, on the other hand, indicates that child *i* experiences a working-age adult death in the next period. For instance, if a child experiences a working-age death in the household in the second period, then the pre-mortality variable (D_{it+1}) takes a value of one in the first period and zero in the second period.

Finally, we also include the attrition dummy variable in Equation 2 to test whether the sample attrition problem may cause an attrition bias in model estimation. If the attrition variable is not significant, then the result indicates that the children whose information is missing in 2002 are not statistically different from other children, after controlling for observed information. This test is proposed by Fitzgerald, Gottschalk, and Moffitt (1998) and used by others, e.g., Alderman et al. (2001).

Thus, the estimated schooling equation is

$$S_{it} = \beta_{HIV}\, HIV_{jt-K} + \beta_D\, D_{it} + \beta_{post}\, D_{it-1} + \beta_{pre}\, D_{it+1} + \beta_A\, A_{it} + \beta_X\, X_{it} + u_{it} \qquad (3)$$

We use pooled data from the 2000 and 2002 surveys in this probit estimation. As discussed in Section 2, the sample is stratified into two groups ranked by initial wealth in 1997, and by gender, to obtain better understandings on the pathways that the adult mortality affects the child schooling.

Lastly, we re-estimate Equation 3 using fixed effects. Household fixed effects models purge the potential correlation between working-age adult mortality variables and unobserved household-fixed effects from the estimates while still being able to estimate the effects of child-specific characteristics, such as relationship to the household head. Further, we can purge child-fixed effects from the estimates by using the child-fixed effects model. We estimate these fixed effects models with conditional logit models.

When estimating Equation 3 with the household- or child-fixed effects model, we cannot include time-invariant variables. In addition, we need to exclude one of the three working-age adult mortality variables (pre-, during-, and post-) because we have only two observations for each child. Therefore, we exclude D_{it} from Equation 3 when we estimate the household- or child-fixed effects model. The pre- and post-mortality variables in the child-fixed effects model measure the difference in probabilities of the same child being in school depending on whether he or she experiences the working-age adult mortality before or after the observation on school.

4.2. Variables

As discussed in Section 2, we have excluded children who had already completed primary school. Thus the dependent variable, S_{it}, is an indicator of whether a child is attending a primary school who is eligible for enrollment. The dummy variable on working-age mortality, D_{t}, equals one if there is at least one working-age adult death in a household during a period t. The HIV-prevalence variable, $HIV_{j\,t-K}$, is the average ratio of pregnant women who visited the nearest urban sentinel surveillance site and tested HIV positive during the five-year period from 1990-94 for the 2000 samples and from 1992-96 for the 2002 samples. Data from 11 such sites, maintained by the National AIDS and STDs Control Programme (NASCOP), were matched at the district-level to all households in the sample (Appendix Table A2). While unobserved time invariant effects are controlled for using child fixed-effects models, it is still possible that the lagged HIV-prevalence term may be picking up the effects of time variant unobservables. With this caveat, we include lagged HIV-prevalence rates in the models to account for broader community level effects of AIDS on child schooling.

We also include an attrition variable equalling one for 345 children whose information is not available in 2002 either because their households were not interviewed in the 2002 survey (75 percent of the 345 children) or they could not be identified by the respondents in their households (25 percent). The descriptive statistics of these and other variables are presented in Appendix Table A1.

Child characteristics include the age of the child, its squared term, and a gender dummy variable for girls. We also include two dummy variables indicating whether the child's relationship to the household head is as a grandchild, nephew, or niece, or as a distant relative or a non-relative who lives in the household.

Because the effects of working-age mortality are potentially devastating, household characteristics that are usually considered exogenous or fixed in most household models could be rapidly and severely affected by adult mortality. Because of this, we feel it is inappropriate to include in the models current values of variables such as asset levels, family size, or landholding size. For this reason, we use household characteristics based on values from the initial 1997 survey. These household characteristics are the years of schooling for the most educated person in the household in 1997; a binary variable for polygamous households; a binary variable for female-headed households in 1997, the acres of land owned in 1997 in logs; and the value of asset holdings in 1997 in logs.

We also include two community variables designed to control (albeit imperfectly) for access to markets and services, and interactions outside the village community: distance of the village to the nearest bus/taxi stop, and distance to the nearest piped water outlet. Finally, five provincial dummies are included, with Eastern Province as the reference province.

5. Results

5.1. Determinants of Experiencing Prime-age Adult Mortality

We first discuss the results from Equation 1, the determinants of the probability of experiencing at least one working-age adult death in the first and second periods. The binary dependent variable, $D_{1997\text{-}2000}$, equals one if a child resides in a household experiencing at least one working-age adult death over this three-year period. Table 3, column A presents the results without including the lagged-HIV prevalence variable.5 As expected from the results in Table 1, children in Nyanza province are 8.5 percent more likely to experience working-age adult mortality in their households than children in Eastern province (the reference group). Once the lagged HIV-prevalence variable is included in column B, however, the estimated coefficient of Nyanza province becomes smaller. This provides evidence that working-age adult mortality in Nyanza province is strongly associated with HIV (and thus AIDS). The lagged-HIV prevalence variable is highly correlated with a child experiencing adult death in his/her household at the one percent level of significance.6

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5 We report the marginal probabilities in Table 3 and the following tables. For dummy variables, the "marginal" probabilities are calculated by changing the value of dummy variables from zero to one, holding other variables constant at their sample means.

6 When we tried the current HIV prevalence rate from 1995-99 instead of the lagged HIV prevalence rate from 1990-94, the size of the estimated coefficient declined to 0.321 (t-stat =5.19) from 0.487 (t-stat=5.22). Thus, the lagged HIV prevalence rate is better correlated with the

On the attrition variable, we find a positive correlation between the attrition variable and the probability of experiencing the adult mortality. Thus, this indicates that the attrition did not occur randomly and suggest a possibility of an attrition bias in the next model where we use the pooled data from the 2000 and 2002 surveys. As far as the results in Table 3 are concerned, we do not need to worry about the attrition bias because we only use the cross-section data from the 2000 survey, before the attrition occurs.

Turning to the other variables in the model, we find that children who are away from bus stops are less likely to experience adult mortality in their households. This is consistent with previous studies that HIV-prevalence rates are relatively high along the major highways, as discussed in section 2.2.

We also find that children in polygamous households have a lower probability of experiencing working-age adult mortality than children in monogamous households. This could be because we do not count polygamous husbands as household members unless the husbands actually live in the sampled household for more than six months. On the other hand, an additional male member in the household increases the probability of children experiencing working-age adult mortality by 1.4 percent. By contrast, the number of female members does not significantly affect the probability. Lastly, a household's landholding size (in acres) positively influences the probability of experiencing working-age adult mortality. This suggests that children who experienced working-age adult mortality in the first period tend to be from households with greater assets and socioeconomic status.

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probability of experiencing the adult mortality than the current HIV prevalence rate as the long-asymptomatic period suggests.

Overall, these results suggest a grave situation for children in rural Kenya in the near future because HIV-prevalence rates among pregnant women at the sentinel surveillance sites have increased between 1990 and 2000 in nine of the eleven urban-sentinel-surveillance sites nationwide (NASCOP, 2001). A simple simulation based on the results in Table 3 indicates that an increase in the HIV-prevalence rate from 5.0 percent to 13.5 percent (from the nationwide level in 1990 to that in 2000) would increase the probability that a child experiences the death of a working-age adult over next five years from 2.39 percent to 6.07 percent.[7] Thus, unless there is significant progress in reducing HIV prevalence rates, there will be a significant increase in the number of rural children in Kenya faced with the death of a working age adult in their households.

5.2. Impact of Working-age Adult Mortality

In Table 4 and 5, we present the Probit results based on Equation 3. First, we estimate the model for all children. Second, we stratified the sample into two groups based on the initial wealth in 1997. Finally, we stratified the sample by gender (Table 5).

The HIV prevalence rate

The results in Table 4 indicate that the HIV prevalence rate at the nearest sentinel site negatively influences children's schooling among the poor (children in households whose total asset value was below the median in 1997). A simple simulation based on the results among the

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7 These probabilities are calculated after changing the value of the HIV prevalence variable from one value to another, using mean sample values of all other variables except the HIV prevalence.

poor in Table 4 (column B) indicates that the probability of attendance decreases by 2.5 percentage points from 92.1 percent to 89.6 percent when the HIV prevalence rate increases from 5.0 percent to 13.5 percent (from the 1990 level to the 2000 level). We find no significant impact of the HIV prevalence rate on child schooling among the relatively less poor.

The HIV prevalence rate may be capturing the indirect effects of the HIV/AIDS epidemic, other than the direct household-level effects of adult mortality on schooling, because we already include information on working-age adult mortality in the model. However, it is also possible that the HIV prevalence rate and child school attendance are correlated through other regional factors.

The working-age adult mortality

Working-age adult mortality does not significantly influence children's schooling at the time of death. But it negatively affects children's schooling before and after they experience working-age adult mortality among the poor (column B in Table 4). When we stratify the sample by gender, we find a larger negative impact of the pre-mortality variable among girls than boys in poor households (column C and D in Table 5). This indicates that girls are likely to be taking care of the sick members in the households prior to their deaths. The result indicates that girls in the poor households are 15.1 percent less likely to be in school in a period prior to the adult mortality, while boys are 12.4 percent less likely to be in school during the same period. The both estimated coefficients are significant at the 10 percent level.

Among the boys, we find a strong negative impact of the post-mortality variable on schooling (-0.258, t-stat = -3.62), especially among the poor. The result indicates that boys in the poor households are 25.8 percent less likely to be in school for some time after a death of a working-age member. This could be because boys are replacing the loss of family labor in farm production or other income generating activities, or that school fees can no longer be afforded. Even among the less-poor households, we find a negative yet much smaller and weaker impact of the post mortality variable on boys' schooling (-0.062 with t-stat=-1.64).

Fixed effects models

Next, we estimate various fixed effects models based on Equation 3 to determine the effects of adult death on child school attendance (Table 6). Again, we estimate the model separately for the poor and non-poor (columns B and C). We present the results from conditional logit models with household-fixed effects and with child-fixed effects. Note, however, that only observations with variations in the dependent variable within a group can be included for estimations in conditional logit models. This is why there are fewer observations in the conditional logit models. Especially when we stratify the sample by initial wealth, the number of observations declines significantly and many estimators are no longer precisely identified. Thus, we face a trade-off between the consistency and efficiency. Because of this trade-off, we use the results in Table 6 mainly as a check for robustness of the results in Table 4 and 5.

The results in Table 6 indicate that even after controlling for the child-fixed effects, the lagged HIV prevalence rate retains its significantly negative influence on schooling among the poor. Thus, the lagged HIV-prevalence rate is not only representing the fixed relationship between the lagged HIV-prevalence rate and schooling but also a relationship between a change in the lagged HIV-prevalence rate and a change in schooling. We do not find any significant influence of the lagged HIV-prevalence rates on school attendance among the non-poor.

Turning to the effects of a working-age adult death in the household, we find that children in the relatively poor households are less likely to be in school in the one to two year period before their households experience a working-age death. The household fixed effects models also indicate that within the household, there is no significant difference in schooling between household heads' own children and grandchildren, nephews, and nieces. The only group of children who are less likely to be in school compared with the household heads' own children in the same household is "non-relative" children who have distant relationships or no relationship with the household heads. These results are similar to those found by Case, Paxson, and Aleidinger (2002) and suggest that children are treated equally as long as they are living with their close relatives. Unfortunately, because we do not know the orphan-status of all sampled children, we cannot determine whether orphans are treated differently than non-orphans in their relatives' households. However, there is likely to be some overlap between the "non-relative" category and those children in the sample who are orphans.

6. Conclusions

A rapidly increasing mortality rate among adults due to the AIDS epidemic in sub-Saharan Africa has raised concerns about intergenerational effects, including child education. Using a panel of 1,422 households in rural Kenya, we first estimated the determinants of primary school-aged children experiencing working-age adult mortality. We find a high correlation between lagged HIV-prevalence at nearby urban sentinel surveillance sites and the probability that a child aged 7 to 14 years experiences the death of a working-age adult in his or her household. The lagged HIV prevalence rate is negatively correlated with primary school attendance, especially among girls, and in relatively poor households (those whose initial asset levels at the time of the first survey in 1997 were below the median) even after controlling for working-age adult mortality. These findings may indicate that there are important community impacts of the HIV/AIDS epidemic on schooling among the poor, although it cannot be ruled out that this variable is picking up unobserved and unrelated factors correlated with these changes in HIV prevalence over time.

We also find that children, especially girls, in relatively poor households are less likely to be in school in the period prior to the adult death in their household compared with children in unafflicted households. In the 1-2 year period directly after the death of an adult, there is a significant decline in the probability that boys in relatively poor households attend school. The fact that we find larger impacts among the poor could be because households closer to the edge of economic survival are forced to take more extreme measures to adjust to major shocks to their livelihoods, even at the expense of long-run human capital development, than their neighbors. Because they have fewer options, poor households appear more likely to reallocate their children's time from schooling to care-giving for sick adults or to providing labor to compensate for the lost labor of the sick adult. However, because of this study spans only a few years, it is unclear whether the effects on schooling as measured in this study are long-term or only temporary.

Because of limited capacity of local hospitals compared with the overwhelming number of AIDS patients, most AIDS patients are taken care of at their homes in rural areas. Although home-based care should be promoted to ease the burden on the medical system in rural areas, children appear to be bearing part of the burden of taking care of the sick. Policies to reduce the burden of taking care of the sick at home, such as improved community health care systems, may have an added advantage of helping afflicted households keep their children in school.

In Kenya, primary school enrollment rates are high compared with neighboring countries. Thus, it is quite possible that we would find much larger impacts of the working-age adult mortality on the primary school enrollment in other countries. There is a need to deepen our understanding on the impacts of adult mortality on child schooling in countries that are suffering from the AIDS epidemic so that governments and donor institutions can determine the best use of limited financial and human resources to mitigate the impacts of HIV/AIDS. Otherwise, there is the risk that the AIDS epidemic may produce as yet unanticipated intergenerational consequences on human capital development that might have been mitigated if understood and addressed earlier.

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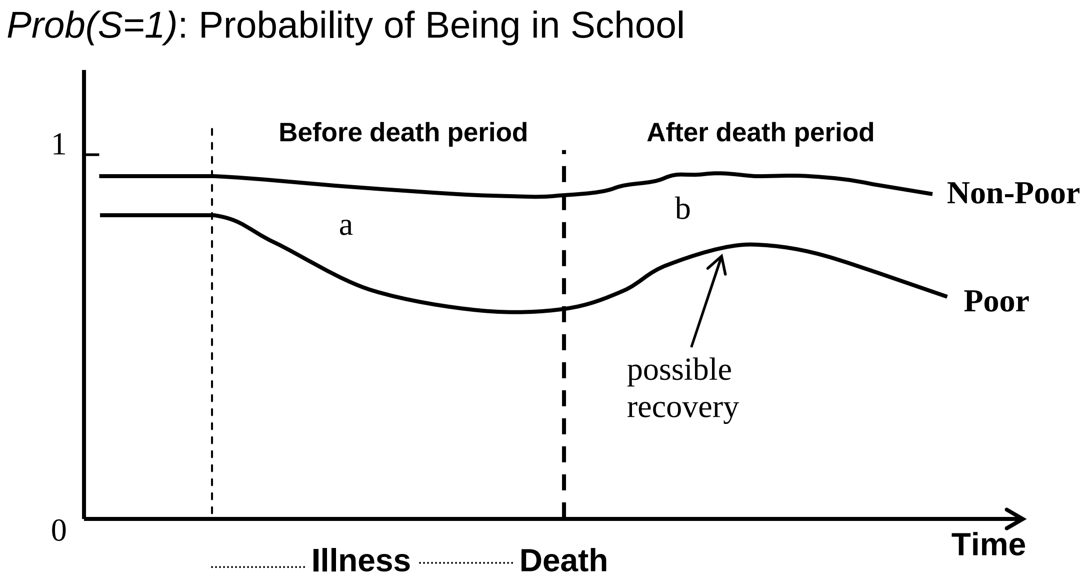

Figure 1. Impact of Working-age Adult Mortality: Hypotheses

Notes: (a) hypothesized decline in probability of school attendance due to greater opportunity cost of children's time and financial resources. (b) possible recovery period due to reduced demands on children's time for care giving.

Table 1. Working-Age [a] Adult Mortality and School Enrollment in Rural Kenya

Province District	Sampled Households in 1997 & 2000[b]	Sampled Households in 1997, 2000, & 2002[c]	Households incurring working-age mortality, 1997-2002	% of Children aged 7-14 in School 2000	% of Children aged 7-14 in School 2002	HIV prevalence at urban sentinel sites in 1990-94[d]
	(A)	(B)	(C)	(D)	(E)	(F)
			- % -	- % -	- % -	- % -
Coastal	88	71	11.4	59.0	67.5	13.2
Eastern	233	215	6.4	87.1	94.0	6.3
Nyanza	262	245	17.6	89.0	88.2	12.6
Kisumu/Siaya	177	176	23.7	88.4	84.8	21.6
Kisii	85	69	4.7	90.2	95.4	3.6
Western	290	272	7.2	80.9	82.4	15.8
Central	174	164	5.2	92.3	88.5	9.6
Rift Valley	375	299	5.3	87.8	88.0	12.3
Total	1,422	1,266	8.5	89.7	88.3	

Source: Tegemeo Institute/Egerton University Agricultural Monitoring and Policy Analysis Household Surveys in 1997 and 2000. National AIDS and STDs Control Programme (NASCOP, 2001)

Note: (*a*) Working-age is defined as 15-49 for women and 15-54 form men. (*b*) Sample is restricted to households that were interviewed in the 1997 and 2000 surveys. (*c*) Sample is restricted to households that were interviewed in the 1997, 2000, and 2002 surveys. (*d*) The average percentage of pregnant women who visited the urban-sentinel-surveillance sites and tested HIV positive in 1990-1994. Data are taken from 11 urban sentinel surveillance sites (NASCOP, 2001).

Table 2. Primary School Enrollment by Working-age Adult Mortality

	Did household incur Working-age Mortality?					
	NO		**YES** between 1997-2000		**YES** between 2000-2002	
	2000 (A)	2002 (B)	2000 (C)	2002 (D)	2000 (E)	2002 (F)
All Children						
Enrollment (%)	90.1	88.8	91.1	81.6	70.0	89.6
Grade (years)	3.50	2.88	3.58	2.86	2.78	2.38
Age (years)	10.7	10.8	10.7	10.9	10.5	10.7
Number	2,358	1,934	157	125	50	48
Poor						
Enrollment (%)	88.4	86.9	86.4	72.1	61.3	83.3
Grade (years)	3.25	2.66	3.62	2.44	2.03	1.90
Age (years)	10.6	10.7	10.8	10.7	10.1	10.5
Number	1,170	951	66	43	31	30
Non-Poor						
Enrollment (%)	91.8	90.6	94.5	86.6	84.2	100
Grade (years)	3.75	3.09	3.55	3.09	4.00	3.17
Age (years)	10.8	10.8	10.6	10.9	11.1	10.9
Number	1,188	983	91	82	19	18

Source: Tegemeo Institute (Nairobi)/Michigan State University Agricultural Monitoring and Policy Analysis Household Surveys in 1997, 2000, and 2002.

Table 3. Determinants of Children Experiencing Working-age Adult Mortality in Their Household, 2000 Survey Sample (Probit[a])

	Working-age adult mortality in 1997-2002: Prob ($D_{1997\text{-}2000}$=1)	
	(A)	(B)
HIV Prevalence rate		
Ratio of *HIV+* pregnant women		0.487
In 1990-94		(5.22)**
Attrition in 2002		
Attrition Dummy (=1)	0.027	0.021
	(2.15)*	(1.75)
Province Dummies		
Nyanza province	0.085	0.050
	(5.14)**	(3.32)**
Coastal province	0.020	0.026
	(1.00)	(1.29)
Western province	-0.013	-0.002
	(0.94)	(0.15)
Central province	-0.035	-0.007
	(2.21)*	(0.34)
Rift Valley province	-0.024	-0.017
	(2.11)*	(1.51)
Household Characteristics		
Max. years of male schooling	-0.001	0.000
	(0.46)	(0.02)
Max. years of female schooling	-0.001	-0.001
	(0.98)	(1.16)
Female headed (=1)	0.001	-0.005
	(0.05)	(0.29)
Polygamous household (=1)	-0.023	-0.025
	(2.09)*	(2.48)*
Number of male adults	0.014	0.012
	(3.58)**	(3.32)**
Number of female adults	-0.003	-0.002
	(0.57)	(0.44)
Land tenure (=1)	0.012	0.013
	(1.41)	(1.48)
ln (Landholding size in acres)	0.011	0.009
	(2.01)*	(1.83)
ln (Asset value, Shillings)	0.001	0.001
	(0.60)	(0.77)
Distance to Bus Stop (km)	-0.004	-0.005
	(1.87)	(2.34)*
Distance to Piped Water (km)	-0.000	0.000
	(0.02)	(0.29)
Child Characteristics		
Age in years	0.007	0.008
	(0.34)	(0.41)
Age squared	-0.000	-0.000
	(0.45)	(0.50)
Girl (=1)	-0.001	-0.001
	(0.09)	(0.13)
Grand child, Nephew, Niece (=1)	0.019	0.009
	(1.78)	(0.95)
Non Relative (=1)	0.018	0.012
	(0.77)	(0.54)
Number of children	2,565	

Note: Numbers in parentheses are absolute z-scores. ** indicates 1 percent significance level; * indicates 5 percent significance level. (*a*) Estimated coefficients are marginal changes in probability.

Table 4. The Impact of Prime-age Adult Mortality on School Attendance, Pooled 2000 and 2002 Data (Probit[a]), Dependent Variable: Prob(S_{it} =1)

	All (A)	**Poor** (B)	**Non-Poor** (C)
HIV Prevalence at surveillance sites			
Ratio of *HIV+* pregnant women of 1990-94 at 2000, 1992-96 at 2002	-0.215	-0.310	-0.141
	(2.94)**	(3.19)**	(1.23)
Working-age Adult Mortality			
D_t: *Working-age Adult Death at* t	0.018	0.015	0.024
	(1.35)	(0.82)	(1.68)
D_{t+1}: *Pre-death Period*	-0.099	-0.143	-0.006
	(2.68)**	(2.48)*	(0.19)
D_{t-1}: *Post-death Period*	-0.060	-0.106	-0.024
	(2.70)**	(2.50)*	(1.16)
Attrition in 2002			
Attrition Dummy (=1)	0.011	-0.015	0.020
	(0.95)	(0.78)	(1.47)
Child Characteristics			
Age in years	0.026	0.015	0.027
	(1.85)	(0.73)	(1.70)
Age squared	-0.002	-0.002	-0.002
	(2.68)**	(1.62)	(2.16)*
Girl (=1)	0.001	-0.004	0.008
	(0.19)	(0.50)	(1.07)
Grade completed, splined at 3rd grade	0.073	0.105	0.044
	(21.27)**	(16.76)**	(12.47)**
Grade completed, 3rd and higher	-0.012	-0.022	-0.005
	(3.89)**	(4.87)**	(1.30)
Grand child, Nephew, Niece (=1)	-0.002	0.012	-0.023
	(0.21)	(1.10)	(2.22)*
Non Relative (=1)	-0.341	-0.294	-0.340
	(12.16)**	(5.92)**	(10.67)**
Household Characteristics			
Max. years of male schooling	-0.001	0.000	-0.003
	(1.48)	(0.05)	(2.43)*
Max. years of female schooling	0.004	0.005	0.002
	(3.68)**	(3.41)**	(1.44)
Female headed (=1)	0.022	0.036	-0.022
	(1.53)	(2.23)*	(0.73)
Polygamous household (=1)	0.011	0.013	0.009
	(1.33)	(1.13)	(0.87)
Number of male adults	-0.001	-0.001	0.000
	(0.17)	(0.20)	(0.02)
Number of female adults	-0.005	-0.010	-0.001
	(1.71)	(1.91)	(0.44)
Land tenure (=1)	0.004	-0.005	0.002
	(0.63)	(0.46)	(0.19)
ln (Landholding size in acres)	-0.004	0.009	-0.007
	(0.92)	(1.26)	(1.59)
ln (Asset value, Shillings)	0.003	0.004	0.003
	(2.51)*	(2.22)*	(1.20)
Distance to Bus Stop (km)	-0.001	-0.000	-0.001
	(1.87)	(0.22)	(2.83)**
Distance to Piped Water (km)	0.002	0.003	0.002
	(1.66)	(1.45)	(1.37)
Year 2002	0.018	0.026	0.017
	(2.77)**	(2.72)**	(2.15)*
Number of children	4,672	2,291	2,381

Note: Numbers in parentheses are absolute z-scores. ** indicates 1 percent significance level; * indicates 5 percent significance level. (*a*) Estimated coefficients are marginal changes in probability.

Table 5. The Impact of Prime-age Adult Mortality on Child School Attendance by Gender, Pooled 2000 and 2002 Data (Probit[a]), Dependent Variable: Prob(S_{it} =1)

	All		Poor		Non-Poor	
	Boys	Girls	Boys	Girls	Boys	Girls
	(A)	(B)	(C)	(D)	(E)	(F)
HIV Prevalence at surveillance sites						
Ratio of *HIV+* pregnant women	-0.230	-0.131	-0.186	-0.369	-0.187	0.036
of 1990-94 at 2000, 1992-96 at 2002	(2.31)*	(1.27)	(1.65)	(2.64)**	(1.22)	(0.23)
Working-age Adult Mortality						
D_t: *Working-age Adult Death at* t	-0.003	0.032	-0.025	0.033	0.018	0.026
	(0.15)	(1.86)	(0.95)	(1.49)	(0.97)	(1.41)
D_{t+1}: *Pre-death Period*	-0.082	-0.123	-0.124	-0.151	0.026	-0.105
	(1.65)	(2.22)*	(1.80)	(1.77)	(0.80)	(1.41)
D_{t-1}: *Post-death Period*	-0.145	0.009	-0.258	0.015	-0.062	0.009
	(3.72)**	(0.39)	(3.62)**	(0.34)	(1.64)	(0.44)
Attrition in 2002						
Attrition Dummy (=1)	0.015	0.007	0.003	-0.027	0.016	0.014
	(0.99)	(0.43)	(0.16)	(0.93)	(0.90)	(0.79)
Child Characteristics						
Age in years	0.035	0.006	0.028	-0.009	0.034	0.020
	(1.94)	(0.31)	(1.28)	(0.30)	(1.56)	(0.94)
Age squared	-0.002	-0.001	-0.002	-0.001	-0.002	-0.001
	(2.40)*	(0.94)	(1.85)	(0.39)	(1.79)	(1.23)
Grade completed, splined at 3rd grade	0.072	0.070	0.088	0.107	0.044	0.036
	(15.93)**	(13.85)**	(11.99)**	(11.27)**	(9.41)**	(7.67)**
Grade completed, 3rd and higher	-0.017	-0.011	-0.023	-0.020	-0.009	-0.004
	(4.17)**	(2.38)*	(4.52)**	(3.04)**	(1.93)	(0.78)
Grand child, Nephew, Niece (=1)	-0.011	0.005	-0.011	0.029	-0.020	-0.025
	(1.11)	(0.43)	(0.88)	(1.91)	(1.45)	(1.81)
Non Relative (=1)	-0.549	-0.148	-0.617	-0.046	-0.504	-0.164
	(11.84)**	(4.46)**	(6.66)**	(0.94)	(9.31)**	(4.58)**
Household Characteristics						
Max. years of male schooling	-0.002	0.000	0.001	0.000	-0.004	-0.001
	(1.97)*	(0.02)	(0.47)	(0.01)	(2.77)**	(0.49)
Max. years of female schooling	0.003	0.004	0.002	0.007	0.003	0.000
	(2.41)*	(2.68)**	(1.41)	(3.22)**	(1.84)	(0.13)
Female headed (=1)	0.008	0.034	0.020	0.049	-0.056	-0.004
	(0.41)	(1.68)	(1.11)	(2.11)*	(1.15)	(0.12)
Polygamous household (=1)	0.007	0.014	-0.012	0.033	0.023	-0.001
	(0.60)	(1.17)	(0.78)	(2.05)*	(1.69)	(0.09)
Number of male adults	0.004	-0.006	0.004	-0.005	0.004	-0.003
	(0.93)	(1.33)	(0.75)	(0.72)	(0.86)	(0.69)
Number of female adults	-0.004	-0.007	-0.008	-0.012	-0.000	-0.004
	(1.09)	(1.55)	(1.56)	(1.45)	(0.02)	(0.85)
Land tenure (=1)	0.007	-0.001	-0.000	-0.011	0.002	-0.002
	(0.75)	(0.09)	(0.01)	(0.69)	(0.15)	(0.19)
ln (Landholding size, acres)	-0.003	-0.001	0.003	0.011	-0.005	-0.006
	(0.47)	(0.18)	(0.43)	(1.18)	(0.92)	(1.04)
ln (Asset value, Shillings)	0.003	0.003	0.003	0.002	0.000	0.007
	(1.73)	(1.79)	(1.89)	(1.00)	(0.09)	(1.83)
Distance to Bus Stop (km)	-0.000	-0.001	0.000	-0.000	-0.001	-0.001
	(1.25)	(1.56)	(0.83)	(0.63)	(2.78)**	(2.02)*
Distance to Piped Water (km)	0.004	0.000	0.002	0.004	0.006	-0.001
	(2.43)*	(0.03)	(0.82)	(1.47)	(2.83)**	(0.67)
Year 2002	0.022	0.011	0.026	0.023	0.021	0.004
	(2.45)*	(1.11)	(2.35)*	(1.63)	(2.00)*	(0.42)
Number of children	2,421	2,251	1,197	1,094	1,224	1,157

Note: Numbers in parentheses are absolute z-scores. ** indicates 1 percent significance level; * indicates 5 percent significance level. (*a*) Estimated coefficients are marginal changes in probability.

Table 6. The Impact of Prime-age Adult Mortality on Child School Attendance, Controlling for Fixed Effects, Pooled 2000 and 2002 Data (Conditional Logit)

	All		**Poor**		**Non-Poor**	
	HH FE (A)	Child FE (B)	HH FE (C)	Child FE (D)	HH FE (E)	Child FE (F)
HIV Prevalence rate						
Ratio of *HIV*+ pregnant women	-12.82	-47.89	-28.63	-50.02	21.90	-31.65
of 1990-94 at 2000, 1992-96 at 2002	(1.02)	(2.59)**	(1.81)	(2.16)*	(1.02)	(0.83)
Working-age Adult Mortality						
D_{t+1}: Pre-death Period	-1.745	-1.770	-1.783	-1.252	-32.51	-38.88
	(2.09)*	(1.58)	(1.94)	(1.05)	(0.00)	(0.00)
D_{t-1}: Post-death Period	-1.075	-0.958	-0.702	-0.061	-1.369	-38.84
	(1.66)	(1.22)	(0.88)	(0.06)	(1.28)	(0.00)
Child Characteristics						
Age in years	0.766	1.241	0.510	2.195	1.174	-0.196
	(2.04)*	(1.78)	(1.00)	(2.21)*	(2.04)*	(0.16)
Age squared	-0.043	-0.058	-0.031	-0.108	-0.060	0.003
	(2.38)*	(1.80)	(1.26)	(2.36)*	(2.20)*	(0.05)
Girl (=1)	-0.015		0.137		-0.199	
	(0.09)		(0.59)		(0.71)	
Grade completed, splined at 3rd	1.342	0.599	1.523	0.887	1.136	0.664
	(11.7)**	(3.60)**	(9.65)**	(3.48)**	(6.66)**	(2.30)*
Grade completed, 3rd and higher	-0.394	-0.796	-0.512	-0.607	-0.305	-1.543
	(4.21)**	(2.87)**	(4.08)**	(1.83)	(2.05)*	(2.17)*
Grand child, Nephew, Niece (=1)	0.028		0.369		-0.477	
	(0.07)		(0.74)		(0.77)	
Non Relative (=1)	-2.883		-2.088		-3.366	
	(6.71)**		(3.21)**		(5.75)**	
Year 2002 (=1)	0.384	0.916	0.509	0.912	-0.034	1.108
	(1.47)	(1.74)	(1.46)	(1.35)	(0.08)	(1.10)
Number of observations	1,396	270	792	178	604	92

Note: Numbers in parentheses are absolute z-scores. ** indicates 5 percent significance level; * indicates 10 percent significance level.

Appendix Table A1. Descriptive Statistics by Gender, Pooled 2000 and 2002 Survey Data

	Mean	Std. Error	Min	Max
Schooling				
School Attendance (=1)	0.891	0.311	0	1
HIV Prevalence rate				
Ratio of *HIV+* pregnant women	0.129	0.053	0.036	0.250
Working-age Adult Mortality				
D_t: Working-age Adult Death at t (=1)	0.043	0.202	0	1
D_{t+1}: Pre-death Period (=1)	0.009	0.097	0	1
D_{t-1}: Post-death Period (=1)	0.027	0.161	0	1
Attrition in 2002				
Attrition Dummy (=1)	0.074	0.262	0	1
Child Characteristics				
Age in years	10.71	2.247	7	14
Girl (=1)	0.482	0.500	0	1
Grade completed	3.209	2.168	0	7
Grand child, nephew, niece (=1)	0.226	0.418	0	1
No relative child (=1)	0.040	0.196	0	1
Household Characteristics				
Max. years of male schooling	8.040	4.473	0	18
Max. years of female schooling	7.355	3.992	0	17
Female headed (=1)	0.057	0.232	0	1
Polygamous household (=1)	0.136	0.342	0	1
Number of male adults	1.824	1.214	0	8
Number of female adults	1.850	1.171	0	8
Land tenure (=1)	0.383	0.486	0	1
ln (Landholding size in acres)	1.511	0.902	0	4.615
ln (Asset value, Shillings)	5.695	4.359	0	15.85
Distance to Bus Stop (km)	2.313	2.626	0	20
Distance to Piped Water (km)	9.054	11.94	0	70
Year 2002 (=1)	0.451	0.498	0	1
Number of observations		4,672		

Source: Tegemeo Institute (Nairobi)/Michigan State University Agricultural Monitoring and Policy Analysis Household Surveys in 1997, 2000, and 2002.

Appendix Table A2. Three-Year Average HIV-Prevalence Rates Among Pregnant Women At Urban Sentinel Surveillance Sites

City	1990-94	1992-96	1995-99	2000 only
Busia	20.4	25.0	28.6	22.0
Kakamega	11.2	12.0	12.0	12.0
Kisii	3.6	6.4	12.6	16.0
Kisumu	21.6	24.4	28.2	35.0
Kitale	9.8	12.4	12.6	17.0
Kitui	7.2	7.6	6.6	14.0
Meru	5.3	9.5	18.4	35.0
Mombasa	13.2	13.4	15.3	12.0
Nairobi	14.3	17.6	20.0	n.a.
Nakuru	14.8	15.7	22.0	11.0
Nyeri	5.0	6.8	11.0	14.0

Source: NASCOP (2001).