

Left Behind: Intergenerational Transmission of Human Capital and Health Status in the Midst of HIV¹

Mevlude Akbulut-Yuksel
Dalhousie University, IZA and HICN

Belgi Turan
University of Houston

This version: September 2009

Initial draft: February 2008

Abstract

It has been over twenty-five years since the HIV/AIDS epidemic began; yet, it continues to be one of the most serious infectious diseases in the world affecting millions of people internationally. Children may be especially adversely affected by this epidemic given the age-specific aspects of human capital investment. Using information on mother's HIV status contained in recent rounds of the Demographic and Health Surveys, this paper estimates the effects of the HIV/AIDS on intergenerational transmission of education and health status across generations in sub-Saharan Africa. We examine two potential causal mechanisms: mother's HIV status and community HIV prevalence. First, we find that the intergenerational education correlation is 0.26 for five sub-Saharan African countries. Second, our results show that mother's HIV status has substantial and detrimental effect on transmission of human capital across generations, where children of HIV positive mothers are 45% less likely to inherit their mothers' human capital. Third, we find evidence that among non-infected mothers with the same level of education, children in high HIV prevalence communities are less likely to attend school. Moreover, mother's HIV status has stronger negative effects on correlation coefficient relative to community HIV prevalence both along extensive and intensive margins of child's human capital. Since slightly more educated mothers are more likely to be HIV-positive and communities with better human capital endowments have higher HIV prevalence, the findings of this paper suggest that HIV epidemic may be deteriorating the existing stocks of human capital and the intergenerational transfer of that human capital in sub-Saharan Africa. This result is particularly distressing for these already poor countries as in the future they will have even lower overall level of human capital due to the epidemic.

JEL Codes: O12, I1, I2

Key words: HIV/AIDS, Intergenerational Transmission, Human Capital Investment

¹ Akbulut-Yuksel: Assistant Professor, Dalhousie University, Halifax, NS, Canada (email:mevlude@dal.ca); Turan: Ph.D. Candidate, University of Houston, Houston, TX (email:belgituran@gmail.com). We are especially grateful to Chinhui Juhn, for very useful comments and discussions. We also thank Randall Akee, Gary Solon, Mutlu Yuksel and seminar participants at 2009 IZA Mini Workshop; 2008 SOLE; 2008 World Congress of the International Economic Association and University of Houston Workshop for their helpful comments and suggestions. We are responsible for any errors that may remain.

1. Introduction

It has been over twenty-five years since the HIV/AIDS epidemic began; yet, it remains as one of the most serious infectious disease challenges in public health. Even though the HIV prevalence has leveled off and the number of new infections has fallen, there are still 33.2 million people living with HIV across the globe, 2.5 million of which became newly infected, and 2.1 million people have died of AIDS in 2007 alone (UNAIDS/WHO, 2007). HIV/AIDS is the single largest cause of mortality in Sub-Saharan Africa. More than two thirds (68%) of all HIV-positive people reside in this region and this is where more than three quarters (76%) of all AIDS deaths occurred in world in 2007 (UNAIDS/WHO, 2007). Estimates suggest that the majority of people living with HIV in sub-Saharan Africa (61%) are women. This substantial HIV prevalence among women raises serious concerns about the next generation as they are the primary caregivers of children. Therefore, HIV/AIDS epidemic not only destroys existing human capital, it is also likely to hinder the mechanism through which knowledge and abilities are transmitted from one generation to the next.

In fact, it is well established that there is a strong causal association between parent's human capital and that of their children in the US and the European countries. This high correlation between parents' and children's schooling is attributed to the genetic transmission of ability (nature) (Becker and Tomes, 1986) or to parental income and/or wealth, access to pre-school facilities, parental care, parental role model and out-of-school environment that makes schooling more or less accessible (nurture). However, the literature provides limited formal evidence on these potential underlying mechanisms. Among others, even less is known about how being in a disease environment and having a sick parent affect intergenerational transmission of human capital.

In this paper, we first estimate the intergenerational transmission of human capital over generations in the developing economies in sub-Saharan Africa. Given the high HIV prevalence in the region, the second question considered is whether the disease environment alters the human capital transfers from parents to children. We separately analyze the impact of mother's own HIV infection and community HIV prevalence on child's human capital to differentiate household effects from community effects.

This should be of interest for several reasons. First, due to the data limitations, intergenerational transmission of human capital has not been documented extensively for sub-Saharan Africa. Since educational attainment is a good predictor of adult earnings and productivity, the extent of intergenerational transfer of human capital will also provide some insights on the transmission of economic status and income in these countries. Second, while the strong causal relation between parent's human capital and that of their children is well established, understanding the factors that explain this correlation is a recent research interest. This paper adds to this growing literature by analyzing the impact of differential exposure to disease across parents with different socio-economic status. We distinguish between two separate channels that are likely to differentially affect child's human capital by separately examining the effect of mother's/father's HIV status and the community HIV prevalence on the intergenerational education correlation coefficient. We expect that distinguishing mother's/father's HIV status from that of the community will provide insights into the "nature" vs. "nurture" components of intergenerational human capital transfers. Third, this paper sheds light on the potential consequences of growing up in a disease environment on children's human capital formation. Developing economies in sub-Saharan Africa and other parts of the world still suffer from infectious diseases. Understanding the

extent of detrimental effects of having HIV-positive parents and/or being in a high HIV prevalence community on children's human capital accumulation, policymakers can devise better policies and programs to alleviate the negative consequences of this disease.

Our study utilizes newly available micro data from nationally representative surveys to examine the changes in the intergenerational education correlation in countries with high HIV/AIDS prevalence. In the latest rounds of the Demographic Health Surveys (DHS), HIV-testing was administered in 16 African countries. We use 5 of these countries for which we also have an older survey that can be linked at the regional level. For recent waves of DHS, we are able to link individual woman's demographic data to her own HIV status as well as to her children's demographic data. We use earlier rounds to be able to control for unobserved heterogeneity at the regional level. Therefore, this dataset allows us to explore both cross-sectional variation and the long-term changes in transmission that is induced by HIV/AIDS.²

The advantages of this data are multi-fold. First, previously available data are believed to be overestimating the prevalence since they were based on women attending prenatal clinics. However, our data are based on a representative sample of the population. Second, since we have HIV status at the individual level, we can utilize individual level variation in HIV infection to examine the relationship between intergenerational correlation of human capital and HIV/AIDS epidemic at the household level and regional level separately.

To preview our results, we find that the intergenerational education coefficient for 5 sub-Saharan African countries is 0.26, which is virtually similar to corresponding Scandinavian estimates. Second, our results show that mother's HIV status has substantial,

² Although we have a significantly smaller data set when we restrict ourselves to 5 countries, the results change only slightly compared to the analysis using all countries that HIV data is available. Therefore, since this is a more robust identification, we stick to 5 country sample in the empirical analysis.

detrimental effects on the transmission of human capital across generations, i.e. children of HIV positive mothers are 45% less likely to inherit their mothers' human capital. Third, we find evidence that among mothers with the same level of education, children residing in high HIV communities are less likely to attend school. Moreover, mother's HIV status has stronger negative effects on intergenerational human capital transmission relative to community HIV prevalence both along extensive and intensive margins of child's human capital. The findings of this paper are in accord with the existing literature stating the detrimental impact of HIV/AIDS on accumulation of human capital and underlining the importance of preventing HIV/AIDS, which must be a first order policy concern as the epidemic has impacts beyond the current generation.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 provides conceptual framework for the impacts of HIV epidemic on intergenerational education correlation. Section 4 describes the data used in the analyses. Section 5 discusses the empirical strategy and presents the main results. Section 6 reports the extensions and robustness checks. Section 7 concludes.

2. Literature Review

First of all, our study is closely related to the literature looking at association between life expectancy and economic development.³ Other than directly looking at growth, more recent studies look at the determinants of growth, such as education, fertility, labor force participation, to examine the effect of improvements in health and life expectancy. Miguel and Kremer (2004) and Bleakley (2007) show that eradication of hookworm disease

³ There is no consensus on the direction or even the existence of a correlation between life expectancy and economic growth. Shastri and Weil (2003), Weil (2007), Lorentzen, McMillan and Wacziarg (2008) find positive effects of life expectancy on economic growth, whereas, Acemoglu and Johnson (2007) find no effects.

increased school attendance in Kenya and American South, respectively. Jayachandran and Lleras-Muney (2009) find similar evidence in Sri Lanka suggesting that improvements in life expectancy increased literacy and years of schooling.

As a shock to life expectancy, HIV/AIDS provides a valuable experiment to study the impact of mortality on growth.⁴ Mainly focusing on orphans, the existing literature has established that HIV/AIDS epidemic has significant negative impacts on educational attainment. Case, Paxson, Ableidinger (2004) in sub-Saharan countries, Case and Ardington (2006) in South Africa, Evans and Miguel (2007) in Kenya show that HIV/AIDS epidemic substantially hinders the human capital accumulation of orphaned children. On the other hand, few studies show that HIV/AIDS epidemic has adverse effects beyond orphans through changing incentives for human capital investment among non-orphans too. For instance, Meltzer (1992) reviews the existing literature and presents estimates suggesting that the AIDS epidemic can have a strong negative effect on the incentive to invest in education. Using data from Demographic and Health Surveys (DHS) in sub-Saharan Africa, Fortson (2007) also shows that high local HIV/AIDS prevalence significantly impedes the human capital investment for non-orphan women born after 1980s.

Several prior studies have also analyzed the effects of HIV epidemic on fertility revisiting the question of quality-quantity trade-off in the presence of the epidemic. Using cohort-by-country variation in HIV infection and fertility, Young (2005) estimates a large negative effect of HIV prevalence on fertility. Juhn, Kalemli-Ozcan and Turan (2008), on

⁴ Bloom and Mahal (1997) find that the AIDS epidemic had no effect on GDP growth. Bonnel (2000), on the other hand, shows a negative relationship. Corrigan, Gloom, and Mendez (2005) show calibration results that imply large negative effects of the epidemic on growth. Werker, Ahuja, and Wendell (2006) instrument HIV/AIDS prevalence by national circumcision rates and show that there is no impact of the epidemic on growth or savings. Papageorgiou and Stoytcheva (2008), on the other hand, find a negative effect on the level of income per capita.

the other hand, show that the disease significantly lowers an infected woman's fertility, but local HIV prevalence has no significant effect on non-infected women's fertility. Fortson (2009) confirms the lack of any significant effect on fertility. Therefore, given this empirical evidence, it is of interest to investigate whether exposure to HIV/AIDS epidemic alters infected mothers' incentives to transfer more or less of their human capital to their reduced number of children.

This study also contributes to the literature on intergenerational mobility of human capital. Haveman and Wolfe (1994) review the literature and conclude that parents' education is the most important factor in explaining children success at school. Among others, Couch and Dunn (1997) examine the intergenerational education correlation in the U.S. and Germany and find that children inherit around 40 percent of their parents' human capital in both countries. A set of studies also provide similar evidence from other countries in Europe, including Bauer and Riphahn (2007) for Switzerland; Van Ours and Veenman (2003) for the Netherlands; Hammarstedt and Palme (2005) and Osterberg (2000) for Sweden; Dustmann and Theodoropoulos (2005) for Britain; Yuksel (2007) and Dustmann (2008) for Germany.⁵

On the other hand, a set of studies seeks to explicitly estimate the causal association between parents' and child's human capital. Black, Devereux and Salvanes (2005) show weak evidence of a causal relationship between parental education and children's outcomes in Norway. Oreopoulos, Page and Stevens (2006), on the other hand, using various US Censuses suggest that an increase in the parental education due to the compulsory schooling laws reduces the probability of child's grade retention. Studies that focus on adoptees in the US provide more formal evidence on "nature" and "nurture" question (Plug and Vijverberg (2003) and Sacerdote (2002)). Using Korean-American adoptees and parents' biological

⁵ See Corak (2004) for the review of this literature.

children, Scardote (2002) finds that parental education increases adoptee's human capital; however, this increase is higher for parent's biological children. Plug and Vijverberg (2003) present similar evidence suggesting that genetically transmitted ability working through parents' income explains most of the intergenerational transmission of human capital.

3. Conceptual Framework

A body of theoretical models discusses the underlying mechanisms behind parent's decision on child's educational attainment. A strand of literature studies the effect of changes in child mortality on human capital investment. Ehrlich and Lui (1991), Meltzer (1992), Kalemli-Ozcan, Ryder and Weil (2000) and Kalemli-Ozcan (2002) show that improvements in life expectancy increase investment in human capital. As child mortality decreases, utility of having larger families decreases and parents have fewer children, and quantity-quality trade-off shifts towards fewer children with more education. Later, Soares (2005) shows that not only child mortality but also adult longevity is in the heart of human capital investment decision. Adult longevity is particularly important because gains in adult life expectancy increase the time horizon over which benefits of human capital investment can be realized. HIV/AIDS, in this manner, can decrease incentives for more years of schooling as both child and adult mortality increases due to epidemic. Given that life expectancy is 40-45 years of age in many sub-Saharan countries due to the high HIV prevalence (CIA World Fact Book, 2008), individuals and parents may prefer less educational investment, and this may affect the intergenerational coefficient on education.

Additionally, HIV prevalence might affect transmission coefficient through reductions in household income. In their empirical analysis of educational outcomes for five

birth cohorts of American males, Cameron and Heckman (1998) show that long-term factors such as permanent parental income and possibly genetic family background are central for schooling decisions. From the sub-Saharan point of view, this result implies that having a HIV positive parent might affect both child's educational choices and the correlation between child's and parent's educational outcomes, as permanent parental income decreases due to parental mortality and morbidity. Under such circumstances, child may need to drop out from school and start working as a child labor, which is a widespread phenomenon in the developing world. In fact, children's participation in the labor force exceeds 30 percent in many areas in Africa (ILO, 2008).

HIV/AIDS might also affect human capital investment through changes in the school and community environment. Deterioration along class size, peers, teachers and other school inputs can reinforce the negative impacts of HIV on child's educational outcomes. Or, parents might be less willing to send their children to school in high HIV prevalence communities due to the stigma and misconceptions associated with the epidemic. In fact, in our dataset 55% of the parents do not approve HIV positive teachers to continue teaching.

4. Data

We use nationally representative samples from Demographic and Health Surveys (DHS)⁶. DHS provides a wide range of information on individual and household characteristics as well as parental background and detailed information on health and nutrition. In recent waves of DHS, respondents were asked to provide a few drops of their blood to be tested for HIV virus. The results from HIV-testing provide reliable information

⁶ DHS datasets are available at www.measuredhs.com, MEASURE DHS, Macro International Inc.

on individual HIV status for a representative sub-sample of women and men who are interviewed.

The strengths of this data are multifold. First of all, we can actually link children to their parents, which is not possible in most of the available data for both developed and developing countries. Most of the previous studies were able to study the intergenerational correlation using synthetic cohorts. HIV-testing results, women/men and children surveys can all be linked by household and person identification numbers. Secondly, all previously available HIV data were based on samples of women attending prenatal clinics. Timberg (2006) and some other studies argue that this method leads to an over-estimate of HIV prevalence because pregnant women, by definition engaging in unprotected sex, have higher risk of HIV infection. Our data, however, are based on a representative sample of the population including both women and men. Response rate for HIV-testing is very high, 86% in average, for our sample of countries as shown in Table 1. One may argue that DHS estimates may be biased downwards due to the voluntary nature of the testing, however, in our view, these are the most reliable and representative estimates of HIV prevalence available.

Thirdly, in addition to examining the effect of local HIV prevalence using this representative information, this dataset allows us to actually assess the direct effect of having a HIV positive mother/father. Since we have HIV status of parents, we can utilize this information to examine the relationship between intergenerational transmission and parent's HIV status and distinguish it from the effect of local HIV prevalence.

Although there are 16 recent country surveys with HIV testing, we only use 5 of those for which we also have an older round from early 1990s. The reasons for using old surveys

are twofold. First, we would be able to document the intergenerational transmission of human capital in early 1990s when the HIV/AIDS was virtually negligible. Second, and most importantly, we could account for regional unobserved heterogeneity by controlling for regional fixed effects. Therefore, in order to document the effect of HIV/AIDS both longitudinally and cross-sectionally, we use following 10 surveys: Burkina Faso (2003, 1992), Cameroon (2004, 1991), Malawi (2004, 1992), Niger (2006, 1992) and Senegal (2005, 1992).⁷

Data consists of mothers between ages 15-49 and children between ages 0-19. In order to capture the effect of HIV on transmission of human capital across generations, mothers' human capital accumulation should be unaffected by HIV epidemic. To account for this concern, since before 1980 HIV prevalence is negligible, only women who were born before 1980 are used in the analysis.⁸ On the other hand, we exclude from the analysis children younger than 7 years of age who are likely to be younger than school age.⁹

It is likely that children in our sample are still at school continuing their education. Thus, to quantify the educational progress of the children, we construct additional measure of education including school attendance and progress through school. Although these additional measures only allow us to capture the progress of the children, not the realized educational attainment, there is strong evidence suggesting that these progress outcomes are likely to correlate with other measures of children's success. The National Center for Education Statistics (1997) for example, estimates that approximately one quarter of young adults who had performed poor in progress through school dropped out of school later on.

⁷ All of the empirical analyses in this paper are also done using all the available data. Since the results are just about same and this is a more robust identification, we only report the results of 5 country analyses. Results using other countries are available from the authors upon request.

⁸ Mothers who were born before 1980 account for 91 % of all mothers in our sample.

⁹ The empirical results are quantitatively similar when 6 years old children are included in the analysis.

We define these additional measures of educational attainment as follows: We assign a value of 1 to the variable "*School Attendance*" if the child has completed one or more years of schooling, zero otherwise. Similarly, we create a variable as "*Progress through School*", which is correct-grade-for-age, computed by dividing the years of schooling by years since age 6. Finally, our last measure classifies children whose educational attainment is below the median for their age at their region as those who are held back. In other words, we estimate the number of years a child "should" have completed based on the median grade reached among those who are the same age and live in the same region. Thus, our third dependent variable, "*Below Median Grade*" is equal to 1 if a child's grade is below the median and 0 otherwise.

Table 2a presents the descriptive statistics for children using 1990s' waves of DHS in Column 1 and 2000s' waves of DHS in Column 2. Moreover, Columns 3 and 4 display children's characteristics by their mother's HIV status. Table 2a points to a positive trend in educational attainment in sub-Saharan Africa, in which years of schooling increased around 0.4 years in ten years (Columns 1 and 2). On the other hand, this table reveals that children with HIV positive mothers have higher educational attainment, are almost half years older, more likely to be female and less likely to live in rural areas (Columns 3 and 4).

Table 2b reports the characteristics of mothers from earlier and contemporaneous waves of DHS surveys. It seems that educational attainment of mothers also increased since 1990s. Columns 3 and 4 further compare HIV-positive and HIV-negative mothers. Similar to children's generation, HIV-positive mothers are not only slightly more educated but also wealthier, less likely to be married, less likely to work and have less children compared to

HIV-negative mothers. This highlights the importance of controlling for household and regional characteristics in estimating intergenerational education correlation.

Tables 3a and 3b present the characteristics of children and mothers by community HIV prevalence. From these tables, it appears that both children and mothers have higher educational attainment in high HIV prevalence regions. However, it seems that other characteristics of children and mothers do not differ substantially by the HIV prevalence in the region they are residing.

As discussed earlier, it is likely that some of the children in our sample are still at school continuing their education. Ideally, it would have been appealing to observe children's generation at later ages when they completed their education. Nevertheless, given the low levels of educational attainment in sub-Saharan Africa, as summarized in Table 2 and 3, it seems that censoring in educational attainment is less likely to be a concern in the analysis of intergenerational transmission in sub-Saharan Africa.

5. Empirical Framework and Results

We conduct our empirical analysis in three parts. First, we estimate the intergenerational correlation of human capital across mothers and children in sub-Saharan Africa. Second, we examine the effect of mother's own HIV status on child's human capital controlling for mother's human capital and other household and regional characteristics. In the third part, we analyze the impact of community HIV prevalence on the transmission of human capital across generations.

5.1. Intergenerational Transmission of Human Capital

Before incorporating the effects of HIV, first, we want to analyze the transmission coefficient of human capital in sub-Saharan Africa. We use the standard specification relating the human capital of child to the human capital of mother:

$$\text{ChildOutcomes}_i = \alpha + \beta_1 * \text{MotherOutcomes}_i + \pi \mathbf{X}'_i + \varepsilon_i \quad (1)$$

Child Outcomes_i stands for child's human capital, while *Mother Outcomes_i* is the mother's years of schooling (and health outcomes in some specifications); \mathbf{X}'_i is a vector of other covariates including a wide range of child and parental characteristics such as child's age, sex and number of siblings, mother's age, marital status and current working status, family's wealth, rural and region dummies. ε_i is a random error term.

The coefficient β_1 in equation (1) measures the degree of persistence or immobility in the society and is the fraction of the mother's human capital that her child inherits. Estimates of β_1 close to unity imply high persistence and limited mobility, whereas values of β_1 close to zero suggest low persistence and almost complete intergenerational mobility in outcomes. Presumably, any real number could be obtained from the estimation of equation (1); a negative value of β_1 would refer to a situation where mothers are high in their generations' distribution of human capital, while their children tend to be low in their own generations' distribution (Aydemir, Chen and Corak, 2009). On the other hand, the average education of generations will evolve through time, and it may be that many or all members of a generation will have higher educational attainment than what their parents had in the past. This is captured in equation (1) by the value of α .

Equation (1) should be regarded as a reduced-form equation, where β_l being determined by multiple factors containing genetic and behavior attributes transmitted from mothers to children (nature and nurture). In this formulation, *MotherOutcomes_i* controls for all of the factors that affected mother's human capital, while \mathbf{X}_i includes everything else, such as the genetic heritage of father and additional characteristics of the child and mother that did not affect mother's own human capital formation. Apparently, we do not observe all the characteristics of the mothers that might be correlated with child's human capital. However, ignoring \mathbf{X}'_i variables that might be correlated with child's education may yield to upper bound estimates of the coefficient. Therefore, to address the potential omitted variables problem, we introduce more controls to equation (1) including family's background characteristics. We also incorporate rural and region dummies in our regressions to account for the differences across regions and different types of residence.

In addition, we also re-estimate equation (1) including household fixed effects. Household fixed effects enable us to assess the effect of mother's human capital on child's human capital, exploiting a variation between children residing in same household but have different mothers. Including household fixed effects allows us to control for genetic traits, mother's background characteristics and the family environment child is growing up. The difference that may arise between models with and without household fixed effects can be attributed to all other remaining genetic differences and contemporaneous factors that differentially affect child's human capital. All other remaining factors affecting children's human capital but not associated with parental human capital are assumed to be captured by ε_i (Aydemir, Chen and Corak, 2009).

In the intergenerational mobility literature, there is an ongoing debate on whether maternal or paternal education is more important in child's human capital formation. Child development literature suggests that mother's education has prime influence on child's educational attainment (Haveman and Wolfe, 1994). However, Behrman and Rosenzweig (2002), Gang and Zimmerman (2003) and Aydemir, Chen and Corak (2009) find that child's post-secondary education is positively related to that of both parents, but somewhat more strongly to fathers. To address these mixed findings in the literature, we investigate whether maternal or paternal education matters more in our setting. Results with paternal education are summarized in Appendix Table 1. Our analysis suggests that in sub-Saharan Africa, mother's education has more influence on child's education. This may stem from the fact that most of the mothers and children have low levels of education, and mother's human capital is more important for the basic human capital formation. Therefore, in the remainder of our analysis, we use maternal education in estimating intergenerational transmission of human capital.

Table 4 reports the intergenerational correlation coefficients of human capital in sub-Saharan Africa. Panel A presents results from DHS data collected in 2001-2006, while Panel B shows the analysis using 1991-1992 DHS data. The baseline specification that only controls for child's characteristics (reported in Column 1 of Panel A) suggests that correlation coefficient of education is 0.26 in developing economies in sub-Saharan Africa in 2000s. In column 2, we control for household characteristics by including family's wealth, mother's age, working and marital status and number of children to account for the fact that children's human capital may be sensitive to family background. Correlation coefficient, β presented in Column 2 is similar to the baseline specification suggesting that even after controlling for

household characteristics we observe persistence in education across generations. Just as importantly, to account for differences in educational attainment across regions, in Column 3, we include region fixed effects and rural dummy into the baseline specification. The coefficient estimate in Column 3 drops by 35 percent once we control for regional characteristics. Finally, Column 4 shows models incorporating household fixed effects. This specification takes advantage of variation among children within the same household with different mothers as only source of variation, and therefore, controls for many permanent unobserved factors that may vary across families. Despite the fact that standard errors are larger in this specification, the point estimates are still statistically significant, suggesting persistence of human capital across generation in sub-Saharan Africa even after controlling for unobservable time invariant characteristics within households.

This correlation coefficient is similar to corresponding Scandinavian estimates (which range from 0.13-0.23) and slightly lower than the correlation coefficient in the US (0.43). One of the possible reasons for this difference between our estimates and estimates for the US may be the fact that children in our sample are still at school. This may lead to underestimation of the correlation. However, mean education among mothers is 2.9 years and not considerably higher than mean education among children, which is 2.1 years. Therefore, it is not likely that this accounts for low correlation among children and their mothers. Second possible reason for low correlation might be the measurement error in mothers' and children's human capital. However, given that respondents in our data report their human capital only once, it is not possible to formally test for the measurement error.

In Panel B, we analyze the persistence coefficient of human capital from earlier waves of DHS. Following the aforementioned specifications, in Panel B, we find that the

intergenerational correlation is somewhat higher in 1990s compared to 2000s in sub-Saharan Africa. A likely mechanism for change in the intergenerational mobility seems to be the increasing HIV prevalence in the region. Of course it is not possible to provide definitive proof of this story, and undoubtedly additional mechanisms are at work too, but this seems to be a plausible and important mechanism for the negative trend in correlation coefficient (which we will rigorously elaborate in the next section).

5.2. Mother's HIV Status and Intergenerational Transmission of Human Capital

Although we start with models estimating the direct impact of mother's education outcomes on child's human capital, our primary interest is to determine whether differential exposure to HIV epidemic alters the human capital transfer between mothers and children in sub-Saharan Africa. In order to examine whether HIV epidemic has impacts on the intergenerational transmission of human capital, we allow intergenerational education correlation to differ for children with HIV-positive and HIV-negative mothers by interacting mother's human capital with mother's HIV status. More specifically, we estimate the following baseline specification using only 5 recent surveys with HIV testing:

$$\text{ChildOutcomes}_i = \alpha + \beta_1 * \text{MotherOutcomes}_i + \beta_2 * \text{MotherOutcomes}_i * \text{Mother'sHIVStatus}_i + \theta * \text{Mother'sHIVStatus}_i + \pi \mathbf{X}'_i + \varepsilon_i \quad (2)$$

where *Mother's HIV Status* is a dummy variable that takes a value of 1 if mother *i* is HIV positive, and zero otherwise. In this specification, β_1 is the intergenerational correlation coefficient for children whose mothers are HIV-negative, whereas β_2 measures whether

transmission coefficient differs for children with HIV positive mothers. Therefore, for children with HIV positive mothers, the degree of persistence can be measured by the sum of coefficients $\beta_1 + \beta_2$. Moreover, θ is the average deviation for the outcomes of HIV-positive mothers from all population average of outcomes. We estimate equation (2) following the specifications discussed in the previous section.

Table 5 shows the results incorporating mother's HIV status. The differential exposure to HIV epidemic across mothers with different income and education levels can impact child's human capital along extensive margin (whether child attends school or not) and/or intensive margin (years of schooling child attains). To capture the impacts of HIV epidemic on both dimension of child's human capital formation, Panel A reports results from the analysis of child's years of schooling, while Panel B presents the analysis for child's school attendance.¹⁰ Panel A shows that mother's exposure to HIV hinders the human capital transmission across generations in all specifications. Children of HIV positive mothers are 45% less likely to inherit their mother's human capital compared to children with HIV negative mothers. We find quantitatively similar results in models incorporating household characteristics (Column 2), and region fixed effects (Column 3) which show that human capital is less persistent across generations if mother is HIV positive even after controlling for unobserved heterogeneity across regions.

Panel B of Table 5 presents similar results along the extensive margin of child's education. Column (1) of Panel B shows that among children whose mothers have the same years of schooling, children of HIV-positive mothers are about 60% less likely to attend

¹⁰Additional analysis examines progress through school and being below median grade as alternative measures for child's human capital to account for the concern that some of children in our sample are still at school continuing their education. Results are quantitatively similar when the outcome of interest is progress through school; therefore we will mainly focus on child's years of schooling in our analysis to be able to draw parallel conclusions to the existing intergenerational mobility of education literature.

school relative to children of HIV-negative mothers. We find similar results in specifications controlling for household characteristics and region dummies. Taken together, these findings suggest that the HIV epidemic has substantial and detrimental consequences beyond mothers' generation. Since slightly more educated mothers are more likely to be HIV-positive, in fact, HIV epidemic decreases the inequality in sub-Saharan Africa, per se. However, it is not that the disadvantaged population is doing any better, but the advantageous fraction of the population is worse off and overall wellbeing of the countries suffers due to HIV/AIDS epidemic.

One of the potential mechanisms underlying our findings might be underinvestment in child's human capital. This suggests that even though HIV-positive mothers are decreasing their fertility as shown by Young (2005) and Juhn, Kalemli-Ozcan, Turan (2008), they are not investing more on their remaining children, which contradicts to quality-quantity theory. On the other hand, this deterioration in child's human capital investment can be attributable to the pure physiological impact of the disease (which disables mothers to take proper care of their children), change in family structure (60% of the fathers are also HIV positive) or behavioral response of mothers stemming from the fact that expected longevity have declined in the region after the epidemic. This is, children have limited time to realize returns to their education due to the short life expectancy. To disentangle the potential channels responsible for the estimated effects of mother's HIV status, Table 6 reports the analysis including father's characteristics along with his HIV status and variables proxying for parents' investment on child's human capital. As measures of parental human capital investment on their children, we use mother's frequency of reading newspaper and magazine to child and child's frequency of listening radio and watching television. The coefficients on parental

human capital investment measures and fathers' characteristics are positive and statistically significant. However, the interaction coefficient of mother's education and mother's HIV status is still economically and statistically significant if we control for father's characteristics and HIV status and proxies for child's human capital investment. These results provide suggestive evidence that it is not the change in family structure or deterioration in investment in child's human capital that is responsible for estimated effects of mother's HIV. A likely mechanism seems to be the physiological impacts of the epidemic left standing.

5.3. Community HIV Prevalence and Intergenerational Transmission of Human Capital

In the previous section, we present models incorporating mother's HIV status. However, HIV epidemic may affect the human capital formation more broadly beyond the children of HIV-infected mothers. In this section, we will quantify the effects of growing up in a high HIV prevalence and short life expectancy community on child's human capital accumulation. This section provides more formal evidence on how out-of-school environment impacts the human capital transfers across generations. To isolate the pure impact of the community prevalence on child's human capital accumulation, in this section, we restrict our analysis to children whose mothers are HIV negative.¹¹ We run the following regression exclusively on children with HIV negative mothers using both new and old surveys:

¹¹ Results are very similar when we include children whose mothers are HIV positive. But since, we found a significant effect of mother's HIV status on correlation coefficient in the previous section; in this part of the paper we prefer to restrict our analyses to children of HIV negative women only. Results are available upon request.

$$\text{ChildOutcomes}_{irt} = \alpha + \beta_1 * \text{MotherOutcomes}_{irt} + \beta_2 * \text{MotherOutcomes}_{irt} * \text{CommunityHIV}_{rt} + \theta * \text{CommunityHIV}_{rt} + \delta_r + \gamma_t + \pi \mathbf{X}'_{irt} + \varepsilon_{irt} \quad (3)$$

where t refers to time period which specified as two periods, 1991-1992 and 2001-2006. Community HIV is defined as the fraction of all adults 15-49 (both men and women) with positive HIV status in each region. HIV prevalence is assumed to be zero for all communities (regions) in 1991-1992 since it was virtually negligible at that time. Following Bertrand, Duflo and Mullainathan (2004), the standard errors are clustered by region by time to account for the correlations in outcomes between individuals residing within the same community in the same time period. δ_r is community-specific fixed effects, controlling for the fact that communities may be systematically different from each other. γ_t is the time-specific fixed effect, controlling for the likely secular changes over time. This specification allows us to account for potential differences across region in child's human capital endowment that is not related to mothers' human capital. That is, children residing in regions with higher average human capital endowment are less likely to suffer from the potential adverse effects of HIV epidemic and, therefore the human capital of mothers' generation may be more crucial in explaining the degree of intergenerational mobility. Before turning to the results incorporating community HIV prevalence, we report some descriptive statistics of communities in table 7. As table 7 shows, community level HIV prevalence ranges from 0 to 18 percent with the average being approximately 4 %.

We present evidence on the effect of community HIV prevalence on intergenerational transmission of human capital in Table 8. On the one hand, Panel A reports that community HIV prevalence has a marginal, positive impact on the intensive margin of intergenerational

human capital transfers, i.e. children in high HIV prevalence regions are 1% more likely to inherit their mothers' human capital after controlling for regional and time-specific fixed characteristics (Column 4). On the other hand, results summarized in Panel B suggest that community HIV prevalence has negative effects along extensive margin of children's human capital. That is, among children whose mothers have same levels of education, children residing in high HIV prevalence communities are less likely to attend school compared to children in low HIV prevalence communities. More specifically, children residing in a community with mean HIV prevalence (4 percent from Table 7) are 20% less likely to attend school compared to children in other communities whose mothers has the same levels of education. Moreover, we also find that once children in high HIV prevalence communities attend to school, they are more likely to be below median grade and progress slower. Therefore, our results suggest that HIV prevalence have substantial and detrimental effects beyond children of HIV-positive mothers.

Given shown that community HIV prevalence has opposite effects along extensive and intensive margins of human capital formation, it is likely that in high HIV prevalence communities, parents are less willing to send their children to school due to the decrease in incentives for education, credit constraints or deterioration in school environment. As stated in conceptual framework section, in our dataset 55% of the parents do not approve HIV positive teachers to continue teaching. Therefore, in high HIV prevalent environment, parents may provide basic skills such as literacy and innumeracy that would be sufficient in the labor market by themselves at home or hire private tutors.

6. Further Analysis

Previous studies on intergenerational transmission of human capital suggest that the daughters are more likely to inherit their mother's human capital than that of sons (Couch and Dunn, 1999; Van Ours and Veenman, 2003). On the other hand, an extensive literature has shown that under unfavorable circumstances and scarcity of resources, household resources are redistributed in favor of boys (Shemyakina, 2006). Therefore, mother's HIV status and HIV prevalence in the community can have differential impacts by child's gender. To investigate whether mother's HIV status has differential impacts by child's gender, in Table 10 we present the results that mimic Table 5 for mother-daughter pairs (Panel A) and mother-son pairs (Panel B), separately. Table 10 shows that indeed daughters are more likely to inherit their mothers' human capital relative their male siblings. Additionally, it seems that daughters of HIV-positive mothers are less likely to resemble their mothers' human capital; while the effect of mother's HIV status is negligible for sons.

Similarly, Table 11 repeats the same specifications as in Table 8, but allows the effect of community HIV prevalence to differ by child's gender. Similar to previous table, we find that daughters and their mothers are more alike in terms of their human capital compared to sons and their mothers. However, we find no evidence suggesting that the effects of community HIV prevalence differ by child's gender.

7. Conclusion

The literature on education has established that there is a strong correlation between parent's human capital and that of their children in the US and the European countries while the childhood environment is also essential in forming child's future human capital. This

study examines this relationship in developing economies in sub-Saharan Africa, incorporating the effect of HIV/AIDS epidemic, which has clearly altered the childhood environment and consequently, human capital investment for recent cohorts. Using old and recent Demographic Health Survey for 5 countries in sub-Saharan Africa, this study attempts to separate out the household effect and community effect of the disease by distinguishing the effect of mother's HIV status from the community prevalence rate.

We find that in developing economies in sub-Saharan Africa, children inherit 26% of their human capital from their mothers. However, our results show that HIV-positive mothers are less likely to transfer their human capital to their children. That is, children with HIV-positive mothers are 45% less likely to inherit their mother's human capital and 48% less likely to attend school compared to children of HIV-negative mothers with same levels of education. Moreover, it seems that daughters of HIV-positive mothers are less likely to resemble their mothers' human capital, while mother's HIV status has negligible effect on sons. On the other hand, we find that children residing in a community with mean HIV prevalence are 20% less likely to attend school compared to children in other communities whose mothers have the same levels of education. We also find that once children in high HIV prevalence communities attend to school, they are more likely to be below median grade and progress slower. Therefore, our results suggest that HIV prevalence have substantial and detrimental effects beyond children of HIV-positive mothers.

We incorporate different measures of child's education to investigate whether HIV epidemic affects intergenerational transfers along extensive or intensive margins of human capital. We find that both mother's HIV status and HIV prevalence in the community have sizeable and detrimental effects along both dimension of child's human capital. However,

mother's HIV status has stronger effects on intergenerational education coefficient compared to community HIV prevalence. This effect is likely driven by deterioration in mothers' ability to nurture as a result of HIV/AIDS in the region.

Since slightly more educated mothers are more likely to be HIV-positive and communities with higher human capital endowments have higher HIV prevalence, HIV epidemic decreases the inequality in sub-Saharan Africa, per se. However, it is not that the disadvantaged population is doing any better, but the advantageous fraction of the population is worse off and overall wellbeing of the countries suffers as result of HIV/AIDS. The findings of this paper are in accord with the existing literature stating the detrimental impact of HIV/AIDS on accumulation of human capital and underlining the importance of combat against HIV/AIDS, which must be a first order policy concern as epidemic has impacts beyond the current generation. Given that almost half of the African population is children, and that the high incidence of HIV/AIDS is leading to a decrease in the middle aged population, all accounts suggest that dramatic steps are required to aggressively curb further loss of human capital accumulation and step up efforts to ensure that all African children can grow up to lead productive and healthy lives.

References

- Aydemir, Abdurahman; Chen, Wen-Hao and Corak, Miles.** 2009, "Intergenerational Earnings Mobility among the Children of Canadian Immigrants." *Review of Economics and Statistics*, 91(2), pp. 377–397.
- Bauer, Philipp and Riphahn, Regina T.** 2007, "Heterogeneity in the Intergenerational Transmission of Educational Attainment: Evidence from Switzerland on Natives and Second Generation Immigrants." *Journal of Population Economics*, 20(1), pp. 121-148.
- Becker, Gary S. and Tomes, Nigel.** 1986, "Human Capital and the Rise and Fall of Families." *Journal of Labor Economics*, 4(3), pp. 1-39.
- Behrman, Jere R. and Rosenzweig, Mark R.** 2002, "Does Increasing Women's Schooling Raise the Schooling of the Next Generation?" *American Economic Review*, 92(1), pp. 323-334.
- Bertrand, Marianne; Duflo Ester and Mullainathan, Sendhil.** 2004, "How Much should We Trust Difference-in-Difference Estimates?" *Quarterly Journal of Economics*, 119(1), pp. 249-275.
- Black, Sandra; Devereux, Paul J. and Salvanes, Kjell G.** 2005, "Why the Apple Doesn't Fall Far: Understanding the Intergenerational Transmission of Education." *American Economic Review*, 95(1), pp. 437-449.
- Bleakley, Hoyt.** 2007, "Disease and Development: Evidence from Hookworm Eradication in the American South," *Quarterly Journal of Economics*, 122(1), pp. 73-117.
- Cameron, Stephen V. and Heckman, James J.** 1998, "Life Cycle Schooling and Dynamic Selection Bias: Models and Evidence for Five Cohorts of American Males." *Journal of Political Economy*, 106(2), pp. 262-333.
- Case, Anne and Ardington, Cally.** 2006, "The Impact of Parental Death on School Outcomes: Longitudinal Evidence from South Africa." *Demography*, 43(3), pp. 401-420.
- Case, A., Paxson, Christina, and Ableidinger, Joseph.** 2004, "Orphans in Africa: Parental Death, Poverty, and School Enrollment." *Demography*, 41(3), pp. 483-508.
- Corak, Miles.** *Generational Income Mobility in North America and Europe.* Cambridge: Cambridge University Press, 2004.
- Couch, Kenneth A. and Dunn, Thomas A.** 1997, "Intergenerational Correlations in Labor Market Status. A Comparison of the United States and Germany." *Journal of Human Resources*, 32(1), pp. 210-232.
- Dustmann, Christian.** 2008, "Intergenerational Mobility and Return Migration: Comparing Sons of Foreign and Native Born Fathers." *Journal of Human Resources*, 43(2), pp. 660-687.

Dustmann, Christian and Theodoropoulos, Nikolaos. 2006, "Ethnic Minority Immigrants and their Children in Britain." Centre for Research and Analysis of Migration (CReAM) Discussion Paper No: 610.

Ehrlich, Isaac and Lui, Francis T. 1991, "Intergenerational Trade, Longevity, and Economic Growth." *Journal of Political Economy*, 99(5), pp. 1029-1059.

Evans, David K., and Miguel, Edward. 2007, "Orphans and Schooling in Africa: A Longitudinal Analysis." *Demography*, 44(1), pp. 35-57.

Fortson, Jane. 2008, "Mortality Risk and Human Capital Investment: The Impact of HIV/AIDS in Sub-Saharan Africa." *unpublished subscript*, University of Chicago.

Gang, Ira N. and Zimmermann, Klaus F. 2000, "Is Child Like Parent? Educational Attainment and Ethnic Origin." *Journal of Human Resources*, 35(3), pp. 550-569.

Hammarstedt, Mats and Palme, Marten. 2005, "Intergenerational Mobility, Human Capital Transmission and the Earnings of Second-Generation Immigrants in Sweden." Institute for the Study of Labor, IZA Discussion Papers: No. 1943.

Haveman, Robert and Wolfe, Barbara. 1994, *Succeeding Generations: On the Effects of Investments in Children*. New York: Russell Sage Foundation.

Jayachandran, Seema and Lleras-Muney, Adriana. 2009, "Life Expectancy and Human Capital Investments: Evidence from Maternal Mortality Declines." *Quarterly Journal Economics*, 124(1), pp. 349-398.

Juhn, Chinhui; Kalemli-Ozcan, Sebnem and Turan, Belgi. 2008, "HIV and Fertility in Africa: First Evidence from Population Based Surveys.", National Bureau for Economic Research, NBER Working Paper No: 14248.

International Labor Organization *Child Labor*, 2008.

Kalemli-Ozcan, Sebnem; Ryder, Harl and Weil, David N. 2000, "Mortality Decline, Human Capital Investment and Economic Growth." *Journal of Development Economics*, 62(1), pp. 1-23.

Kalemli-Ozcan, Sebnem. 2002, "Does Mortality Decline Promote Economic Growth?" *Journal of Economic Growth*, 7(4), pp. 411-439.

Kalemli-Ozcan, Sebnem. 2007, "AIDS, Reversal of the Demographic Transition and Economic Development: Evidence from Africa." National Bureau for Economic Research, NBER Working Paper No: 12181.

Lauer, Charlotte. 2003, "Family Background, Cohort and Education: A French-German Comparison Based on a Multivariate Ordered Probit Model of Educational Attainment." *Labour Economics*, 10(2), pp. 231-251.

Meltzer, David. 1992. "Mortality Decline, the Demographic Transition and Economic Growth." *PhD Dissertation*, University of Chicago.

Miguel, Edward, and Kremer, Michael. 2004, "Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities." *Econometrica*, 72(1), pp. 159–217.

National Center for Education Statistics. 1995, "Dropout Rates in the United States," NCES Research Paper, No: 97-473.

Oreopoulos, Philip; Page, Marianne and Stevens, Ann H. 2006, "Does Human Capital Transfer from Parent to Child? The Intergenerational Effects of Compulsory Schooling." *Journal of Labor Economics*, 24(4), pp. 729-760.

Osterberg, Torun. 2000, "Economic Perspectives on Immigrants and Intergenerational Transmissions." *Ekonomiska Studier*, 102, Goteborgs Universitet, Sweden.

Plug, Erik and Vijverberg, Wim. 2003, "Schooling, Family Background, and Adoption: Is It Nature or Is It Nurture." *Journal of Political Economy*, 111(3), pp. 611-641.

Sacerdote, Bruce. 2002, "The Nature and Nurture of Economic Outcomes." *American Economic Review*, 92(2), pp. 344-348.

Soares, Rodrigo R. 2005, "Mortality Reductions, Educational Attainment, and Fertility Choice", *American Economic Review*, 95(3), pp. 580-601.

Timberg, Craig. "How AIDS in Africa Was Overstated", *Washington Post*, 2006.

UNAIDS/WHO AIDS Epidemic Updates, 2007.

U.S. Census Bureau HIV Surveillance Database, 2007.

Van Ours, Jan C. and Veenman, Justus. 2003, "The Educational Attainment of Second Generation Immigrants in the Netherlands." *Journal of Population Economics*, 16(4), pp. 739-753.

Young, Alwyn. 2005, "The Gift of the Dying: The Tragedy of AIDS and the Welfare of Future African Generations." *Quarterly Journal of Economics*, 120(2), pp. 423-466.

Yuksel, Mutlu. 2007, "Intergenerational Mobility of Immigrants in Germany: Moving with Natives or Stuck in their Neighborhoods?" *unpublished manuscript*, University of Houston.

Table 1: DHS HIV Testing Response Rates

	Response Rate (%)	HIV Prevalence (%)
	(1)	(2)
Burkina Faso (2003)	92.3	1.8
Cameroon (2004)	92.1	6.6
Malawi (2004)	70.4	13.3
Niger (2005)	90.7	0.7
Senegal (2005)	84.5	0.9

Notes: Column 1 is the fraction of sample of men and women who were actually tested. Based on the reason for non-response, individuals who were not tested are divided into four categories: those who refused testing, those who were interviewed in the survey but who were absent when the health worker arrived for testing, those who were never interviewed, and those who had missing test results due to technical problems. Rates shown in column (2) are country averages calculated using DHS HIV data including women ages 15-49 and weighted using HIV survey sample weights.

Table 2a. Descriptive Statistics for Children by Mother's HIV Status

	All 1990s (1)	All 2000s (2)	HIV-Positive 2000s (3)	HIV-Negative 2000s (4)
Completed Years of Schooling	1.448 (1.968)	1.877 (2.235)	2.734 (2.420)	1.839 (2.219)
Progress through School	0.366 (0.867)	0.410 (0.459)	0.593 (0.492)	0.401 (0.456)
School Attendance	0.528 (0.499)	0.639 (0.480)	0.863 (0.344)	0.630 (0.483)
Age	10.018 (2.266)	10.492 (2.644)	10.784 (2.870)	10.480 (2.633)
Female	0.498 (0.500)	0.511 (0.500)	0.537 (0.499)	0.510 (0.500)
Rural	0.621 (0.485)	0.724 (0.447)	0.716 (0.451)	0.725 (0.447)
Group Share			0.042	0.958
N max.	20135	15678	654	15024

Notes: Standard deviations are reported in paranthesis. Asterisks denote significance levels (*=.10, **=.05, ***=.01).

Table 2b. Descriptive Statistics of Mothers by HIV Status

	All 1990s (1)	All 2000s (2)	HIV-Positive 2000s (3)	HIV-Negative 2000s (4)
Completed Years of Schooling	1.601 (3.080)	2.037 (3.344)	3.920 (3.657)	1.955 (3.305)
Poorest		0.200 (0.400)	0.142 (0.350)	0.203 (0.402)
Working Status	0.555 (0.497)	0.668 (0.471)	0.700 (0.458)	0.666 (0.472)
Married	0.941 (0.236)	0.922 (0.267)	0.696 (0.460)	0.932 (0.251)
Number of Children Living	5.310 (1.991)	5.361 (2.026)	4.450 (1.930)	5.401 (2.021)
Age	35.377 (6.358)	36.617 (6.317)	35.413 (6.111)	36.670 (6.320)
Rural	0.621 (0.485)	0.724 (0.447)	0.716 (0.451)	0.725 (0.447)
Group Share			0.042	0.958
N max.	20135	15678	654	15024

Notes: Standard deviations are reported in paranthesis. Asterisks denote significance levels (*=.10, **=.05, ***=.01).

Table 3a. Descriptive Statistics of Children by Community HIV Prevalence

	All Communities	Communities with Above Avg. HIV Prevalence	Communities with Above Avg. HIV Prevalence
	(1)	(2)	(3)
Completed Years of Schooling	2.823 (2.371)	2.870 (2.350)	1.484 (2.055)
Progress through School	0.583 (0.428)	0.603 (0.436)	0.332 (0.442)
School Attendance	0.932 (0.251)	0.936 (0.244)	0.525 (0.499)
Age	10.958 (2.909)	10.880 (2.868)	10.342 (2.533)
Female	0.520 (0.500)	0.517 (0.500)	0.508 (0.500)
Rural	0.727 (0.446)	0.703 (0.457)	0.732 (0.443)
N max.	15024	3833	11191

Notes: Standard deviations are reported in paranthesis. Average community average is approximately 4%.

Table 3b. Descriptive Statistics of Mothers by Community HIV Prevalence

	All Communities	Communities with Above Avg. HIV Prevalence	Communities with Above Avg. HIV Prevalence
	(1)	(2)	(3)
Completed Years of Schooling	1.955 (3.305)	4.335 (3.675)	1.140 (2.727)
Poorest	0.203 (0.402)	0.139 (0.346)	0.225 (0.417)
Working Status	0.666 (0.472)	0.701 (0.458)	0.654 (0.476)
Married	0.932 (0.251)	0.882 (0.323)	0.950 (0.219)
Number of Children Living	5.401 (2.021)	5.171 (1.939)	5.479 (2.042)
Age	36.670 (6.320)	36.474 (6.378)	36.736 (6.300)
Rural	0.725 (0.447)	0.703 (0.457)	0.732 (0.443)
N max.	15024	3833	11191

Table 4. Intergenerational Transmission of Human Capital

	(1)	(2)	(3)	(4)
Panel A: 2003-2006				
Mother's Year of Schooling	0.261*** (0.003)	0.257*** (0.003)	0.171*** (0.003)	0.046*** (0.015)
R ²	0.436	0.437	0.484	0.797
N	42223	42175	42175	41388
Panel B: 1991-1992				
Mother's Year of Schooling	0.272*** (0.004)	0.271*** (0.004)	0.162*** (0.004)	0.025 (0.035)
R ²	0.389	0.392	0.480	0.800
N	20021	20016	20016	20016
Child's Age and Sex	Yes	Yes	Yes	Yes
Household Characteristics		Yes	Yes	Yes
Region Fixed Effects			Yes	Yes
Household Fixed Effects				Yes

Table 5. Effects of Mother's HIV Status on Intergenerational

	(1)	(2)	(3)	(4)
Panel A: Completed Years of Schooling				
Mother's Year of Schooling	0.262*** (0.006)	0.216*** (0.006)	0.148*** (0.008)	0.054 (0.038)
HIV Positive Mother* Mother's Year of Schooling	-0.122*** (0.028)	-0.106*** (0.027)	-0.082*** (0.027)	-0.070 (0.153)
HIV Positive Mother	0.300* (0.160)	0.182 (0.156)	0.006 (0.158)	-0.188 (0.392)
R ²	0.411	0.442	0.469	0.597
N	7864	7849	7849	7849
Panel B: School Attendance				
Mother's Year of Schooling	0.058*** (0.001)	0.052*** (0.001)	0.016*** (0.002)	0.005 (0.007)
HIV Positive Mother* Mother's Year of Schooling	-0.035*** (0.007)	-0.033*** (0.007)	-0.018*** (0.006)	-0.011 (0.028)
HIV Positive Mother	0.189*** (0.046)	0.172*** (0.046)	0.006 (0.158)	-0.105 (0.107)
R ²	0.172	0.183	0.331	0.564
N	7864	7849	7849	7849
Child's Age and Sex	Yes	Yes	Yes	Yes
Household Characteristics		Yes	Yes	Yes
Region Fixed Effects			Yes	Yes
Household Fixed Effects				Yes

Notes: Standard errors are reported in parenthesis. Asterisks denote significance levels (*=.10, **=.05, ***=.01).

Table 6. Effects of Mother's HIV Status on Intergenerational Transmission, Controlling for Father's Characteristics and Child's Human Capital Investment

	(1)	(2)	(3)	(4)
Panel A: Completed Years of Schooling				
Mother's Year of Schooling	0.200*** (0.007)	0.196*** (0.007)	0.131*** (0.009)	0.036 (0.048)
HIV Positive Mother*	-0.113*** (0.028)	-0.117*** (0.028)	-0.093*** (0.027)	-0.047 (0.158)
Mother's Year of Schooling				
HIV Positive Father	0.562*** (0.106)	0.571*** (0.106)	0.440*** (0.106)	
Mother Read Newspaper or Magazine	0.404*** (0.072)	0.380*** (0.072)	0.479*** (0.071)	0.384 (0.395)
Listen Radio	0.153*** (0.038)	0.143*** (0.039)	0.213*** (0.040)	0.228 (0.178)
Watch TV	0.631*** (0.044)	0.636*** (0.044)	0.711*** (0.051)	-0.474* (0.287)
R ²	0.433	0.438	0.465	0.786
N	7834	7805	7805	7805
Panel B: School Attendance				
Mother's Year of Schooling	0.049*** (0.002)	0.048*** (0.002)	0.020*** (0.002)	0.008 (0.011)
HIV Positive Mother*	-0.032*** (0.007)	-0.033*** (0.007)	-0.023*** (0.006)	-0.014 (0.029)
Mother's Year of Schooling				
HIV Positive Father	0.178*** (0.024)	0.181*** (0.024)	0.084*** (0.023)	
Mother Read Newspaper or Magazine	-0.014 (0.013)	-0.016 (0.013)	0.000 (0.012)	-0.012 (0.082)
Listen Radio	0.063***	0.061***	0.059***	0.066

Notes: Standard errors are reported in parenthesis. Asterisks denote significance levels (*=.10, **=.05, ***=.01). Each column also controls for mother's HIV status.

Table 7. Descriptive Statistics for Communities

	Mean	Standard Deviation	Min	Max
Panel A: Between 2003-2006 (5 countries, 25 Regions)				
Child Years of Schooling	1.97	1.01	0.82	4.25
Child School Attendance	0.66	0.25	0.29	0.98
Mother Years of Schooling	2.26	2.28	0.25	7.98
Father Years of Schooling	3.24	2.64	0.35	9.45
HIV Prevalence	0.03	0.04	0.00	0.18
Panel B: Between 1991-1992 (5 countries, 25 regions)				
Child Years of Schooling	1.47	0.95	0.41	3.54
Child School Attendance	0.53	0.28	0.17	0.98
Mother Years of Schooling	1.61	1.77	0.15	6.82
Father Years of Schooling	2.71	2.66	0.13	8.85

Table 8. Effects of Community HIV Prevalence on Intergenerational Transmission

	(1)	(2)	(3)	(4)
Panel A: Completed Years of Schooling				
Mother's Year of Schooling	0.270*** (0.013)	0.216*** (0.012)	0.165*** (0.008)	0.161*** (0.008)
Community HIV * Mother's Year of Schooling	-0.003* (0.002)	-0.002 (0.002)	-0.001 (0.002)	0.000 (0.002)
Community HIV	0.031** (0.015)	0.047*** (0.016)	0.028** (0.011)	-0.006 (0.005)
2001-2006				0.319*** (0.045)
R ²	0.397	0.441	0.468	0.471
N	27885	27865	27865	27865
Panel B: School Attendance				
Mother's Year of Schooling	0.069*** (0.005)	0.053*** (0.006)	0.031*** (0.003)	0.029*** (0.003)
Community HIV * Mother's Year of Schooling	-0.004*** (0.001)	-0.004*** (0.001)	-0.003** (0.001)	-0.003** (0.001)
Community HIV	0.035*** (0.009)	0.040*** (0.010)	0.024*** (0.006)	0.009*** (0.003)
2001-2006				0.135*** (0.026)
R ²	0.2126	0.2694	0.3457	0.3545
N	27885	27865	27865	27865
Child's Age and Sex	Yes	Yes	Yes	Yes
Household Characteristics		Yes	Yes	Yes
Region Fixed Effects			Yes	Yes
Time Fixed Effects				Yes

Notes: Standard errors are reported in parenthesis. Asterisks denote significance levels (*=.10, **=.05, ***=.01). Standard errors are clustered by region and time period.

Table 9.a. Effects of Community HIV Prevalence on Years of Schooling

	(1)	(2)	(3)	(4)
Mother's Year of Schooling	0.272*** (0.014)	0.219*** (0.012)	0.162*** (0.008)	0.162*** (0.008)
Community HIV * Mother's Year of Schooling	-0.004* (0.002)	-0.002 (0.002)	-0.001 (0.002)	-0.001 (0.002)
Community HIV	0.025 (0.016)	0.042*** (0.013)	0.012 (0.012)	-0.004 (0.019)
Know Someone with or Died of AIDS	0.153 (0.113)	0.255** (0.111)	0.346*** (0.059)	0.229* (0.124)
Know Someone with or Died of AIDS*Community HIV	-0.007 (0.015)	-0.015 (0.014)	-0.018 (0.013)	-0.003 (0.020)
2001-2006				0.131 (0.118)
R ²	0.4067	0.4507	0.4821	0.4823
N	25504	25498	25498	25498
Child's Age and Sex	Yes	Yes	Yes	Yes
Household Characteristics		Yes	Yes	Yes
Region Fixed Effects			Yes	Yes
Time Fixed Effects				Yes

Notes: Standard errors are reported in paranthesis. Asterisks denote significance levels (*=.10, **=.05, ***=.01). Standard errors are clustered by region and time period.

Table 9.b. Effects of Community HIV Prevalence on School Attendance

	(1)	(2)	(3)	(4)
Mother's Year of Schooling	0.069*** (0.006)	0.054*** (0.006)	0.029*** (0.003)	0.029*** (0.003)
Community HIV * Mother's Year of Schooling	-0.004*** (0.001)	-0.004*** (0.001)	-0.003** (0.001)	-0.003** (0.001)
Community HIV	0.034*** (0.010)	0.039*** (0.010)	0.021*** (0.006)	0.013** (0.006)
Know Someone with or Died of AIDS	0.004 (0.047)	0.044 (0.045)	0.101*** (0.024)	0.041 (0.044)
Know Someone with or Died of AIDS*Community HIV	0.000 (0.007)	-0.003 (0.006)	-0.009** (0.004)	-0.001 (0.005)
2001-2006				0.068 (0.056)
R ²	0.2245	0.2821	0.3722	0.4823
N	25504	25498	25498	25498
Child's Age and Sex	Yes	Yes	Yes	Yes
Household Characteristics		Yes	Yes	Yes
Region Fixed Effects			Yes	Yes
Time Fixed Effects				Yes

Notes: Standard errors are reported in paranthesis. Asterisks denote significance levels (*=.10, **=.05, ***=.01). Standard errors are clustered by region and time period.

Table 10. Effects of Mother's HIV Status on Intergenerational Mobility by Gender

	(1)	(2)	(3)	(4)
Panel A: Mother-Daughter Pairs				
Mother's Year of Schooling	0.293*** (0.007)	0.243*** (0.008)	0.148*** (0.010)	0.050 (0.060)
HIV Positive Mother*	-0.059** (0.023)	-0.053** (0.023)	-0.013 (0.023)	0.074 (0.269)
Mother's Year of Schooling				
HIV Positive Mother	0.698*** (0.134)	0.645*** (0.132)	0.233* (0.131)	-0.210 (0.638)
R ²	0.456	0.482	0.52	0.875
N	7976	7967	7967	7222
Panel B: Mother-Son Pairs				
Mother's Year of Schooling	0.236*** (0.006)	0.181*** (0.006)	0.116*** (0.007)	0.057 (0.047)
HIV Positive Mother*	-0.033 (0.027)	-0.028 (0.027)	0.000 (0.026)	-0.072 (0.198)
Mother's Year of Schooling				
HIV Positive Mother	0.163 (0.132)	0.149 (0.131)	-0.059 (0.133)	-0.048 (0.727)
R ²	0.407	0.446	0.473	0.855
N	7639	7632	7632	7632

Child's Age and Sex Yes Yes Yes Yes Yes
Household Characteristics Yes Yes Yes Yes Yes
Region Fixed Effects Yes Yes Yes Yes Yes
Household Fixed Effects Yes Yes Yes Yes Yes

Notes: Standard errors are reported in paranthesis. Asterisks denote significance levels (*=.10, **=.05, ***=.01).

Table 11. Effects of Community HIV Prevalence on Intergenerational Mobility by Gender

	(1)	(2)	(3)	(4)
Panel A: Mother-Daughter Pairs				
Mother's Year of Schooling	0.285*** (0.013)	0.226*** (0.013)	0.174*** (0.006)	0.170*** (0.006)
Community HIV * Mother's Year of Schooling	-0.002 (0.001)	0.000 (0.001)	0.002** (0.001)	0.002** (0.001)
Community HIV	0.037*** (0.010)	0.051*** (0.011)	0.033*** (0.008)	0.002 (0.006)
2001-2006				0.315*** (0.047)
R ²	0.439	0.477	0.496	0.499
N	30697	30674	30674	30674
Panel B: Mother-Son Pairs				
Mother's Year of Schooling	0.244*** (0.010)	0.188*** (0.011)	0.152*** (0.007)	0.150*** (0.007)
Community HIV * Mother's Year of Schooling	-0.002 (0.001)	0.000 (0.001)	0.002 (0.001)	0.002* (0.001)
Community HIV	0.014** (0.007)	0.027*** (0.007)	0.020*** (0.006)	-0.002 (0.008)
2001-2006				0.214*** (0.051)
R ²	0.414	0.452	0.465	0.466
N	30893	30863	30863	30863
Child's Age and Sex	Yes	Yes	Yes	Yes
Household Characteristics				
Region Fixed Effects		Yes	Yes	Yes
Time Fixed Effects			Yes	Yes

Appendix Table 1. Intergenerational Transmission of Human Capital

	(1)	(2)	(3)	(4)
Panel A: 2003-2006				
Father's Year of Schooling	0.236*** (0.004)	0.233*** (0.004)	0.148*** (0.005)	-0.031 (0.046)
R ²	0.423	0.424	0.476	0.787
N	12161	12142	12142	11228
Panel B: 1991-1992				
Father's Year of Schooling	0.233*** (0.006)	0.208*** (0.010)	0.128*** (0.010)	-0.084 (0.195)
R ²	0.409	0.289	0.386	0.712
N	5294	3341	3341	3341
Child's Age and Sex	Yes	Yes	Yes	Yes
Household Characteristics		Yes	Yes	Yes
Region Fixed Effects			Yes	Yes
Household Fixed Effects				Yes

Notes: Standard errors are reported in paranthesis. Asterisks denote significance levels (*=.10, **=.05,***=.01).

Appendix Table 2. Effects of Father's HIV Status on Intergenerational Transmission

	(1)	(2)	(3)	(4)
Panel A: Completed Years of Schooling				
Father's Year of Schooling	0.243*** (0.004)	0.201*** (0.005)	0.124*** (0.006)	-0.032 (0.049)
HIV Positive Father* Father's Year of Schooling	-0.085*** (0.021)	-0.087*** (0.020)	-0.083*** (0.020)	-0.418 (0.584)
HIV Positive Father	0.885*** (0.144)	0.829*** (0.137)	0.666*** (0.136)	0.595 (2.594)
R ²	0.429	0.457	0.492	0.784
N	10970	10952	10952	10087
Panel B: School Attendance				
Father's Year of Schooling	0.051*** (0.001)	0.047*** (0.001)	0.018*** (0.001)	-0.001 (0.009)
HIV Positive Father* Father's Year of Schooling	-0.027*** (0.004)	-0.027*** (0.004)	-0.022*** (0.003)	-0.168 (0.147)
HIV Positive Father	0.265*** (0.034)	0.258*** (0.033)	0.147*** (0.029)	0.242 (0.635)
R ²	0.217	0.225	0.342	0.761
N	10104	10088	10088	10088
Child's Age and Sex	Yes	Yes	Yes	Yes
Household Characteristics		Yes	Yes	Yes
Region Fixed Effects			Yes	Yes
Household Fixed Effects				Yes

Notes: Standard errors clustered by country by region by time period are reported in paranthesis. Asterisks denote significance levels (*=.10, **=.05, ***=.01).