Knowledge of HIV-Negative Status and Household Decision-making: Experimental Evidence from Malawi

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Abstract: This paper examines the causal relationship between learning one's HIV negative status and decisions made within households using survey data from the Malawi Longitudinal Study of Families and Health (MLSFH). We find that there is no effect on marital stability two years after a woman learns her HIV negative status, but that the marriage is less likely to stay intact if the husband discovers he is HIV negative. We argue that this result can be explained by the different strategies men and women use to increase the number of children. Men who learn they are HIV negative are more likely to divorce older wives, which suggests they prefer to find a partner with more remaining childbearing years. Women prefer to increase their fertility within the existing marriage: we find positive actual fertility and desired fertility effects of the wife learning that she is HIV negative. We also find a significant increase in the share of household expenditures that are spent on children's schooling. This could reflect that HIV negative parents are increasing their investments for the future in response to changes in their life expectancy. These findings illustrate that HIV testing can be an effective policy tool for increasing the incentives to invest in children's welfare and human capital.

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I. Introduction

HIV has had a tremendous impact on Malawi's population; 10.6% of individuals are currently infected with HIV and 65% of deaths among the 15-59 year old population are attributed to AIDS every year (Measure DHS 2010). Despite the high prevalence of HIV in Malawi, HIV testing has been very limited until recently.[2] Previous studies have examined the impact of HIV testing on risky behavior (Gong, 2009; Thornton, 2008; Delavande and Kohler, 2009: Fedor, Kohler, and Behrman 2013), but there could be other consequences of testing on household decision-making and more generally on household structure. In this paper, we investigate the effect of individuals learning their HIV negative status on marital stability. We then consider changes in decision-making within households in response to each spouse learning their HIV negative status.

Malawi is characterized by high marriage and divorce rates, and there is evidence that a woman who suspects that her husband is infected with HIV uses divorce as a means of preventing HIV infection (Reniers 2008). On the other hand, there may be benefits to marriage that outweigh the risk of contracting HIV, such as risk sharing and the production of public goods (children). In the theoretical considerations section below we examine in greater detail the potential effects of learning one's HIV status on the divorce decision-making process, as well as the indirect effect on household resource allocations. We show that men and women can respond differently to the revelation of their HIV negative status if they value the production of public goods within the current marriage differently.

On the empirical side, we identify the causal effect of learning one's HIV negative status on marital stability and household resource allocations. In our estimation, we use panel data from the Malawi Longitudinal Study of Families and Health (MLSFH) between 2004 and 2006. Data collection began in 1998 with a sample of ever-married women and their co-resident spouses. Before the sample was offered testing in 2004, very few had been tested already, but many believed they knew their status based on their behavior and that of their partner.

[2] Until 2003, less than 1% of adults in Malawi had received HIV testing and counseling (Yoder and Matinga 2004)

Test results in 2004 were not available until four to six weeks after testing, so individuals had to make a decision to go to a small mobile clinic to receive their results and post-test counseling. Because of the potential social and financial costs to attending the clinic, those who chose to learn their results have different preferences for learning their status than those who did not. The 2004 MLSFH study was designed provide information that would permit controlling for the possible endogeneity of preferences for receiving results: randomized incentives of varying amounts were offered during pre-test counseling, and the location of the mobile clinics was randomized (Thornton 2008).

Exploiting the randomization of financial incentives as an instrumental variable for getting results, we find that there is no effect on marital stability when a woman learns her HIV status. However, the marriage is less likely to stay intact if the husband discovers he is HIV negative. These results suggest that, relative to his wife, the husband either values his outside options more or has a lower valuation of the current marriage. For example, a man may wish to increase the number of children in response to learning his HIV negative status. He may prefer to divorce an older spouse and find a younger wife with more childbearing years by reentering the marriage market. Consistent with this theory, we find that the negative effect of a husband learning he is HIV negative on marital stability is increasing with the age of the wife. Amongst households that stay intact, our fertility results indicate that having additional children is a benefit that women value more highly than men. We show positive actual fertility and desired fertility effects of the wife learning that she is HIV negative, and the opposite effect when the husband learns he is HIV negative. We also discover that women decrease their share of resource expenditures, but there is no effect on male expenditure shares. Women appear to be reallocating personal consumption in favor of expenditures on children.

There is evidence that parents are updating their mortality expectations after learning their HIV negative status, and that this has consequences for child investments. We find a significant increase in the share of expenditures that are spent on children's schooling. These results are consistent with the idea that parents are increasing investments in their children's human capital now that they can enjoy the returns to these investments over a longer time horizon. While it is well documented that HIV epidemic has

contributed to an underinvestment in human capital, our study is the first to show that learning one's negative status can mitigate this effect. In other words, HIV testing can be an effective policy tool for increasing the incentives to invest in children's human capital.

This paper fits into a broad literature on the impact of HIV on household outcomes. Young (2005) finds a negative relationship between fertility and the HIV epidemic in South Africa, but his analysis relies on cohort-level variation in HIV infection rates. Juhn and Turan (2008) use Demographic and Health Surveys in 13 African countries to examine the relationship between an individual woman's fertility and her HIV status. The authors find a negative relationship between own HIV status and fertility. The drawback of these papers is that they link current HIV status to retrospective fertility outcomes so they cannot determine the causal relationship between learning one's HIV status and fertility.

Using the MLSFH data, Yeatman (2009) looks at the effect of finding out one's HIV status on the desire for children in Malawi. She finds that individuals who are surprised that they are HIV positive (negative) desire fewer (more) children. While she separates the effects of HIV status and knowledge of that status, she does not control for the endogeneity of the decision to get the HIV test results. When considering the policy implications of HIV testing, the policy-relevant effect would be the effect of learning one's HIV status. Shapira (2010) estimates a life cycle model of fertility using MLSFH data and finds a reduction in fertility amongst HIV positive women in response to testing.

Papers that have used the randomization of incentives in the MLSFH survey have focused on risky behavior or beliefs about HIV status as the outcomes of interest. Thornton (2008) looks at risk-reducing behavior in response to a positive or negative HIV diagnosis. She finds that individuals who learn they are HIV positive are more likely to purchase condoms than HIV positive individuals who do not receive their test results. There is no difference in condom purchases between HIV negative individuals who learn their test results and HIV negative individuals who do not learn their test results. Thorton (2012) considers whether consumption and savings patterns change in response to HIV testing, since learning one's HIV status can alter an individual's belief about his or her life expectancy. She does

not find significant changes in savings or agricultural investments among individuals who find out their HIV status. However, she does not look at children's medical and schooling expenditures as outcomes.

In order for HIV testing to have an effect on long-term decision-making, it must alter an individual's beliefs about HIV status and mortality. Delavande and Kohler (2009) find that individuals who learn that they are HIV positive are more likely to report a higher likelihood of being HIV positive two years after testing. They also find that individuals who learn their HIV negative status report a higher likelihood of being HIV positive two years later compared to negative individuals who did not learn their status.

The remainder of the paper is structured as follows. The randomization of financial incentives to receive HIV test results and data are described in Section 2. Section 3 lays out the identification strategy and estimating equations. Results are presented in Section 4, and Section 5 concludes.

II. Theoretical Considerations

In this section we consider some potential factors in the decision-making process regarding marriage, fertility, and household resource allocations. Prior to learning her status, a woman has beliefs about her current status; after discovering her status, she has both knowledge of her current status and an updated expected probability of infection in the future. If her spouse learns his HIV negative status, this information could also be used to update her risk of infection. This assumes that spouses disclose their result to one other. In fact, it is not obvious that test results were shared between spouses.[3]

After learning her HIV negative status, the woman may revise the relative benefits and costs associated with maintaining the current marriage versus divorce. Some benefits of marriage include risk sharing (Mazzocco 2004) and the consumption of public goods (Browning, Chiappori, and Weiss 2011).

[3] Discussion with survey administrators suggests that spouses did not share their results immediately even if they went to the clinic on the same day. The mobile clinics were tents, and some meters away there were others waiting to get their results. The VCT counselors did not find that people who had learned they were positive showed any indication of this as they left the mobile tent. Further, Anglewicz and Kohler (2008) find that spouses do not necessarily share information with one another.

When there is uncertainty regarding one's HIV status, a husband and wife may form a health risk sharing agreement where they care for one another in the event one of them is HIV positive.[4] If the uncertainty surrounding one's HIV status is eliminated, risk-sharing agreements may be harder to uphold. For example, if the woman discovers she is HIV negative, there will be less of an incentive to remain in the marriage because the insurance value of marriage has decreased.

If there is uncertainty about her spouse's status, a woman who learns her HIV negative status may want to divorce her partner in order to minimize the risk of contracting HIV (Reniers 2008)[5]. Additionally, a woman's value in the marriage market may have increased after learning her HIV negative status, which would make divorce an appealing option[6]. Gender differences in the impact of learning one's HIV negative status on marital stability may arise if men value entering the marriage market more highly than women. For example, men with older wives can marry a younger woman if he would like to have more children, but women do not have this option for increasing their fertility.

While learning one's negative status may decrease the value of staying in the current marriage, this negative effect on marital stability could be counteracted by an increased value of existing public goods within the marriage, namely children. Economic models of intergenerational transfers suggest that parents invest in their children for old age support or altruistic motives (Ehrlich and Lui, 1991; Kalemi-Ozcan et al., 2000). An individual who learns his or her HIV negative status now has a higher own life expectancy, which increases the value of future transfers from children. Parents may want to invest more in their children's human capital now that the returns to these investments will flow over a longer period. Because now there are higher returns to investing in children, someone who learns they are HIV negative may also want to increase the quantity of children rather than just the quality of the existing stock of children. On the other hand, the benefit of minimizing unprotected sex may outweigh the marginal utility of an additional child.

[4] Note that in 2004, Antiretroviral treatment (ART) was not available in rural areas, which meant that people would believe that sooner or later the infected person would need care.
[5] She must believe she can match with a man with a lower likelihood of being HIV positive.
[6] This assumes that individuals can credibly signal their HIV negative status on the marriage market.

After learning her HIV negative status, a woman may revise her beliefs about her children's life expectancy and current period health status because she learns there was no mother to child HIV transmission. As a result, the child's expected benefit of human capital investments increases, so a mother may choose to increase investments in her children for altruistic motives. The link between a father's HIV status and his children's status is less clear since it's possible that his wife entered the marriage HIV positive and transmitted the virus to their children.

It is ultimately an empirical question as to whether the costs outweigh the benefits of marriage after learning one's HIV negative status. It is also possible for husbands and wives to evaluate the marriage differently in response to learning their HIV negative status. Men may be more willing to divorce if their remarriage prospects are better than women, or if they value household consumption of public goods less than women. If learning one's HIV negative status decreases the value of marriage, the spouse who does not learn his or her HIV negative status may have to compensate the other to stay in the marriage by reducing his or her share of household consumption. Conversely, if learning one's HIV negative status increases the value of public goods, then the spouse who learns their HIV negative status may decrease their share of household consumption in favor of increased public good consumption.

III. Data

The Malawi Longitudinal Study of Families and Health (MLSFH) is a panel data set with surveys in 1998, 2001, 2004, 2006, and 2008. Three districts in Malawi were selected to participate, one in the northern region (Rumphi), one in the central region (Mchinji), and one in the southern region (Balaka).

The 2004 wave was the first survey round in which individuals were offered HIV testing: 91% agreed. Table 1 reports the characteristics of women in 2004 based on whether the woman was present in the 2006 survey. Attrition is a concern; individuals who did not learn their HIV status and tested HIV positive were more likely to exit the sample in 2006. HIV positive individuals are more likely to divorce and migrate out of the region, which is discussed in greater detail by Anglewicz (2012). We address the potential selection bias in two ways: we restrict our analysis to couples who both tested HIV negative, and

our estimation strategy requires us to observe only one of the spouses in the 2006 survey wave. Table 2 presents summary statistics for our primary estimation sample. Husbands in the sample tend to be older and have higher educational attainment than their wives, which could give them more bargaining power in the household.

Because HIV testing was new and there were concerns that respondents would be concerned about their blood being taken, the MLSFH used saliva tests rather than rapid blood tests. The specimens were analyzed in a laboratory, causing a substantial delay between the test and the availability of results. In a field experiment, Thornton (2008) randomized two factors that influence the decision to return to a testing center. First, respondents were offered a voucher between zero and three dollars, which was redeemable upon showing up at a voluntary counseling and testing (VCT) center to find out their test results. The average value of the voucher was one dollar, which is equivalent to about a day's wage. Second, the testing centers were randomly placed within the villages. Individuals who returned to a VCT center were told their status and received counseling about HIV prevention methods.

What were an individual's beliefs about his or her HIV status prior to HIV testing? The 2004 wave included a question regarding an individual's self-assessed likelihood of being HIV positive, where the individual could choose from 4 risk categories ranging from "no likelihood" to "high likelihood." She could also answer "Don't Know". Tables 2 and 3 report the HIV prevalence by gender and beliefs about own HIV status in 2004 and 2006, respectively. HIV prevalence across the sample is 8%. For women, there is a positive relationship between HIV prevalence and self-assessed likelihood of being HIV positive. This suggests that women are able to assess their relative risk fairly accurately. On the other hand, there is not a clear relationship between men's beliefs about their status and actual HIV status. As a result, there may be a larger behavioral response among men if they have less accurate beliefs about their HIV status prior to testing.

HIV status could have no effect on individual's decision-making in the short term if they do not believe that the disease will affect their life expectancy or quality of life. In the 2006 wave, women were asked to compare the mortality rates of four hypothetical women: a woman of the same age as the

individual who is healthy and does not have HIV, a women who is infected with HIV, a women who is sick with AIDS, and a women who is sick with AIDS and is treated with antiretrovirals (ART). Responses are reported in Table 5. Mortality rates are increasing over the time horizon and with the degree of illness of the hypothetical woman. For example, a woman who is uninfected with HIV has a 20% mortality rate over a one year period, while a woman who is infected with HIV has a 45% mortality rate over the same period. A woman who is sick with AIDS has a 70% mortality rate. In the next five years, the women believe a healthy woman, a woman infected with HIV, and a woman with AIDS have a 41%, 70%, and 91% chance of dying, respectively. These are significantly higher than actual rates of mortality which Zwahlen and Egger (2006) calculate as a 47.3% probability of death for someone infected with HIV and a 72.3% probability of death for someone with AIDS over a 5 year horizon.

Because we are interested in the effect of both the husband and wife's learning their HIV negative status, we limit our sample to married women whose husband was also tested. In the 2004 sample, both the husband and wife were HIV positive in 2.4% of all monogamous couples. The husband was HIV positive and the wife negative in 4.9% of couples, and the husband was negative and the wife positive in 3.4% of couples. For the sero-discordant couples, there is potential for both HIV risk-reduction through divorce and remaining at risk by staying in the marriage. Due to the small number of serodiscordant couples, our primary estimation sample consists of the 89.3% of couples who both tested HIV negative.

Reiniers (2008) reports that divorce rates in Malawi are between 30-50% within the first 15 years of marriage. In our data, it also appears that short term divorce rates vary across regions. Between 2004 and 2006, 8% of marriages in Balaka dissolve with 5.6% through divorce; in Rumphi, we have only one case of divorce out of 405 couples; finally, in Mchinji, 1.3% of couples divorce while one marriage ends in widowhood. We also observe that women who transition from marriage to divorce over a two year period have a substantially higher HIV rate in 2004 than women who stay married. There could be two

explanations: first, that the spouse is trying to prevent infection; second, the husband could be divorcing her because she is the risky type and not a good partner.[7]

We construct expenditure shares in order to examine how household resource allocations change in response to learning one's negative HIV status. Individuals report household expenditures over the past three months across various expenditure categories. Categories include: personal non-medical expenditures, personal medical expenditures, expenditures on children's clothing, expenditures on children's schooling, children's medical expenditures, and farm related expenditures. Individuals were not asked about their spouse's household expenditures, so our measure of household expenditures is an imperfect measure of total household expenditures.[8]

We next turn to fertility. An ideal fertility measure would reflect the number of children who were conceived after results were received. We count the number of children present at the time of the 2006 household survey by counting children on the household roster.[9] Results were available in November and December of 2004 so the first children who could be conceived after obtaining test results would be born in late 2005. Since we do not have birth month, a woman is considered to have a new child if the child was born in 2006 or if the woman reported being pregnant at the time of the 2006 survey.[10] We restrict our sample to women under age 40 who we expect to be of child-bearing age in our fertility regressions. Around 13% of women had a child in this sample, resulting in 96 new children.[11] Observed fertility is the composition of two effects: the demand for children and the demand for risky sex. A

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[7] Most individuals in the MDICP say it is not acceptable to divorce a spouse because they have HIV.

[8] A subset of our primary estimation sample includes individuals whose spouse also reports household expenditures. For these couples, we can include the spouse's reported personal expenditures in order to construct a more complete measure of total household expenditures. For example, we add a husband's self-reported personal expenditures to his wife's household expenditure reports. See the Appendix for a more detailed description of the alternate estimation samples.

[9] This is a lower-bound estimate of the number of children ever born due to mortality between birth and the time of the 2006 survey.

[10] In another study, it was shown that some women do not want to tell others they are pregnant until the pregnancy begins to show, so our data will understate pregnancies in 2006.

[11] There is some evidence that there are some inconsistencies in the reported number of children across the survey waves, so this is why we rely on the observed number of children in the household in 2006 instead of a woman's reported number of children.

woman who learns she is negative may want more children, but decreasing the amount of unprotected sex could offset this effect. To separate these two potentially opposing effects, we examine both actual fertility and a women's desired fertility after individuals learn their negative status.

IV. Identification Strategy

We estimate the impact of learning one's HIV negative status on marital stability, fertility, and household expenditures. For marital status, our unit of analysis is the marital outcomes in 2006 of couples who are married in 2004. The estimating equation for marriage is:

$$(1) \qquad Marry_i = \alpha + \beta_1 Wife\_result + \beta_2 Man\_result + X_i'\mu + \varepsilon_i$$

where *Wife_result* is equal to one if the wife received her result and similarly for the man. A vector of controls, ***X***, including age, age-squared and region fixed effects is included. Our sample is limited to couples in which both individuals are HIV negative due to the small number of HIV positive individuals in the sample.[12] The regression is similar for actual and desired fertility but we add controls for the number of children in 2004 and the wife's level of education. For individuals who are HIV negative, the effect of learning your status is β_1 for women and β_2 for men. Alternative specifications only include the husband's or the wife's result variable. The alternate specifications are discussed in greater detail in the results section.

Thornton (2009) finds that individuals who engage in risky sexual behavior and who are less likely to believe they are HIV positive are more likely to return to a clinic to find out their HIV status; this could bias the estimated effect of learning one's HIV status on marital stability and household decision-making. For example, individuals who engage in risky behavior may be more likely to divorce, which would bias the coefficient on learning one's HIV negative status downward. Conversely, having a lower subjective probability of being HIV positive would bias the estimated effect of learning one's HIV negative status towards zero because these individuals already have low priors about the likelihood of being HIV

[12] There are only 52 HIV positive individuals in the full sample, so we do not have enough statistical power to identify effects of being HIV positive or learning one's HIV positive status. See online appendix for details.

positive. In other words, learning one's status would not be new information for this group of individuals. To account for these biases, we exploit Thornton's randomization of the distance to the nearest VCT center and the incentives received by the individual to return to the VCT center as instrumental variables for the decision to obtain test results. For specifications where only one spouse learns their HIV negative status, the first stage regression is:

$$(2) \qquad \begin{aligned} Got\_result_i &= \alpha + \beta_1 Any_i + \beta_2 Amt_i + \beta_3 Amt_i^2 \\ &+ \beta_4 Dist_i + \beta_5 Dist_i^2 + X_i'\mu + \varepsilon_i \end{aligned}$$

where *Any* refers to whether the individual received any incentive and X is the same vector of covariates. For our main analysis at the couple level, we include both the man and wife's financial incentives:

$$(3)\ Got\_result_i = \alpha + \beta_1 Wife\_any_i + \beta_2 Wife\_amt_i + \beta_3 Wife\_amt_i^2 + \beta_4 Man\_any + \beta_4 Man\_amt + \beta_5 Man\_amt_i^2 + \beta_6 Total\_amt_i^2 + \varepsilon_i$$

The identifying assumption is that the incentives do not affect the outcomes of interest except through their effect on the probability of receiving results.

V. Results

A. Marriage

We first examine marital stability in response to learning one's HIV negative status we restrict to couples who are married in 2004. We define two outcome variables: first, we define "married" equal to one if the wife is married to anyone in 2006; second, we define a variable "changed spouse" which is equal to one if the woman is either no longer married (widowed or divorced) or is married to someone else. The second variable is a better measure of stability of the marriage from 2004, while the first measure captures the woman's decision to remarry if she becomes widowed or divorced.

Before using the randomization of incentives to learn one's HIV status as an instrument for receiving results, we first present OLS estimates of the effect of learning one's HIV negative status on marital stability. OLS results for HIV-negative couples from equation (1) are presented in Table 7. The

effect of choosing to get results is negative for the wife and positive for the spouse, suggesting that the selection mechanism of who chooses to receive results differs between men and women. Coefficients are similar across both regressions. Women who learn that they are HIV negative are less likely to be married to the same person in 2006; the opposite is true if the husband learns his HIV-negative status.

The selection of individuals who choose to get their results could bias the OLS coefficients. For this reason, we use the randomized incentives, as well as the randomization of the distance of the VCT center from the village, as instruments for getting results. We use both the wife and husband's individual incentives as instruments. The first stage from Equation 3 is presented in Table 6. The instruments predict the two endogenous variables well and the F-statistics are large (F>10) for both variables. As expected, the size of the financial incentive has a positive effect on the decision to return to a testing center. Individuals who live farther away are less likely to return to the testing center. There is some evidence that financial incentives affect the decision-making of the spouse who did not receive the incentive. While the husband's financial incentive does not have a significant effect on his wife's decision to return for her test results (Column 1), his wife's financial incentive increases the likelihood that the husband obtains his test results (Column 2). We also use only one spouse's status in some regressions. Point estimates of the effect of each individual's financial incentives are similar to the estimates in Table 6 when excluding the spouse's incentives.

We show the IV results for both being married in 2006 and not changing spouses in 2006 in Table 7. There is a striking difference between the IV and OLS coefficients. In particular, the sign of the estimated coefficients change from positive to negative for men, and negative to positive for women. In the IV regression, if a husband learns his status, the wife is 2.3 percentage points less likely to be married in 2006. Similarly, in column (4), we see that the marriage is 7.2 percentage points less likely to survive until 2006 when the husband learns his HIV negative status.

We investigate the selection of who chooses to receive results by comparing characteristics of those who got results and those who did not get results in 2004. The selection mechanism does act differently across sexes. Women who get results are on average 1.5 years younger, less likely to have a

primary education (by 8 percentage points), and are slightly (1.5 percentage points) more likely to report using a condom with their spouse. Men that choose to learn their HIV negative status are 3 years older on average, somewhat less likely to have a primary education (4 percentage points), and 1 percentage point less likely to report using a condom with their spouse. Surprisingly, the two groups do not differ on HIV expectations, number of prior marriages, or sexual behavior.

Our hypothesis for the negatively biased OLS coefficient for women and positively biased OLS coefficient for men is that the women's result is driven primarily through the large differences in primary school education and that the men's result stems from differences in unobservable characteristics between younger and older men. In fact, women who do not have a primary school education are more likely to divorce which is consistent with the negative OLS coefficient. Also, older men are much less likely to divorce; the fact that men who get results are much older means that comparing those who get results to those who do not get results without controlling for this selection will bias the coefficient upwards.[13]

There might be some concern that the two receiving results variables are highly correlated if the couple attends together. Therefore, Table 9 presents the same IV regressions but with only the female coefficients and then only the male coefficients. Similar patterns present themselves in this regression: if the wife learns her HIV status, there is no effect on marriage outcomes. However, the husband learning his status has a negative effect on the marriage and the probability of the woman being married in 2006.

It appears that husbands who learn their HIV negative status value the options outside of marriage more highly than women who learn their HIV negative status. A possible explanation is that men have the option of increasing the number of children by marrying a younger woman, while women do not. Conversely, women may value the benefits of their current marriage more highly than men. For example, women may want to invest in more children or invest in her existing children, whereas men may prefer to father children with a new partner.

[13] Controlling for primary school and male age in the regression does not completely erase the difference between the OLS and IV coefficients; this is either because (a) these variables are not very good measures of the underlying unobservable characteristics associated with age and education; or (b) there are other unobservable characteristics which explain the differences. In fact, OLS estimates become more extreme in the case where we do not control for age or education, suggesting that these characteristics do bias the OLS estimates.

If men choose to divorce after learning their HIV negative status, then we predict that couples in which the woman is older are less likely to stay intact after the man learns his status. In fact, this is the case. In Table 10, we show that marital stability of couples in which the woman is under 30 is not affected by the man learning his HIV negative status. However, if the woman is 30 or above, the probability that the couple divorces if the man learns his HIV status increases by 7.9 percentage points. If the woman is above 40, the sample size is too small to capture any significant effect of the man learning his HIV negative status, but the point estimate is similar. This finding is consistent with our hypothesis that both men and women want to invest in more children in the case of learning their HIV negative status, but that they choose to do this differently. We provide evidence that the wife increases the quantity of children *within* the current marriage in the next section.

B. Fertility

Fertility results are presented in Table 10. All regressions consider couples who were married in 2004. The first two columns consider both the woman's and man's HIV status. The OLS and IV estimates are of the same sign but the OLS are smaller. This suggests that there is less selection bias than in the marriage regressions. We find significant effects of learning your HIV negative status, and that these effects differ across men and women. If the wife learns her HIV negative status, there is an increase in children of 0.327 children. Conversely, couples have 0.252 less children if the husband learns his HIV negative status; this is not driven by a higher probability of divorce.

Considering the results of the husband and wife separately in columns (4) and (6), respectively, we see that these patterns remain consistent. Learning her status increases the number of children by 0.205. For men, the number of new children decreases by a statistically insignificant 0.202.

These results could be explained by either a change in desired fertility or a change in the willingness to engage in unprotected sex. In particular, it is unclear whether a man learning his negative

status reduces fertility due to changes in family planning or wanting to minimize his potential exposure to HIV. To separate these two effects, we next turn to desired fertility results.

C. Desired Fertility

To isolate the effect of knowledge of HIV status on family planning, we consider a dummy variable equal to one if the woman says that she desires more children. The variable is equal to zero if she does not want more children, and is missing if she says "don't know". Column 1 of Table 11 reports the OLS regression results. The point estimates are similar in magnitude and sign as the IV regression results, which are reported in Column 2. For a woman, the marginal effect of learning that she is HIV negative is a 23.1 percentage point increase in the probability of wanting another child. For men, there is no significant effect. These results suggest that the observed increase in fertility due to a woman learning her HIV negative status is driven by an increased desire for more children.

The results from the observed and desired fertility also suggest that men and women respond differently to learning one's HIV status along this margin. While both men and women have an increased desire for children after learning their HIV negative status, it is only the women who wish to increase the quantity of children within the current marriage. This difference could also explain why men may be more willing to divorce after learning their HIV negative status than women: women have more to gain from keeping the marriage intact (having more children) than men. Men, on the other hand, can increase the number of children by divorcing an older spouse and marrying a younger woman with more remaining childbearing years. Learning your HIV status appears to be associated with an increased desire for additional children, but there may be a quality response to this information as well. In the following section we examine whether there are changes in household expenditures after learning your HIV negative status, particularly relating to investments in children.

D. Expenditure Shares

We present expenditure share results in Table 12, where our measure of total household expenditures does not include expenditures of the respondent's spouse. The estimation sample consists of all individuals who tested HIV negative in 2004[14]. Women and men are considered separately in Panels A and B, and then together (Panel C). There some notable differences in the signs of the estimated coefficients between the male and female samples. For women, learning one's HIV negative status is associated with a twelve-percentage point reduction in personal (non-medical expenditures), but there is no decrease in personal expenditures among HIV negative men who find out their status. The distribution of resources seems to shift away from women's personal expenditures, possibly because they value expenditures on children more highly than men after learning their HIV negative status.

If parents revise their beliefs about their children's life expectancy and their own life expectancy in response to learning their own HIV negative status, then the value of investing in children's human capital should increase. Consistent with this, we find that there is a significant positive effect of learning one's negative HIV status on children's schooling expenditure shares. Based on the marriage regression results, men who learn they are HIV negative appear to value their options outside of the current marriage more highly than women, but the expenditure results reveal that they also appear to have a stronger investment motive for spending on their existing children. The positive and significant coefficient on children's schooling expenditures in the pooled sample (Panel C) appears to be driven by the male sample; the coefficient is positive and significant in the male only sample (Panel B) and positive and insignificant in the female only sample (Panel A). Men who learn they are HIV negative decrease expenditures on children's clothing in favor of children's schooling, which also points to an increased preference for investment related expenditures.

We also find some evidence of increased expenditures on agriculture related expenses, which could be another form of investing for the future. Point estimates for agricultural expenditure shares are positive across all samples, and significant in the pooled sample estimates. Thornton (2012) does not find

[14] Alternative estimation samples were considered where the estimation sample was restricted to couples where both spouses tested HIV negative and both reported household expenditures. While underpowered, the same patterns remain. Results are available upon request.

any significant effects of HIV testing on the level of expenditures on agricultural activities, but our results for expenditure shares may reflect a shift in the relative preference for long term investments.

V. Conclusion

Previous research has not found significant changes in economic activity in response to learning one's HIV negative status (Thorton 2012), but our findings suggest that individuals may respond to this information in other ways. With respect to marriage, we find a higher likelihood that the marriage dissolves when the husband learns his negative status. There is no evidence of increased marital dissolution when the wife learns her HIV status. This differential effect could be due to two reasons. First, a woman's utility outside of the current marriage may be lower compared to men's utility outside marriage. We find evidence that men are more likely to divorce older wives after they learn their HIV negative status, which suggests that they prefer to match with a younger woman with higher fertility. Second, women appear to derive more utility from the current marriage than men, possibly because they have a higher taste for public goods. Consistent with this, we find that women have an increased desire for more children after learning their HIV negative status, while men do not.

We also find evidence that HIV testing has positive implications for children in the household. In particular, both men and women invest a greater share of household expenditures on their children's schooling when they learn their HIV negative status. While the HIV epidemic has contributed to an underinvestment in human capital (Akbulut-Yuksel and Turan 2012), our results indicate that HIV testing can be used as a policy tool to increase human capital investments in children.

Our analysis is subject to some limitations. One would expect to find a large behavioral response amongst HIV positive individuals who learn their status, but the relatively small scale of the MLSFH prevents us from being able to make any inferences about HIV positive individuals. Larger scale experiments are needed to be able to examine the effect of learning one's HIV positive status on household outcomes. Furthermore, researchers should consider household decision-making as a joint process that depends on a husband and wife's preferences, beliefs about their own HIV status, and the

status of their spouses. While we control for both a husband and wife learning their own HIV status, we cannot identify the effect of learning your spouse's status. Because it is unclear whether test results are shared between spouses, future experiments should be designed to compare the effect of joint HIV testing and counseling among couples versus individual testing and counseling.

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Table 1: Comparison of Women in 2004 and 2006 waves by panel status

	2004				2006			
	All		Panel		All		Panel	
	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
Consented to HIV test	1487	0.90	1139	0.91	1563	0.93	1139	0.94
Got test result	1343	0.69	1040	0.73	1457	0.97	1071	0.98
HIV positive	1323	0.08	1026	0.06	1438	0.07	1053	0.07
Married	1482	0.86	1136	0.87	1446	0.87	1071	0.88
Widowed	1482	0.04	1136	0.04	1446	0.05	1071	0.04
Divorced	1482	0.04	1136	0.04	1446	0.06	1071	0.06
Age	1209	35.0	953	35.4	1474	34.3	1139	37.0
Rumphi	1132	0.33	1132	0.33	1556	0.32	1132	0.33
Mchinji	1132	0.30	1132	0.30	1556	0.35	1132	0.30
Balaka	1132	0.37	1132	0.37	1556	0.33	1132	0.37
Multiple wives					1260	0.32	942	0.32

Table 2: Summary Statistics of HIV Negative Couples, 2004 Survey Wave

	Obs	Mean	Std Dev
Wife's age	576	36.73	10.84
Wife has primary education	576	0.72	0.45
Wife got test result	576	0.77	0.42
Husband's age	572	43.99	11.53
Husband has primary education	576	0.82	0.38
Husband got test result	576	0.72	0.45
Number of children	576	1.83	1.74
Region=Rumphi	576	0.41	0.49
Region=Mchinji	576	0.25	0.43
Region=Balaka	576	0.35	0.48

Table 3: HIV rates by self-assessed likelihood to be HIV positive in 2004

	Women		Men	
	Obs	Mean	Obs	Mean
no likelihood	719	0.06	720	0.06
Low	208	0.09	121	0.07
Medium	123	0.07	54	0.04
High	107	0.14	38	0.03
don't know	275	0.12	230	0.12

Table 4: HIV rates by self-assessed likelihood to be HIV positive in 2006 (on a scale of 0 to 10)

	Women		Men	
	Obs	Mean	Obs	Mean
likelihood=0	572	0.03	527	0.02
1<=likelihood<=2	178	0.04	120	0.06
3<=likelihood<=4	87	0.17	36	0.08
5<=likelihood<=6	78	0.06	26	0.19
7<=likelihood<=8	20	0.15	9	0.22
9<=likelihood<=10	20	0.40	13	0.23

Table 5: Beliefs about Mortality Likelihood of Hypothetical Women on a Scale of Zero to Ten

	Woman who is healthy and no HIV	Woman who is infected with HIV	Woman who is sick with AIDS	Woman who is sick with AIDS and treated with ARV
Individual will die within one year	2	4.5	7	4.5
	(1.7)	(1.8)	(2.0)	(1.9)
Individual will die within five years	4.1	7	9.1	6.9
	(2.0)	(2.0)	(1.3)	(1.9)
Individual will die within ten years	6	8.6	9.8	8.7
	(2.1)	(1.6)	(0.5)	(1.6)

*Standard deviations in brackets

Table 6: First stage regressions for decision to learn HIV negative status where spouse's incentives are included as controls

	(1) Wife_result	(2) Husband_result
Wife_any	0.266***	0.099
	(0.073)	(0.070)
Husband_any	0.034	0.263***
	(0.059)	(0.086)
Wife_incentive	0.0024***	0.0016**
	(0.0006)	(0.0008)
Husband_incentive	0.0008	0.0022**
	(0.0007)	(0.0009)
Wife_incentive^2	-0.000005***	-0.000003
	(0.0000005)	(0.000005)
Husband_incentive^2	-0.000006	-0.000002
	(0.000004)	0.000002
Distance from VCT	-0.067	-0.052
	(0.053)	(0.055)
Distance^2	0.0086	0.0107
	(0.0098)	(0.0103)
R-squared	0.2809	0.2855
F-statistic	13.44	14.54
N	564	564

Notes: Regressions include controls for number of children under age 15 in the household in 2004, both spouses' education, age, and age-squared as well as region fixed effects. Robust standard errors, clustered at the village level, are presented in parentheses. F-statistics are presented for the joint significance of the instruments. Wife_result and husband_result are equal to one if the wife or husband received their HIV testing results in 2004. Incentives to learn one's status were individually assigned; amounts ranged from zero to three dollars.

Table 7: Effect of learning one's HIV negative status on Marriage Outcomes, both spouses' status

	(1)	(2)	(3)	(4)
	Not Married in 2006		No longer with spouse from 2004	
	OLS	IV	OLS	IV
Wife_result	0.002	-0.023	0.025	0.009
	(0.017)	(0.032)	(0.018)	(0.036)
Husband_result	-0.019	0.049*	-0.017	0.072*
	(0.017)	(0.016)	(0.023)	(0.043)
N	564	564	564	564

Notes: Regressions include controls for number of children under age 15 in the household in 2004, both spouses' education, age, and age-squared as well as region fixed effects. Robust standard errors, clustered at the village level, are presented in parentheses. The regressions restrict to couples which were married in 2004. The outcome variable in columns (1) and (2) is equal to one if the woman is no longer married in 2006 and zero otherwise. The outcome variable in columns (3) and (4) is equal to one if the wife is no longer with the same spouse in 2006 (she is widowed, divorced, or married to a different man).

Table 8: Effect of learning one's HIV negative status on marriage outcomes, spouses' status entered separately

Panel A: Outcome =Not Married in 2006				
	(1) OLS	(2) IV	(3) OLS	(4) IV
Wife_result	-0.006	-0.001		
	(0.015)	(0.026)		
Husband_result			-0.018	0.049*
			(0.015)	(0.027)
Panel B: Outcome = Not married to the same spouse in 2006				
	(5) OLS	(6) IV	(7) OLS	(8) IV
Wife_result	0.018	0.046		
	(0.017)	(0.033)		
Husband_result			-0.009	0.074*
			(0.022)	(0.039)

Notes: N=564. Regressions include controls for number of children under age 15 in the household in 2004, both spouses' education, age, and age-squared as well as region fixed effects. Robust standard errors, clustered at the village level, are presented in parentheses. The regressions restrict to couples which were married in 2004. The outcome variable in Panel A is equal to one if the woman is no longer married in 2006 and zero otherwise. The outcome variable in Panel B is equal to one if the wife is no longer with the same spouse in 2006 (she is widowed, divorced, or married to a different man).

Table 9: Differential effects on marriage of learning one's HIV negative status by age

	Outcome = No longer married to the same spouse in 2006.			
	(1)	(2)	(3)	(4)
	Original IV	Wife's age <30	Wife's age>30	Wife's age>40
Wife_result	0.009	0.009	0.029	0.063*
	(0.036)	(0.086)	(0.040)	(0.035)
Husband_result	0.072*	-0.011	0.079**	0.066
	(0.043)	(0.064)	(0.039)	(0.051)
N	564	186	405	212

Notes: Regressions include controls for number of children under age 15 in the household in 2004, both spouses' education, age, and age-squared as well as region fixed effects. Robust standard errors, clustered at the village level, are presented in parentheses. The regressions restrict to couples which were married in 2004. The outcome variable is equal to one if the wife is no longer with the same spouse in 2006 (she is widowed, divorced, or married to a different man) and equal to zero if she is married to the same person.

Table 10: Second stage results: Fertility

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
Wife_result	0.097*	0.327***			0.083*	0.205**
	(0.052)	(0.126)			(0.042)	(0.100)
Husband_result	-0.031	-0.252**	0.004	-0.202		
	(0.052)	(0.112)	(0.042)	(0.108)		
N	380	380	380	380	380	380

Notes: Regressions include controls for number of children under age 15 in the household in 2004, both spouses' education, age, and age-squared as well as region fixed effects. Robust standard errors, clustered at the village level, are presented in parentheses. The regressions restrict to couples which were married in 2004 and to women who were under age 40 in 2004. The outcome variable is equal to the number of new children between the 2004 and 2006 waves plus one if the woman reports being pregnant in 2006.

Table 11: Second stage results: Desired fertility

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
Wife_result	0.014	0.231*			0.005	0.152
	(0.049)	(0.131)			(0.044)	(0.106)
Husband_result	-0.023	-0.137	-0.017	-0.072		
	(0.052)	(0.126)	(0.047)	(0.120)		
N	379	379	379	379	379	379

Notes: Regressions include controls for number of children under age 15 in the household in 2004, both spouses' education, age, and age-squared as well as region fixed effects. Robust standard errors, clustered at the village level, are presented in parentheses. The regressions restrict to couples which were married in 2004 and to women who were under age 40 in 2004. The outcome variable is equal to one if the woman reports in 2006 that she would like to have more children and zero if she reports that she does not want more children.

Table 12: Second Stage IV Expenditure Share Results for Respondents Who Tested HIV Negative

Panel A: Women's Expenditure Reports

	(1) Own Personal Expenses	(2) Own Medical Expenses	(3) Children's Clothes	(4) Children's Schooling	(5) Children's Medical	(6) Farm Expenses
Own_Result	-0.1239**	-0.0086	0.0367	0.0452	-0.0273	0.0810
	(0.048)	(0.027)	(0.045)	(0.031)	(0.029)	(0.050)
N	758	758	758	758	758	758
R-Squared	0.037	0.047	0.032	0.094	0.019	0.009

Panel B: Men's Expenditure Reports

	(1) Own Personal Expenses	(2) Own Medical Expenses	(3) Children's Clothes	(4) Children's Schooling	(5) Children's Medical	(6) Farm Expenses
Own_Result	0.0035	0.0042	-0.1004*	0.0675**	-0.0174	0.0447
	(0.041)	(0.017)	(0.056)	(0.030)	(0.021)	(0.053)
N	554	554	554	554	554	554
R-Squared	0.066	0.044	0.023	0.082	0.011	0.034

Panel C: Both Men and Women's Expenditure Reports

	(1) Own Personal Expenses	(2) Own Medical Expenses	(3) Children's Clothes	(4) Children's Schooling	(5) Children's Medical	(6) Farm Expenses
Own_Result	-0.0647**	-0.0041	-0.0236	0.0547**	-0.0214	0.0618*
	(0.030)	(0.016)	(0.031)	(0.021)	(0.018)	(0.034)
N	1,312	1,312	1,312	1,312	1,312	1,312
R-Squared	0.059	0.044	0.042	0.088	0.017	0.017

Robust standard errors clustered at the village level. Total household expenditures exclude the spouse's expenditures, which were not reported. All regressions include controls for age, age squared, educational attainment, regional dummies, number of children under the age of 15. Panel A reports regression results for the effect of a woman finding out she is HIV negative on her reports of household expenditure shares. Panel B reports regression results for the effect of a man finding out he is HIV negative on his reports of expenditure shares. Panel C includes both men and women's reports. Controls in Panel C also include a male dummy variable. *** p<0.01, ** p<0.05, * p<0.1

Appendix

To preserve sample size, our main estimation sample for expenditures includes individuals who tested HIV negative, but his or her spouse may or may not have been tested. Table A.1 presents summary statistics of the expenditure shares for the different estimation samples and measures of expenditure shares. Respondents in Panel A tested HIV negative in 2004 but their spouse may or may not have been tested. The samples in Panel B consist of respondents and their spouses who tested HIV negative. On average, men and women report similar expenditure shares across the different categories and samples. In other words, the men and the women's household expenditure reports seem to be consistent with one another. This is reassuring since there is an overlap of households across the men and women's samples. The only exception is children's clothing expenditures, where men report a higher expenditure share than women. The discrepancy could arise if only one parent purchases children's clothing: only one parent would have an accurate estimate of children's clothing expenditures.

Table A.1 also reports summary statistics for households where we observe both the husband and wife's reported household expenditures. For this sample, our measure of total household expenditures includes expenditures on the respondent's spouse. According to the men's expenditure reports, a husband and wife have similar shares of household expenditures.

To compare whether the different samples vary across observables, Table A.2 reports summary statistics for all the samples. The samples look similar across observables, which reduces concerns regarding selection bias.

Table A.1: Summary Statistics of Expenditure Shares

Panel A: Respondent was HIV tested

	Partial Shares						Total Shares					
	Men			Women			Men			Women		
	Obs	Mean	SD	Obs	Mean	SD	Obs	Mean	SD	Obs	Mean	SD
Personal expenditures	554	0.22	0.24	758	0.23	0.25	353	0.17	0.20	423	0.16	0.19
medical expenditures	554	0.04	0.12	758	0.06	0.14	353	0.03	0.10	423	0.03	0.08
farm expenditures	554	0.18	0.24	758	0.17	0.26	353	0.19	0.25	423	0.18	0.26
children's clothing	554	0.29	0.25	758	0.24	0.25	353	0.23	0.21	423	0.17	0.20
children's school	554	0.10	0.18	758	0.11	0.21	353	0.09	0.15	423	0.09	0.18
children's medical	554	0.06	0.11	758	0.08	0.17	353	0.05	0.10	423	0.05	0.11
spouse's expenditures							353	0.16	0.21	423	0.25	0.29

Panel B: Respondent and spouse were HIV tested

	Partial Shares						Total Shares					
	Men			Women			Men			Women		
	Obs	Mean	SD	Obs	Mean	SD	Obs	Mean	SD	Obs	Mean	SD
Personal expenditures	420	0.20	0.23	480	0.22	0.24	394	0.17	0.21	352	0.15	0.19
medical expenditures	420	0.04	0.12	480	0.04	0.13	394	0.04	0.07	352	0.03	0.09
farm expenditures	420	0.20	0.25	480	0.18	0.27	394	0.20	0.25	352	0.20	0.28
children's clothing	420	0.29	0.26	480	0.24	0.26	394	0.23	0.22	352	0.16	0.20
children's school	420	0.11	0.19	480	0.13	0.23	394	0.09	0.15	352	0.10	0.19
children's medical	420	0.07	0.12	480	0.07	0.16	394	0.06	0.11	352	0.05	0.11
spouse's expenditures							394	0.15	0.20	352	0.24	0.29

A.2: Descriptive Statistics of Different Samples

Panel A: Respondent was HIV tested

	Respondent reported expenditures						Spouse also reported expenditures					
	Men			Women			Men			Women		
	Obs	Mean	SD	Obs	Mean	SD	Obs	Mean	SD	Obs	Mean	SD
Age	554	42.52	12.01	758	37.00	11.74	353	45.36	10.44	423	37.79	10.37
Primary Education	554	0.83	0.38	758	0.65	0.48	353	0.81	0.39	423	0.68	0.47
Land (Hectares)	554	4.45	4.13	758	3.46	3.47	353	4.58	4.02	423	3.88	3.97
Boys	554	1.56	1.23	758	1.52	1.21	353	1.68	1.26	423	1.65	1.24
Girls	554	1.59	1.34	758	1.39	1.16	353	1.75	1.37	423	1.49	1.18
Total HH members	554	5.82	2.12	758	5.36	1.99	353	6.24	2.00	423	5.75	1.92
Mchinji region	554	0.31	0.46	758	0.28	0.45	353	0.31	0.46	423	0.27	0.44
Balaka region	554	0.32	0.47	758	0.37	0.48	353	0.30	0.46	423	0.31	0.46
Rumphi region	554	0.37	0.48	758	0.35	0.48	353	0.38	0.49	423	0.43	0.50

Panel B: Respondent and spouse were HIV tested

	Respondent reported expenditures						Spouse also reported expenditures					
	Men			Women			Men			Women		
	Obs	Mean	SD	Obs	Mean	SD	Obs	Mean	SD	Obs	Mean	SD
Age	420	44.99	10.45	480	38.61	10.53	394	45.58	10.42	352	38.42	10.05
Primary Education	420	0.82	0.39	480	0.69	0.46	394	0.81	0.39	352	0.72	0.45
Land (Hectares)	420	4.57	4.12	480	3.80	4.01	394	4.51	3.98	352	3.98	4.27
Boys	420	1.64	1.22	480	1.64	1.27	394	1.70	1.22	352	1.66	1.28
Girls	420	1.74	1.33	480	1.53	1.19	394	1.76	1.32	352	1.54	1.18
Total HH members	420	6.18	2.01	480	5.84	1.96	394	6.29	1.94	352	5.88	1.95
Mchinji region	420	0.29	0.45	480	0.24	0.43	394	0.28	0.45	352	0.24	0.43
Balaka region	420	0.32	0.47	480	0.32	0.47	394	0.32	0.47	352	0.28	0.45
Rumphi region	420	0.39	0.49	480	0.44	0.50	394	0.40	0.49	352	0.47	0.50