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THE ASSOCIATION BETWEEN HIV AND LABOR MARKET PARTICIPATION IN THE SOUTHERN AFRICAN DEVELOPMENT COMMUNITY

Introduction

The human suffering and declines in health associated with HIV/AIDS have been well-documented; however, the disease also has consequences for the economic wellbeing of a country. HIV/AIDS strikes adults in their prime working years, which impairs their ability to work and invest in their future, thereby exacerbating existing poverty and inequality. Thus far, the African continent has borne the significant brunt of the damage resulting from the HIV epidemic, which will likely remain as one of its biggest challenges in the new millennium. In particular, sub-Saharan Africa is currently the most affected region, home to just over 10% of the world's population but more than two-thirds of those living with HIV. Within the region, southern Africa has been the most severely affected (Joint United Nations Programme on HIV/AIDS, 2007).

In the absence of a cure or affordable pharmaceutical therapy for all those afflicted, it is vital to better understand how HIV impacts the workforce. It is important to note the potential loss of a significant source of working ability in the household since those infected are often the major decision makers in their households. Traditionally, in this setting men are usually the primary breadwinners, contributing the majority of household income, whereas women play a bigger role in rearing children. The men's role in wealth accumulation may stem from cultural practices, whereby they have to pay *lobola* in order to obtain a bride to start their own families (Montgomery et al, 2008). However, this dichotomy of roles may be shifting, as more women find it necessary to bring home earnings[1].

[1]For example, 45.73% of male respondents in Lesotho reported covering at least half of household expenditures with their earnings, whereas the corresponding figure for women is lower (39.69%). For Malawi, 72.97% (57.29%) of men (women) covered at least half of household expenditures.

Recent Demographic and Health Surveys (DHS) include voluntary HIV testing with results linked to individuals. Cross-sectional DHS data from four countries in the Southern African Development Community (SADC) – Lesotho, Malawi, Swaziland, and Zimbabwe – were used to determine the association between HIV and current employment in order to better understand the effect of HIV on economic outcomes.

This study has important implications for the macroeconomic stability and future growth of the countries under investigation. By identifying the potential effects of HIV on labor market participation, it is hoped that appropriate policies can be designed to help all afflicted individuals and families.

Southern African Development Community (SADC)

In 1980, the Southern African Development Coordination Conference, an informal gathering of nine countries[2] came into being so as to lessen economic dependence on South Africa, then still under apartheid rule. SADC developed into its current legal form in 1992, and seeks, among justice and security goals, to improve the economic lives of those living in the region (SADC, 2008).

Four countries were included by virtue of having conducted HIV testing in their most recent DHS: Kingdom of Lesotho (2004), Republic of Malawi (2004), Kingdom of Swaziland (2006) and Republic of Zimbabwe (2005/2006), with the year in parentheses referring to the most recent DHS with HIV testing for that particular country. Table 2.1 provides background information for the four countries. The countries vary in terms of both geographical and population size, with Swaziland being the smallest and Zimbabwe being the largest in both measures. However, the populations residing in the four countries are similar in a number of ways. The majority of each country's population resides in rural areas. The levels of human development are low, as measured through the Human Development Index (HDI) provided through the UN Development Project. Also, a high proportion of each country's population is living below threshold levels or poverty, as reflected through the Human

[2]These nine countries are: Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe.

Poverty Index (HPI). Gender disparities are also prevalent (see Gender-related Development Index, GDI).

HIV/AIDS in SADC

In terms of the four countries included in this study, the HIV prevalence rate is currently the highest in Swaziland (26%). While the HIV prevalence rate is lowest in Malawi (12%), Malawi's rate is still considerably higher when compared to the countries in the rest of the world. Table 2.2 provides a snapshot of the number of HIV positive adults and adult HIV prevalence rates for the four countries.

The vast majority of HIV infections in the sub-Saharan region occur through heterosexual contact. Given the high HIV prevalence rates in the general population, substantial HIV transmission occurs during intercourse not directly involving prostitution. The continuum of sexual exchanges ranges from transactions involving money to sexual concurrency to monogamy. The prevalence is higher among women (who are biologically more susceptible), young people and in urban areas. Although the situation may seem bleak, improvements, such as a gradual drop in the number of new infections (UNAIDS, 2008) have occurred. While recent research has shown that the modes of HIV transmission in the region are more diverse than previous evidence would suggest, injection drug use and sex between men still do not play a significant role (UNAIDS, 2008; Avert, 2008). Since homosexuality is illegal (or highly stigmatized) in the four countries included in this study, no information is available on the number of infections resulting from that avenue.

Voluntary counseling and testing (VCT) has been available in the region since the mid 1990's; however, due to a fear of stigma, the number of individuals actually accessing VCT services is low. Anti-retroviral drugs (ARVs), which delay the onset of AIDS for HIV positive people, have been available since the early 2000's, with the number of people receiving them on the rise (without HIV treatment, the development of HIV into AIDS varies by individuals, depending on for example, nutrition). As the number of individuals receiving HIV treatment grows, so will the number of people living with HIV, reiterating the need to understand the association between labor market participation and HIV status. Nevertheless, while financial affordability is becoming less of an issue, access is still

a problem due to a shortage of medical staff and other problems such as lack of transportation in rural areas (Avert, 2008).

HIV/AIDS and the Labor Market

Although HIV/AIDS undoubtedly affects a country's economic growth, the evidence about its direction of influence has thus far been mixed. Bloom and Mahal (1997) used changes in prevalence of AIDS and rate of growth of GDP per capita to find that the AIDS epidemic had an insignificant effect. Using mortality by disease data, Acemoglu and Johnson (2006) came to a similar conclusion. Given the link between HIV/AIDS and reduced working years (both through deterioration in health and shorter lifespan), it is natural to expect a negative correlation between life expectancy and economic growth. However, they found that life expectancy has a smaller effect on current and future GDP than previously estimated. A variety of explanations are plausible. First, surplus labor exists to take the place of those who have succumbed to AIDS, thereby minimizing negative impacts in the short-term. Second, community based organizations and extended family networks may help to mitigate the loss in income. Third, projections for the number of individuals infected by HIV may be overstated as HIV/AIDS prevention practices become more widespread. In terms of behavioral change, HIV positive individuals may also increase their precautionary savings and limit their consumption in anticipation of the expected future drop in earnings. From simulations using data from South Africa, Young (2005) found that the AIDS epidemic actually results in higher per capita consumption since the reduction in fertility dominates the decline in educational attainment through 2050.

In contrast, even though HIV prevalence rates are starting to stabilize or even decline, simulations conducted using an overlapping generations model show that, in the absence of interventions, severe shrinkages in the size of the South African economy in the future can be expected (Bell, Devarajan, Gersbach, 2006). Bruhns (2006) used Kenyan data from 1920-2000 to forecast effects of HIV/AIDS for the years 2000-2040, and found that per capita income grew significantly more slowly after epidemic outbreak.

Despite the prevalence of diseases other than HIV/AIDS in southern Africa, such as malaria, the effects of HIV on economic outcomes are nevertheless thought to be greater in comparison (Beegle, 2005). HIV strikes adults in their prime working years, and there has also been evidence showing that more educated (and presumably wealthier) individuals are more likely to be HIV positive (Fortson, 2008). Indeed, if HIV was limited to the poor and uneducated, the effects on economic growth would be similarly constrained to that population.

Past research on how HIV affects labor market participation in developing countries has been inconclusive. Werker et al (2006) found that the AIDS epidemic has thus far not had a measurable impact on economic behavior. McKelvey (2007) used a similar approach by taking advantage of the fact that male circumcision reduces the risk of contracting HIV for obtaining identification, and found that HIV does reduce labor force participation for men in certain developing nations. Research has also shown that anti-retroviral therapy does help HIV positive patients in the workforce. In Kenya, such therapy increases the likelihood of labor force participation and the number of hours worked per week (Thirumurthy et al, 2007). Habyarimana et al (2007) found a significant long-term drop in absenteeism among diamond mineworkers in Botswana workers who participated in a treatment program. Finally, Levinsohn (2008) used 2005 data from South Africa to find that the impact of HIV on the labor market varies significantly between genders as well as for different age groups, with more unemployment among women and younger workers.

Methods

Data

This study utilized cross-sectional data from the most recently completed Demographic and Health Surveys (DHS) for Lesotho, Malawi, Swaziland, and Zimbabwe. The DHS was conducted by the Monitoring and Evaluation to Assess and Use Results (MEASURE) program, which is sponsored by the United States Agency for International Development (USAID) as well as contributions from other donors. A standardized questionnaire addressing fertility, family planning, maternal and child health, child survival, HIV/AIDS, malaria, and nutrition was administered to a large number of

households in developing nations in these surveys. Households were randomly chosen so as to be nationally representative. This process was conducted repeatedly for many countries, and repeated within each country, so that comparisons across country and over time are possible (surveys are typically conducted every five years, but with different households in each survey year). Given the origins of the DHS – a systematic data collection process to provide data and analysis on the population, health and nutrition of women and children in developing countries – the number of female respondents far outnumber that of male respondents. Furthermore, earlier surveys only collected data for the household and women, with no separate modules for men.

Beginning in the early 2000's, surveys from certain countries also included voluntary HIV testing for a portion of respondents using blood spots. Some countries offered testing to all respondents, while others only tested a fraction of the population. While such tests are anonymous and individuals are not given their results, referrals for free voluntary counseling and testing as well as AIDS educational materials are provided. HIV test results are linked to individual surveys for research purposes.

Theoretical Model

Given that most households in SADC are without income generating assets (such as land), individuals will choose to work when the existing wage rate exceeds the marginal rate of substitution (MRS) between consumption and leisure and people should work until wage rate=MRS. For the former, healthier individuals are more productive, which influences wage rates and results in substitution and income effects. With the latter, health is valued of its own accord i.e. affects utility directly. Hence, a labor participation function $L = L(H, S, A, B, \varepsilon)$ where H is health, S is schooling, A is individual attributes, B is household attributes, and ε are the unobservables can be estimated to identify the effects (Strauss and Thomas, 1998).

Empirical Model

Although my analysis was done on people who were randomly chosen to be tested, these individuals may be different from those who were not chosen due to sampling error. To check the

representativeness of the sample drawn for testing, comparisons were made of the individuals chosen for testing versus the individuals who were not chosen for testing through descriptive statistics and simple t-tests of means.

Average Treatment Effects (ATE) of HIV status on Employment

Researchers and policymakers are often interested in the average effect of receiving or not receiving a binary treatment with the assumption that this treatment satisfies exogeneity or unconfoundedness. The treatment in this study is an HIV positive diagnosis (so treatment = 1 if an individual is diagnosed as being HIV positive, and = 0 if HIV negative). This approach assumes that the receipt of treatment is independent of potential outcomes if observable covariates are controlled for. In turn, the independence of treatment assignment implies that differences in outcomes between treated and control units with the same covariate values can be attributed to the treatment (Imbens, 2004).

Heckman Selection Models for Willingness to be Tested

Individuals who were randomly selected to be tested have the option of refusing to be tested. People who refuse testing may be inherently different from those who choose to be tested (for example, they may be more likely to be HIV positive and also work less), and hence bias my results. To address selection, I ran a Heckman selection model to obtain consistent results, where the first step is a probit model ran on the full sample to determine the probability of accepting an HIV test and the second step is also a probit model to determine the association between HIV status and labor market participation.

The relationships of interest are:

(1) Selection Equation: $\Pr(z_i = 1) = \Phi(w_i\gamma)$

(2) Outcome Equation: $\Pr(y_i = 1) = \Phi(x_i\beta)$

Here z_i represents whether the individual accepted the HIV test, w_i are interviewer fixed effects, y_i is whether the respondent is currently working/worked in the past 12 months, and x_i are the control

variables (listed below). Thus, the selection equation addresses whether the respondent accepted the HIV test, and the outcome equation looks at whether the individual is currently working/worked in the past 12 months.

To obtain identification, I use an instrumental variables strategy in the selection equation in the form of interviewer fixed effects which is an exogenous factor that affects probability of test refusal but affects neither HIV status nor labor market participation. For instance, it is plausible that specific interviewer characteristics such as gender are likely to influence whether a respondent agrees to an HIV test. Essentially, this approach imposes the exclusion restriction that $w \neq x$. Tests of rho indicated where sample selection is a concern, and Heckman Selection models were used where appropriate.

Propensity Score (PS) for the endogeneity of HIV status

ATE can be estimated with a number of methods. I also used regression adjustment in which the propensity score is included as a covariate where necessary for this study since it has an advantage over traditional regression methods in that the propensity score is nonparametric and does not impose a functional form.

The use of PS to reduce bias when assessing ATE in nonrandomized, observational data was first introduced by Rosenbaum and Rubin (1983). Instead of directly adjusting for all covariates, one can also adjust for differences in the propensity score, $p(X)$, defined as the conditional probability of receiving treatment given pretreatment characteristics. In this study, the propensity score is the predicted probability of being HIV positive rather than HIV negative. PS reduces bias by comparing the outcomes of treated and control groups who are plausible counterfactuals – i.e. individuals who are virtually identical except for treatment and are equally likely to be in the treated or the control group. Since multiple characteristics can be used, the propensity score method summarizes the baseline characteristics into a single variable and thereby avoids any problems with dimension (Becker and Ichino, 2002).

The endogeneity of HIV status with respect to labor market participation needs to be addressed since HIV was not randomly assigned – random assignment of HIV status would be deemed unethical. The use of PS is thus appropriate since the probability of being HIV positive is based only on pretreatment factors, creating a quasi-randomized experiment (D'Agostino, 1998). Two-stage residual inclusion was used to test for endogeneity (Terza et al, 2008).

Combining Heckman Selection Models and Propensity Scores

Both Heckman selection models and propensity scores were used to resolve the problem of correlation between HIV status (the key explanatory variable) and the error term in the outcome equation. Propensity scores will be included in the outcome equation of the Heckman selection models as a covariate; specifically Heckman selection models will be run with and without the propensity scores to address any remaining bias.

The analysis was conducted at the individual level, for men and women aged 15 and above. This age cutoff corresponds to the DHS definition for adults. Weights provided by DHS were used. Finally, models were stratified by gender for each of the four countries as the association between HIV status and labor market participation is likely to differ between men and women given the context of the region.

Dependent Variables

DHS asked its respondents a variety of questions regarding their employment situation. Although the DHS does not ask for any wage information, it nevertheless has responses for labor market participation which are also important. While the questions differ slightly between the four countries, the following was common to all (possible responses given in parentheses):

- Is the respondent currently working (yes, no)?
- Has the respondent worked in the past 12 months (no, in the past year/currently working)?

Key Explanatory Variables

The key explanatory variables for the selection equation looked at whether individuals accepted HIV testing, namely, the interviewer fixed effects. Given the distribution of people per

interviewer, a dichotomous variable was created for each interviewer that had interviewed 100 or more individuals, while interviewers who had interviewed less than 100 individuals were grouped together.

The key explanatory variable for the labor market participation outcome equation was a binary measure of whether an individual was HIV positive or negative. Given the research question, the sample will be restricted to those who were tested for HIV, and will exclude the very few who had indeterminate or missing results. Interactions with age and rural/urban were included as effects may differ depending on the age of an individual, or their type of residence.

Control Variables

The following observed variables were controlled for in the first stage selection equation as they are likely to influence the decision of whether or not to accept an HIV test: age (and age squared), rural/urban residence, educational level (no schooling, primary schooling, secondary schooling, or higher levels), marital status (married or not married), family structure (whether a household has any children under the age of 5), and wealth. Since the DHS does not include commonly used indicators for household economic status, a durables index was constructed by summing asset ownership of the following: radio, television, refrigerator, bicycle, motorcycle/scooter, and car/truck (Case, Paxson, and Ableidinger, 2004). The same observables were controlled for in the second stage labor market participation outcome equation, and in the construction of the propensity score.

Results

Descriptive Statistics

Tables 2.3a.-2.3h. are the descriptive statistics, presented by country and stratified by gender. The p-values from t-tests of difference in means between groups "Not Chosen for testing" and "Chosen for testing" show that the groups usually only differed by sampling error. Note that in Zimbabwe, all individuals were chosen for testing, as were all Malawian men. The "Accepted" column under the group "Chosen for testing" contains the estimates of interest.

Women in Lesotho (36%) and Zimbabwe (36.5%) are less likely to report that they are currently working, followed by women in Swaziland (41.3%) and Malawi (57%). In all countries, a higher percentage of women reported having worked in the past 12 months, perhaps reflecting the seasonal nature of agriculture, a major source of employment. On average, women across the four countries are around 28 years of age (range: 15-49) with the majority residing in rural areas – Zimbabwe, at 67.4%, has the lowest percent of rural women. Wealth levels, as measured by the six item wealth index, range from Lesotho (0.9) to Swaziland (1.9). Education levels differ across the four countries. The majority of women in Lesotho (61.9%) and Malawi (62.6%) reported primary as their highest level of education, whereas the majority of women in Swaziland (50.6%) and Zimbabwe (58.9%) reported secondary level education. Since only a very small portion of women had received education beyond the secondary level, this group was combined with those whose highest level of schooling was secondary. Marriage rates ranged from the lowest (Swaziland, 44.1%) to the highest (Malawi, 77%). Except for Zimbabwean women, most individuals lived in households with at least one child under the age of five, reflecting the caretaking role often fulfilled by the female members of the household.

For women, refusal of HIV test is lowest in Swaziland (7.65%), which also has the highest HIV prevalence rate (31.70%). The HIV prevalence rates for the rest of the countries are: Lesotho (26.11%), Zimbabwe (20.70%), and Malawi (14.62%).

Men in Lesotho (31.3%) are least likely to report they are currently working, followed by Swaziland (50.7%), Malawi (59.2%) and Zimbabwe (65.5%). Similar to women, a higher percentage of men across all four countries reported having worked in the past 12 months. The average age is 30 years old for men in Lesotho and Malawi, and 26/27 for Swaziland/Zimbabwe respectively, with the majority residing in rural areas – Swaziland, at 67.7% has the smallest rural population. Wealth levels are distributed similarly to the women – the poorest being Lesotho (0.86) and the richest in Swaziland (1.91). Education levels differ across the four countries. The majority of men in Lesotho (56.1%) and Malawi (64.1%) reported primary as their highest level of education, whereas the majority of men in

Swaziland (48.3%) and Zimbabwe (63.1%) reported secondary level education. Since only a very small portion of men had received education beyond the secondary level, this group was combined with those whose highest level of schooling was secondary. Men are much less likely to be married than women, with marriage rates ranging from lowest (Swaziland, 32.2%) to the highest (67.8%). A majority of men in Malawi (64.6%) and Zimbabwe (83.7%) lived with children under the age of five in, whereas slightly less then half of men in Lesotho (46.2%) and Swaziland (49.1%) did.

For men, Swaziland again has the lowest HIV test refusal rate (12.90%) and the highest HIV prevalence rate (19.65%). The HIV prevalence rates for the rest of the countries are: Lesotho (18.68%), Zimbabwe (14.09%), and Malawi (10.10%).

HIV Prevalence Rate by Age Groups

As shown in Table 2.4a. HIV prevalence rates for women are highest in the age 30-39 group for Lesotho, Malawi, and Zimbabwe, and highest in the 20-29 age group in Swaziland, which has high rates in all four age groups. Hence, HIV prevalence rates increase with age, and appear to peak during the 30-39 years before dropping.

Table 2.4b. shows the same information for men. HIV prevalence rates are highest in the 30-39 age group in all four countries. Similar to the women, HIV prevalence shares a positive relationship with age, reaches a maximum during the 30-39 period, after which the relationship becomes negative – this is evident by the decreasing rates in the 40-49 and 50+ groups. Note that the HIV prevalence rates for the age 15-19 group are lower for men than for women

Estimated Models

Tables 2.5-2.8 contain the results for Lesotho, Malawi, Swaziland, and Zimbabwe, where models are stratified by gender. Tables labeled with a. are for women and b. for men. Within each table, columns (1) and (2) are the selection and outcome equations for outcome: currently working, and columns (3) and (4) are the selection and outcome equations for outcome: worked in past 12 months. Propensity score adjustment for endogeneity of HIV status was included where residuals from two stage residual inclusion were significant. Note that due to convergence issues, linear

probability models were used for the outcome equations for women in Malawi and Zimbabwe (instead of probit models, as was the case for all other models).

Selection Equations

Across all four countries, the coefficients from the selection equations show that men and women living in rural areas or with a young child in the household are more likely to accept an HIV test. Age was a significant predictor for HIV test acceptance for men from all countries, and women from Swaziland. Among Malawi women and Zimbabwean men, primary and secondary or higher education (as opposed to no education) meant individuals were more likely to accept an HIV test; however, the reverse is true for men and women from Lesotho and Swaziland, where a secondary education is associated with a higher probability of refusal. In all countries except Malawi, wealthier men and women are less likely to agree to an HIV test. Married men and women from Lesotho and married Zimbabwean man are also less likely to agree.

Since fixed effects models are likely to be more consistent, but random effects models are more efficient, Hausman tests were used to see if a random effects model is consistent. Such tests indicated that fixed effects were appropriate.

Outcome Equations

As expected, age is a significant predictor of employment across all countries and both gender. In Lesotho, women with a primary education are more likely to be working than those without any education. However, surprisingly, Lesotho men with secondary or higher education are less likely to be working than men with no schooling. This is perhaps a reflection of the types of jobs available. Also, men with more education may have a higher reservation wage which employers may not be willing to meet. In Malawi, rural women are more likely to be working, as are married women and women living in households with young children. This is plausible given that the majority of the Malawian population is involved in agriculture, and women may be able to care for young children while simultaneously working in the fields. Wealthier Malawian women are less likely to be working.

Men and women residing in rural areas of Swaziland and Zimbabwe are less likely to be working, perhaps because employment opportunities are not as plentiful in rural areas. Women from wealthier households are also more likely to be working; individuals who work are also more likely than those who do not to be able to afford assets. Married women and women with children under the age of five in the household from Swaziland and Zimbabwe are less likely to be working, reiterating the fact that childcare tasks are usually provided by the women of a household. Married Swazi and Zimbabwean men are more likely to be working than unmarried men, likely reflecting the need to take care of a family.

Marginal Effects

The marginal effects of being HIV positive were calculated by taking linear combinations of the relevant coefficients, based upon an average individual. Standard errors were calculated with the delta method. For example, judging from the descriptive statistics, an average Zimbabwean man would own one of the six household assets used to calculate the wealth index, live in a rural area, and have a secondary level education. As evident from table 2.9, being HIV positive has a significantly negative association with the outcomes currently working, and worked in the past 12 months.

Figure 2.1 plots the marginal effect of HIV versus age for an average Zimbabwean man. Being HIV positive has a significantly negative association with the outcome currently working. This negative marginal effect is largest in absolute value terms for men in the 30-39 age group, where HIV prevalence is highest. It should be noted that not everybody who is HIV positive has full-blown AIDS. The negative marginal effects may become larger as AIDS develops and one gets sicker. Since DHS does not observe the state of disease, the true effects of having AIDS may be bigger.

Discussion

The results show that for an average individual there is a significant negative association between being HIV positive and currently working, as well as having worked in the past 12 months for men and women. This finding for men is in line with that of McKelvey (2007) who used male circumcision for identification.

Being HIV positive may impair the ability of men to work more than it does women because in rural areas, men likely engage more in physical labor which requires good health. A description of the duties and tasks involved is needed to determine the validity of this explanation. Respondents who report being in agriculture work could be engaging in activities requiring strength (e.g, carrying heavy objects) or not (e.g. gathering of firewood). Or, since migrant labor is common in the region, men who are present in the household at the time of the survey are likely the ones that are unable to obtain work.

The direction of causality cannot be determined with cross-sectional data alone. It is possible that a positive HIV status is a byproduct of working, instead of vice versa. For example, individuals who work away from home may be more likely to engage in risky sexual relationships than an individual who works closer to home.

Regardless of the direction of influence, these countries cannot afford further slowdowns in economic growth. Unfortunately, the loss of working age individuals will result in a bimodal distribution of the population, consisting of large proportions of children and the elderly. Increasing numbers of children will be forced to enter the labor force instead of receiving an education. If children are HIV positive themselves, they will succumb to AIDS before reaching school going age or adulthood so will be unable to reap the benefits of what they learned. However, the lack of education will not only limit a child's earnings potential in the future, but on a macro level an uneducated labor force is unsustainable in the long run. As ARV drugs become more widespread, the growing number of HIV positive individuals may mean a diversion of limited resources away from other sectors into healthcare.

This study has looked at the quantity of laborers available; however, the quality of laborers is also a concern. For example, the spread of HIV may result in fewer teachers, leading to overcrowded

classrooms and negatively affecting students (Bennell et al, 2002)[3]. Furthermore, the high HIV prevalence rates may be a contributing factor to the "brain drain' problem suffered by the region, particularly in the health care sector, where educated individuals are choosing to pursue labor opportunities in more developed countries (Schrecker and Labonte, 2004).

Gender discrimination is also likely to worsen, as girls are disproportionately pulled out of school to care for sick family members, worsening the already existent inequality between the sexes (Smith, 2002). Also, in subsistence economies, the loss of a male head of household may mean loss of land for the remaining females of the household. For families in rural areas who rely on their own farming for survival, food security may also be a concern (Haddad and Gillespie, 2001). Deteriorating labor input could lead to lower productivity and thus quantities produced, as well as lower quality of output as skills cannot be passed from one generation to the next. Not only is there a direct loss of labor time, but labor time is also lost to care for the sick)

As evident from the data, the population residing in SADC is poor. The problem is worsened in that the poorest are those who most need the income from labor, but also those least likely to be able to afford the necessary medications and care and for whom funeral expenses are likely to send families into debt. Furthermore, the low level of education means that most individuals will have to engage in informal labor activities which are usually physical in nature, and requires daily presence but provides neither financial security nor health insurance. Currently, social protection is inadequate to cover all those afflicted.

Some limitations of this study should be mentioned. In terms of methods, propensity scores only adjust for bias from observed covariates, and thus bias from unobservables is still a concern.

DHS are cross-sectional in nature and hence static, which did not allow me to address dynamic issues. Although more than one survey has been conducted in most countries, the households interviewed are usually different. There are also not enough cross-sectional surveys over

[3]Percent of study sample who are HIV positive and teachers: Lesotho men (22%), Lesotho women (30%), Malawi men (20%), Malawi women (19%), Swaziland men (28%), Swaziland women (22%), Zimbabwe men (21%), Zimbabwe women (18%).

time for the countries of interest to construct a synthetic panel (HIV testing is only available in the latest survey). In addition, the researcher cannot tell when HIV infection occurred. Since health evolves across time, there are both stock and flow components, the latter of which I am unable to capture. Similarly, the feedback loops between health and income requires a panel data set to really be investigated. It is also possible that the effect of HIV on labor market participation is only felt when it becomes full-blown AIDS, as poor individuals may attempt to work as long as they possibly can before reaching that stage. Additional information regarding the progression of disease would be very useful

Unfortunately, no questions are asked regarding wages. Furthermore, high unemployment rates may have resulted from slack in the labor market and hence be the cause of not working, rather than HIV. Finally, since there are no demand side data, the analysis focuses on a partial equilibrium. Linked to labor demand concerns, a further question is the long run implications of HIV for employers, beyond the rise in medical expenditures and absences (whether employees are ill themselves, or are absent from work to care for family members). For instance, Murray et al (2005) found an increase in injury rates among HIV-positive gold miners in South Africa. Furthermore, given the shortened working life span of HIV positive individuals, the incentive for employers to provide training decreases, which has long-term repercussions for the economic development of a country. Finally, stigmatism about HIV in the workplace and inaccurate knowledge about its transmission modes may result in employers becoming less inclined to hire individuals who may be HIV positive.

It should be noted that the due to DHS survey procedures (exclusion of non-household population), the results cannot be generalized to those residing in institutions or individuals who are homeless. Also, both of these populations may face different HIV prevalence rates.

Despite the data shortcomings, the advantage of having HIV testing and the labor outcomes for a nationally representative sample still make DHS the most appropriate to address this study. To my knowledge, few data sets (especially not panel) for the developing world include HIV testing and

detailed labor outcomes. Furthermore, the recent dates of implementation for DHS assist in making this study both timely and policy relevant.

Using various econometric methods to control for endogeneity, this study has found that HIV positive individuals are less likely to be currently working, and less likely to have worked in the past 12 months. Given the costs associated with being sick, this is likely to exacerbate the already weak financial position of many African households. Assistance from external parties is thus needed to alleviate this negative impact.

Table 2.1 Cross Country Comparison

	Lesotho	Malawi	Swaziland	Zimbabwe
Former name	Basutoland	Nyasaland		Rhodesia
Independence	1966	1964	1968	1980
Bordering countries	South Africa	Mozambique, Tanzania, Zambia	Mozambique, South Africa	Botswana, Mozambique, South Africa, Zambia
Geographical Size	30,355 sq km (slightly smaller than Maryland)	118,480 sq km (slightly smaller than Pennsylvania; Lake Nyasa occupies approximately 20% of area)	17,363 sq km (slightly smaller than New Jersey)	390,580 sq km (slightly larger than Montana)
Population Size	2.1 million	13.9 million	1.1 million	12.4 million
% Population in Urban areas	19	18	25	37
Human Development Index (HDI)	0.549 (138)	0.437 (164)	0.547 (141)	0.513 (151)
Human Poverty Index (HPI)	34.5 (71)	36.7 (79)	35.4 (73)	40.3 (91)
Gender-related Development Index (GDI)	0.541 (118)	0.432 (143)	0.529 (122)	0.505 (129)

Source: CIA World Factbook (2008) and UN Development Project (2007/2008).
HDI is a composite measure of life expectancy, literacy and schooling, and purchasing power parity. Higher HDI values indicate a higher level of development. For instance, the United States has a HDI of 0.950.
HPI focuses on proportion living below threshold level of the same measures (and are only measured for developing countries).
GDI measures inequalities in achievement between men and women (using the same dimensions as HDI, but adjusting for gender). For instance, the United States has a GDI of 0.937.
The rankings listed in parentheses are out of 177 countries.

Table 2.2 Current HIV situation in SADC

	Lesotho	Malawi	Swaziland	Zimbabwe
Adult (15+) living with HIV[1]	260 000	840 000	170 000	1 200 000
Adult (15-49) prevalence rate (%)				
UNAIDS/WHO Epidemiological Fact Sheets[1]	23.2	11.9	26.1	15.3
Demographic and Health Surveys[2]	23.5	12.0	26.0	18.0

Source: [1] 2008 Update. In countries with generalized epidemics, national estimates of HIV prevalence are generated from epidemiological models using data from antenatal clinics.
[2] Lesotho and Malawi (2004), Swaziland (2006) Zimbabwe (2005-2006). HIV prevalence rates are generated from results using ELISA tests with dried blood spots voluntarily provided by eligible respondents.

Table 2.3a Descriptive Statistics (unweighted) – Lesotho women

Total Sample Size (Lesotho Women): 6808

	Not Chosen for testing (n=3467)	**Chosen for testing (n=3341)**		
	Mean	**Mean**		**p-value***
		Refused (n=419, 12.54%)	**Accepted (n=2922, 87.46%)**	
Dependent Variables				
Currently Working	0.376	0.468	0.360	0.788
Worked in past 12 months	0.443	0.520	0.422	0.468
Control Variables				
Age (Range: 15-49)	28.184	29.313	28.159	0.619
Std Dev	9.886	9.886	10.017	
Wealth Index (Range: 0-6)	0.940	1.348	0.901	0.508
Std Dev	1.041	1.041	1.067	
Rural	0.724	0.511	0.755	0.972
No education	0.021	0.012	0.028	0.152
Primary level education	0.619	0.465	0.619	0.116
Secondary level education	0.347	0.489	0.341	0.293
Higher education	0.013	0.033	0.011	0.698
Married	0.565	0.535	0.581	0.408
Any children under 5	0.590	0.442	0.605	0.408

* test of difference in means for "Not Chosen for testing" with "Chosen for HIV testing"

HIV negative 2159 (73.89%)
HIV positive 763 (26.11%)

Table 2.3b Descriptive Statistics (unweighted) – Malawi women

Total Sample Size (Malawian Women): 11441

	Not Chosen for testing (n=7715)	**Chosen for testing (n=3726)**		
	Mean	**Mean**		**p-value***
		Refused (n=922, 24.75%)	**Accepted (n=2804, 75.25%)**	
Dependent Variables				
Currently Working	0.565	0.536	0.570	0.771
Worked in past 12 months	0.598	0.572	0.602	0.704
Control Variables				
Age (Range: 15-49)	27.764	27.107	28.114	0.581
Std Dev	9.207332	8.843	9.095	
Wealth Index (Range: 0-6)	1.284	1.262	1.261	0.251
Std Dev	0.995	0.982	0.961	
Rural	0.860	0.841	0.872	0.570
No education	0.231	0.268	0.238	0.091
Primary level education	0.626	0.592	0.626	0.364
Secondary level education	0.137	0.128	0.134	0.506
Higher education	0.006	0.012	0.002	0.497
Married	0.744	0.742	0.770	0.029
Any children under 5	0.731	0.725	0.756	0.049

* test of difference in means for "Not Chosen for testing" with "Chosen for HIV testing"

HIV negative	2394 (85.38%)
HIV positive	410 (14.62%)

Table 2.3c Descriptive Statistics (unweighted) – Swaziland women

Total Sample Size (Swazi Women): 4628

	Not Chosen for testing (n=16)	Chosen for testing (n=4612)		
	Mean	Mean		p-value*
		Refused (n=353, 7.65%)	Accepted (n=4259, 92.35%)	
Dependent Variables				
Currently Working	0.500	0.561	0.413	0.540
Worked in past 12 months	0.438	0.567	0.434	0.959
Control Variables				
Age (Range: 15-49)	28.875	29.408	27.998	0.754
Std Dev	9.258	9.413	9.804	
Wealth Index (Range: 0-6)	2.063	2.646	1.900	0.770
Std Dev	1.063	1.580	1.408	
Rural	0.875	0.416	0.709	0.104
No education	0.125	0.042	0.086	0.542
Primary level education	0.375	0.201	0.337	0.681
Secondary level education	0.438	0.533	0.506	0.575
Higher education	0.063	0.224	0.071	0.771
Married	0.500	0.476	0.441	0.649
Any children under 5	0.563	0.516	0.668	0.428

* test of difference in means for "Not Chosen for testing" with "Chosen for HIV testing"

HIV negative	2909 (68.30%)
HIV positive	1350 (31.70%)

Table 2.3d Descriptive Statistics (unweighted) – Zimbabwe women

Total Sample Size (Zimbabwean Women): 8622

	Not Chosen for testing (n=0)	Chosen for testing (n=8622)		
	Mean	Mean		p-value*
		Refused (n=1362, 15.80%)	Accepted (n=7260, 84.20%)	
Dependent Variables				
Currently Working		0.390	0.365	
Worked in past 12 months		0.421	0.398	
Control Variables				
Age (Range: 15-49)		27.681	27.765	
Std Dev		9.345	9.437	
Wealth Index (Range: 0-6)		1.859	1.426	
Std Dev		1.531	1.442	
Rural		0.463	0.674	
No education		0.039	0.044	
Primary level education		0.300	0.342	
Secondary level education		0.612	0.589	
Higher education		0.049	0.025	
Married		0.595	0.595	
Any children under 5		0.405	0.390	

* test of difference in means for "Not Chosen for testing" with "Chosen for HIV testing"

HIV negative 5757 (79.30%)
HIV positive 1503 (20.70%)

Table 2.3e Descriptive Statistics (unweighted) – Lesotho men

Total Sample Size (Lesotho Men): 2674

	Not Chosen for testing (n=16)	**Chosen for testing (n=2658)**		
	Mean	**Mean**		**p-value***
		Refused (n=468, 17.61%)	**Accepted (n=2190,82.39%)**	
Dependent Variables				
Currently Working	0.188	0.455	0.313	0.205
Worked in past 12 months	0.438	0.571	0.464	0.716
Control Variables				
Age (Range: 15-59)	25.063	31.209	29.527	0.128
Std Dev	12.556	12.371	12.465	
Wealth Index (Range: 0-6)	1.250	1.297	0.860	0.242
Std Dev	1.390	1.275	0.995	
Rural	0.875	0.592	0.786	0.256
No education	0.125	0.169	0.202	0.475
Primary level education	0.688	0.427	0.561	0.230
Secondary level education	0.125	0.327	0.223	0.279
Higher education	0.063	0.077	0.015	0.353
Married	0.313	0.511	0.469	0.190
Any children under 5	0.688	0.361	0.462	0.095

* test of difference in means for "Not Chosen for testing" with "Chosen for HIV testing"

HIV negative	1781 (81.32%)
HIV positive	409 (18.68%)

Table 2.3f Descriptive Statistics (unweighted) – Malawi men

Total Sample Size (Malawian Men): 3232

	Not Chosen for testing (n=0)	Chosen for testing (n=3232)		
	Mean	Mean		p-value*
		Refused (n=836, 25.87%)	Accepted (n=2396,74.13 %)	
Dependent Variables				
Currently Working		0.568	0.592	
Worked in past 12 months		0.779	0.782	
Control Variables				
Age (Range: 15-54)		28.636	29.646	
Std Dev		10.374	10.274	
Wealth Index (Range: 0-6)		1.386	1.417	
Std Dev		0.987	0.933	
Rural		0.818	0.854	
No education		0.132	0.104	
Primary level education		0.634	0.641	
Secondary level education		0.213	0.239	
Higher education		0.022	0.017	
Married		0.621	0.678	
Any children under 5		0.629	0.646	

* test of difference in means for "Not Chosen for testing" with "Chosen for HIV testing"

HIV negative 2154 (89.90%)
HIV positive 242 (10.10%)

Table 2.3g Descriptive Statistics (unweighted) – Swaziland men

Total Sample Size (Swazi Men): 4123

	Not Chosen for testing (n=21)	**Chosen for testing (n=4102)**		
	Mean	**Mean**		**p-value***
		Refused (n=529, 12.90%)	**Accepted (n=3573, 87.10%)**	
Dependent Variables				
Currently Working	0.714	0.645	0.507	0.083
Worked in past 12 months	0.714	0.698	0.561	0.210
Control Variables				
Age (Range: 15-49)	27.714	28.938	26.196	0.576
Std Dev	10.140	8.832	9.553	
Wealth Index (Range: 0-6)	2.333	2.248	1.909	0.213
Std Dev	1.592	1.461	1.380	
Rural	0.286	0.490	0.677	0.000
No education	0.048	0.078	0.081	0.583
Primary level education	0.190	0.250	0.358	0.139
Secondary level education	0.571	0.493	0.483	0.428
Higher education	0.190	0.180	0.078	0.115
Married	0.381	0.431	0.322	0.663
Any children under 5	0.952	0.348	0.491	0.650

* test of difference in means for "Not Chosen for testing" with "Chosen for HIV testing"

HIV negative	2871 (80.35%)
HIV positive	702 (19.65%)

Table 2.3h Descriptive statistics (unweighted) – Zimbabwe men

Total Sample Size (Zimbabwean Men):
7116

	Not Chosen for testing (n=0)	**Chosen for testing (n=7116)**		
	Mean	**Mean**		**p-value***
		Refused (n=1601, 22.50%)	**Accepted (n=5515, 77.50%)**	
Dependent Variables				
Currently Working		0.655	0.655	
Worked in past 12 months		0.708	0.691	
Control Variables				
Age (Range: 15-54)		28.716	27.707	
Std Dev		10.274	10.598	
Wealth Index (Range: 0-6)		1.715	1.414	
Std Dev		1.463	1.401	
Rural		0.525	0.695	
No education		0.024	0.016	
Primary level education		0.254	0.308	
Secondary level education		0.633	0.631	
Higher education		0.089	0.046	
Married		0.529	0.479	
Any children under 5		0.738	0.837	

* test of difference in means for "Not Chosen for testing" with "Chosen for HIV testing"

HIV negative	4738 (85.91%)
HIV positive	777 (14.09%)

Table 2.4a HIV Prevalence Rates by Age Group – Women

	Lesotho	Malawi	Swaziland	Zimbabwe
Age 15-19	59/732 (8.06%)	18/524 (3.44%)	106/1063 (9.97%)	96/1740 (5.52%)
Age 20-29	310/1006 (30.82%)	189/1191 (15.87%)	642/1493 (43%)	587/2721 (21.57%)
Age 30-39	268/646 (41.49%)	131/661 (19.82%)	411/982 (41.85%)	569/1693 (33.61%)
Age 40-49	126/538 (23.42%)	72/428 (16.82%)	191/721 (26.49%)	251/1106 (22.69%)

Table 2.4b HIV Prevalence Rates by Age Group – Men

	Lesotho	Malawi	Swaziland	Zimbabwe
Age 15-19	12/605 (1.98%)	2/452 (0.44%)	20/1163 (1.72%)	44/1595 (2.76%)
Age 20-29	122/685 (17.81%)	69/881 (7.83%)	231/1267 (18.23%)	165/1866 (8.84%)
Age 30-39	165/417 (39.57%)	103/576 (17.88%)	295/694 (42.51%)	327/1128 (28.99%)
Age 40-49	71/242 (29.34%)	53/355 (14.93%)	156/449 (34.74%)	193/677 (28.51%)
Age 50-59	39/241 (16.18%)	15/132 (11.36%)		48/249 (19.28%)

Table 2.5a Heckman Selection Model – Lesotho women

	Outcome: Currently Working		Outcome: Worked in past 12 months	
	(1)	(2)	(3)	(4)
	Selection	Outcome	Selection	Outcome
HIV status		2.166***		2.390***
		(0.795)		(0.768)
Age * HIV status		-0.124**		-0.135***
		(0.0526)		(0.0505)
Age Squared * HIV status		0.00181**		0.00206**
		(0.000832)		(0.000800)
Rural * HIV status		-0.143		-0.222
		(0.153)		(0.149)
Age	-0.00205	0.166***	-0.00170	0.188***
	(0.0138)	(0.0283)	(0.0137)	(0.0252)
Age Squared	-8.99e-05	-0.00222***	-0.000101	-0.00260***
	(0.000219)	(0.000426)	(0.000219)	(0.000395)
Rural	0.602***	-0.306	0.561***	-0.201*
	(0.0658)	(0.316)	(0.0522)	(0.111)
Schooling (ref: none)				
Primary	-0.130	0.424**	-0.137	0.346**
	(0.111)	(0.206)	(0.126)	(0.175)
Secondary or Higher	-0.307***	0.432*	-0.320**	0.325*
	(0.114)	(0.242)	(0.129)	(0.182)
Wealth index	-0.135***	0.0699	-0.129***	0.0615*
	(0.0270)	(0.0572)	(0.0188)	(0.0330)
Married	0.104**	0.0923	0.0965**	0.0948
	(0.0423)	(0.0764)	(0.0435)	(0.0644)
Any child under 5 years old	0.105**	-0.0906	0.107***	-0.0725
	(0.0460)	(0.0829)	(0.0370)	(0.0599)
Constant	1.343***	-3.374***	1.426***	-3.543***
	(0.351)	(0.446)	(0.259)	(0.387)
Interviewer Fixed Effects	Yes		Yes	
Chi-squared for FE coefficients	219.47		219.47	
Rho		0.1574829		0.5188295
Chi-Squared for Rho		0.01		2.13
Observations	3341	2922	3341	2922

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.5b Heckman Selection Model – Lesotho men

	Outcome: Currently Working		Outcome: Worked in past 12 months	
	(1) Selection	(2) Outcome	(3) Selection	(4) Outcome
HIV status		0.817		1.634**
		(0.816)		(0.729)
Age * HIV status		-0.0393		-0.0807**
		(0.0491)		(0.0399)
Age Squared * HIV status		0.000458		0.000908*
		(0.000683)		(0.000534)
Rural * HIV status		-0.0652		0.0425
		(0.249)		(0.123)
Age	-0.0318***	0.143***	-0.0270***	0.152***
	(0.00854)	(0.0191)	(0.00876)	(0.0166)
Age Squared	0.000338***	-0.00189***	0.000269**	-0.00201***
	(0.000118)	(0.000264)	(0.000122)	(0.000227)
Rural	0.553***	-0.0493	0.566***	-0.0202
	(0.0457)	(0.104)	(0.0460)	(0.0781)
Schooling (ref: none)				
Primary	0.0703	0.00188	0.0752*	0.0159
	(0.0439)	(0.0798)	(0.0416)	(0.0730)
Secondary or Higher	-0.218***	-0.270***	-0.202***	-0.250***
	(0.0545)	(0.0987)	(0.0536)	(0.0914)
Wealth index	-0.128***	0.0393	-0.129***	-0.0476*
	(0.0199)	(0.0331)	(0.0181)	(0.0265)
Married	0.0155	-0.00551	0.0178	0.121
	(0.0437)	(0.0849)	(0.0445)	(0.0783)
Any child under 5 years old	0.154***	0.0513	0.159***	0.0865
	(0.0534)	(0.0787)	(0.0328)	(0.0552)
Constant	1.144***	-2.968***	1.053***	-2.795***
	(0.152)	(0.302)	(0.156)	(0.281)
Interviewer Fixed Effects	Yes		Yes	
Chi-squared for FE coefficients	23.88		24.53	
Rho		0.9955145		0.9999753
Chi-Squared for Rho		0.15		1.92
Observations	2658	2190	2658	2190

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.6a Heckman Selection Model – Malawi women

	Outcome: Currently Working		Outcome: Worked in past 12 months	
	(1) Selection	(2) Outcome	(3) Selection	(4) Outcome
HIV status		0.822**		0.754**
		(0.376)		(0.371)
Estimated Propensity Score		0.672**		0.778***
		(0.284)		(0.281)
Age * HIV status		-0.0469*		-0.0434*
		(0.0243)		(0.0240)
Age Squared * HIV status		0.000657*		0.000603
		(0.000375)		(0.000370)
Rural * HIV status		-0.0372		-0.0188
		(0.0699)		(0.0691)
Age	-0.00273	0.000977	-0.00273	-0.000921
	(0.0200)	(0.0159)	(0.0200)	(0.0157)
Age Squared	0.000196	7.50e-05	0.000196	8.68e-05
	(0.000323)	(0.000240)	(0.000323)	(0.000237)
Rural	0.156*	0.163***	0.156*	0.157***
	(0.0812)	(0.0355)	(0.0812)	(0.0350)
Schooling (ref: none)				
Primary	0.183***	-0.000437	0.183***	-0.000121
	(0.0604)	(0.0243)	(0.0604)	(0.0240)
Secondary or Higher	0.187**	0.0121	0.187**	0.000585
	(0.0923)	(0.0361)	(0.0923)	(0.0356)
Wealth index	0.00149	-0.0186*	0.00149	-0.0205**
	(0.0258)	(0.0103)	(0.0258)	(0.0102)
Married	0.0899	0.0614**	0.0899	0.0742**
	(0.0635)	(0.0295)	(0.0635)	(0.0291)
Any child under 5 years old	0.127**	0.0916**	0.127**	0.110***
	(0.0571)	(0.0403)	(0.0571)	(0.0398)
Constant	-1.493**	0.129	-1.493**	0.198
	(0.677)	(0.172)	(0.677)	(0.170)
Interviewer Fixed Effects	Yes		Yes	
Chi-squared for FE coefficients	263.73		263.73	
Rho		0.09387		-0.03013
Observations	3726	2804	3726	2804

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 2.6b Heckman Selection Model – Malawi men

	Outcome: Currently Working		Outcome: Worked in past 12 months	
	(1) Selection	(2) Outcome	(3) Selection	(4) Outcome
HIV status		2.645*		3.206**
		(1.433)		(1.415)
Age * HIV status		-0.117		-0.185**
		(0.0789)		(0.0776)
Age Squared * HIV status		0.00145		0.00254**
		(0.00111)		(0.00109)
Rural * HIV status		-0.497*		-0.430
		(0.279)		(0.322)
Age	0.0538***	0.136***	0.0642***	0.285***
	(0.0132)	(0.0224)	(0.0142)	(0.0309)
Age Squared	-0.000724***	-0.00175***	-0.000853***	-0.00383***
	(0.000188)	(0.000315)	(0.000200)	(0.000434)
Rural	0.438***	-0.392***	0.328***	0.126
	(0.0588)	(0.0840)	(0.0575)	(0.0961)
Schooling (ref: none)				
Primary	0.0261	-0.0212	0.0591	0.0790
	(0.0594)	(0.103)	(0.0593)	(0.149)
Secondary or Higher	0.0852	-0.180	0.0940	-0.282*
	(0.0677)	(0.110)	(0.0688)	(0.165)
Wealth index	0.00821	-0.00563	0.0287	-0.0563
	(0.0191)	(0.0307)	(0.0199)	(0.0367)
Married	-0.0230	0.307***	-0.0255	0.605***
	(0.0555)	(0.0895)	(0.0583)	(0.111)
Any child under 5 years old	0.00685	-0.191***	0.00289	-0.0824
	(0.0372)	(0.0597)	(0.0374)	(0.0748)
Constant	0.215	-1.496***	-0.184	-4.378***
	(0.213)	(0.374)	(0.256)	(0.433)
Interviewer Fixed Effects	Yes		Yes	
Chi-squared for FE coefficients	1043.89		1305.97	
Rho		-0.8924824		0.6591473
Chi-Squared for Rho		17.85		9.11
Observations	3232	2396	3232	2396

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.7a Heckman Selection Model – Swaziland women

	Outcome: Currently Working		Outcome: Worked in past 12 months	
	(1) Selection	(2) Outcome	(3) Selection	(4) Outcome
HIV status		1.387**		1.143**
		(0.554)		(0.548)
Age * HIV status		-0.0888**		-0.0696*
		(0.0361)		(0.0359)
Age Squared * HIV status		0.00126**		0.000958*
		(0.000566)		(0.000563)
Rural * HIV status		0.203**		0.170*
		(0.0889)		(0.0891)
Age	-0.0355***	0.241***	-0.0357***	0.237***
	(0.00848)	(0.0190)	(0.00839)	(0.0186)
Age Squared	0.000462***	-0.00305***	0.000476***	-0.00304***
	(0.000137)	(0.000298)	(0.000135)	(0.000294)
Rural	0.517***	-0.358***	0.509***	-0.297***
	(0.0260)	(0.0574)	(0.0258)	(0.0573)
Schooling (ref: none)				
Primary	-0.00823	0.0669	-0.0292	0.0480
	(0.0398)	(0.0794)	(0.0395)	(0.0797)
Secondary or Higher	-0.253***	0.0450	-0.267***	0.0607
	(0.0398)	(0.0786)	(0.0394)	(0.0787)
Wealth index	-0.0509***	0.0640***	-0.0507***	0.0542***
	(0.00879)	(0.0158)	(0.00866)	(0.0155)
Married	-0.0133	-0.0898*	-0.0304	-0.0864*
	(0.0289)	(0.0484)	(0.0286)	(0.0480)
Any child under 5 years old	0.182***	-0.104**	0.191***	-0.138***
	(0.0250)	(0.0449)	(0.0245)	(0.0445)
Constant	1.830***	-4.288***	1.887***	-4.125***
	(0.166)	(0.283)	(0.164)	(0.276)
Interviewer Fixed Effects	Yes		Yes	
Chi-squared for FE coefficients	357.34		347.79	
Rho		0.9485232		0.9231157
Chi-Squared for Rho		26.56		29.27
Observations	4612	4259	4612	4259

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.7b Heckman Selection Model – Swaziland men

	Outcome: Currently Working		Outcome: Worked in past 12 months	
	(1) Selection	(2) Outcome	(3) Selection	(4) Outcome
HIV status		2.551***		1.450
		(0.779)		(0.978)
Estimated Propensity Score				-1.854***
				(0.488)
Age * HIV status		-0.139***		-0.0573
		(0.0486)		(0.0616)
Age Squared * HIV status		0.00187**		0.000696
		(0.000730)		(0.000921)
Rural * HIV status		-0.270**		-0.548***
		(0.117)		(0.153)
Age	-0.101***	0.276***	-0.0934***	0.471***
	(0.00852)	(0.0185)	(0.00864)	(0.0315)
Age Squared	0.00147***	-0.00383***	0.00139***	-0.00660***
	(0.000138)	(0.000296)	(0.000137)	(0.000456)
Rural	0.246***	-0.243***	0.259***	-0.332***
	(0.0278)	(0.0558)	(0.0273)	(0.0555)
Schooling (ref: none)				
Primary	-0.0382	0.0495	-0.100**	0.0302
	(0.0487)	(0.0901)	(0.0469)	(0.0978)
Secondary or Higher	-0.0920*	-0.138	-0.154***	-0.278***
	(0.0488)	(0.0876)	(0.0457)	(0.0975)
Wealth index	-0.0563***	0.00324	-0.0496***	-0.00968
	(0.00948)	(0.0165)	(0.00851)	(0.0166)
Married	-0.0362	0.272***	-0.0513	0.521***
	(0.0365)	(0.0667)	(0.0340)	(0.0788)
Any child under 5 years old	0.228***	-0.0299	0.222***	-0.156***
	(0.0238)	(0.0467)	(0.0233)	(0.0453)
Constant	2.493***	-4.293***	2.479***	-6.194***
	(0.150)	(0.279)	(0.150)	(0.399)
Interviewer Fixed Effects	Yes		Yes	
Chi-squared for FE coefficients	274.98		638.48	
Rho		0.9135402		-1
Chi-Squared for Rho		32.33		0.67
Observations	4102	3573	4102	3573

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.8a Heckman Selection Model – Zimbabwe women

	Outcome: Currently Working		Outcome: Worked in past 12 months	
	(1)	(2)	(3)	(4)
	Selection	Outcome	Selection	Outcome
HIV status		0.0565		0.154
		(0.180)		(0.183)
Age * HIV status		-0.00271		-0.00994
		(0.0117)		(0.0119)
Age Squared * HIV status		4.13e-05		0.000159
		(0.000183)		(0.000186)
Rural * HIV status		-0.0353		-0.0470*
		(0.0279)		(0.0284)
Age	-0.00623	0.0548***	-0.00623	0.0623***
	(0.0137)	(0.00545)	(0.0137)	(0.00557)
Age Squared	0.000126	-0.000749***	0.000126	-0.000887***
	(0.000222)	(8.82e-05)	(0.000222)	(9.02e-05)
Rural	0.499***	-0.0566***	0.499***	-0.0674***
	(0.0512)	(0.0209)	(0.0512)	(0.0214)
Schooling (ref: none)				
Primary	0.0192	0.0474	0.0192	0.0547
	(0.0917)	(0.0329)	(0.0917)	(0.0336)
Secondary or Higher	0.0996	0.0575*	0.0996	0.0596*
	(0.0954)	(0.0342)	(0.0954)	(0.0351)
Wealth index	-0.0194	0.0282***	-0.0194	0.0253***
	(0.0143)	(0.00541)	(0.0143)	(0.00554)
Married	-0.0388	-0.0336**	-0.0388	-0.0339**
	(0.0407)	(0.0153)	(0.0407)	(0.0156)
Any child under 5 years old	0.143***	-0.0479***	0.143***	-0.0505***
	(0.0374)	(0.0142)	(0.0374)	(0.0146)
Constant	0.810***	-0.376***	0.810***	-0.412***
	(0.264)	(0.0843)	(0.264)	(0.0863)
Interviewer Fixed Effects	Yes		Yes	
Chi-squared for FE coefficients	266.03		266.03	
Rho		-0.92944		-0.94597
Observations	8622	7260	8622	7260

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.8b Heckman Selection Model – Zimbabwe men

	Outcome: Currently Working		Outcome: Worked in past 12 months	
	(1) Selection	(2) Outcome	(3) Selection	(4) Outcome
HIV status		1.772***		2.355***
		(0.571)		(0.639)
Estimated Propensity Score		-0.753**		-1.038***
		(0.308)		(0.342)
Age * HIV status		-0.105***		-0.150***
		(0.0346)		(0.0396)
Age Squared * HIV status		0.00139***		0.00222***
		(0.000504)		(0.000590)
Rural * HIV status		-0.172		-0.286**
		(0.111)		(0.132)
Age	-0.0173**	0.251***	-0.0182**	0.312***
	(0.00725)	(0.0171)	(0.00718)	(0.0180)
Age Squared	0.000248**	-0.00333***	0.000263**	-0.00418***
	(0.000104)	(0.000235)	(0.000103)	(0.000248)
Rural	0.417***	-0.121**	0.442***	-0.134**
	(0.0294)	(0.0483)	(0.0290)	(0.0528)
Schooling (ref: none)				
Primary	0.543***	0.127	0.535***	0.327*
	(0.0854)	(0.150)	(0.0841)	(0.167)
Secondary or Higher	0.455***	0.0969	0.455***	0.191
	(0.0855)	(0.151)	(0.0844)	(0.168)
Wealth index	-0.0390***	0.0185	-0.0369***	0.0236
	(0.00844)	(0.0145)	(0.00848)	(0.0157)
Married	-0.121***	0.278***	-0.120***	0.352***
	(0.0324)	(0.0651)	(0.0320)	(0.0730)
Any child under 5 years old	0.113***	-0.144***	0.105***	-0.0771*
	(0.0219)	(0.0395)	(0.0214)	(0.0415)
Constant	-0.291*	-3.414***	-0.329*	-4.269***
	(0.172)	(0.280)	(0.169)	(0.306)
Interviewer Fixed Effects	Yes		Yes	
Chi-squared for FE coefficients	1304.21		1337.7	
Rho		-0.9689355		-0.9568463
Chi-Squared for Rho		73.3		67.19
Observations	7116	5515	7116	5515

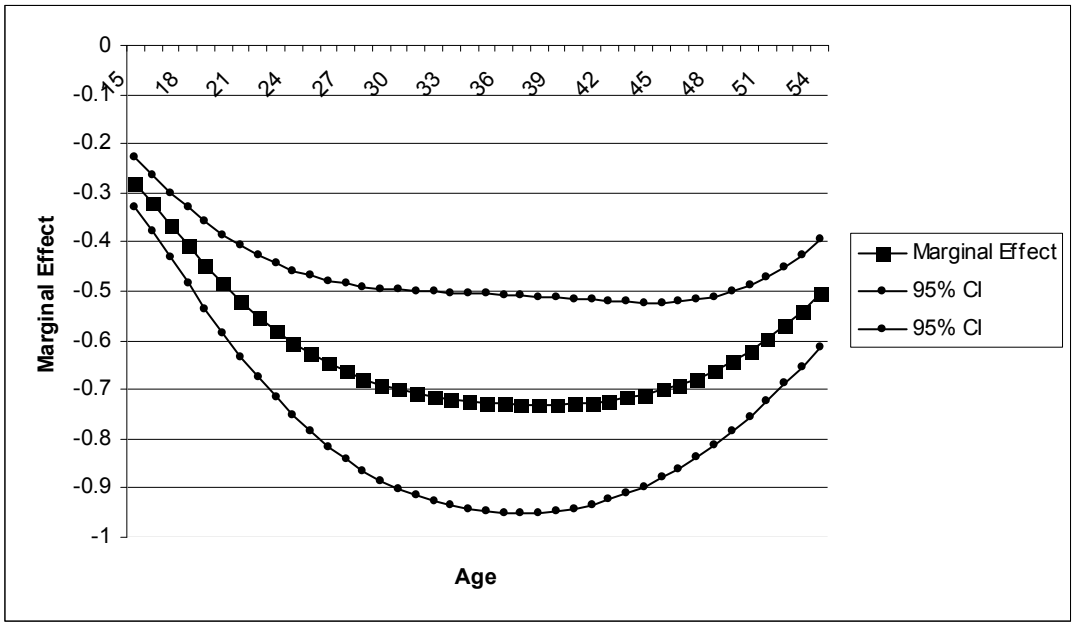
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.9 Marginal Effects of being HIV Positive (average individual)

	Outcome: Currently Working		Outcome: Worked in past 12 months	
Lesotho				
Women	-0.387	***	-0.455	***
	(0.068)		(0.032)	
Men	-0.236		-0.411	***
	(0.164)		(0.083)	
Malawi				
Women	-0.322	**	-0.292	*
	(0.149)		(0.152)	
Men	-0.733	***	-0.907	***
	(0.080)		(0.051)	
Swaziland				
Women	-0.347	***	-0.321	***
	(0.080)		(0.121)	
Men	-0.464	***	-0.559	*
	(0.023)		(0.333)	
Zimbabwe				
Women	-0.027		-0.070	
	(0.067)		(0.070)	
Men	-0.680	***	-0.825	***
	(0.122)		(0.083)	

*** p<0.01, ** p<0.05, * p<0.1

Figure 2.1 Marginal Effect of HIV status on Outcome: Currently Working (Zimbabwean man)



References

1. Acemoglu, Daron and Simon Johnson, 2006, "Disease and Development: The effect of life expectancy on economic growth," *NBER Working Paper 12269*.

2. Becker, Sascha O. and Andrea Ichino, 2002, "Estimation of average treatment effects based on propensity scores," *The Stata Journal*, 2(4): 358-377.

3. Beegle, Kathleen, 2005. "Labor Effects of Adult Mortality in Tanzanian Households," *Economic Development and Cultural Change*, 53: 655-683.

4. Bell, Clive, Shantayanan Devarajan, and Hans Gersbach, 2006, "The long-run economic costs of AIDS: a model with an application to South Africa," *World Bank Economic Review* 20(1): 55-89.

5. Bennell, Paul, Karin Hyde, and Nicola Swainson, 2002, "The Impact of the HIV/AIDS epidemic on the education sector in sub-Saharan Africa," *Centre for International Education, University of Sussex Institute of Education*.

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

7. Bruhns, Ramona, 2006, "The Long-run Effects of HIV/AIDS in Kenya," *Yale University, Economic Growth Center*.

8. D'Agostino, Ralph B, 1998, "Tutorial in Biostatistics; Propensity Score Methods for Bias Reduction in the Comparison of a Treatment to a Non-Randomized Control Group," *Statistics in Medicine*, 17: 2265-2281.

9. Dorward, Andrew R, Idrissa Mwale, and Rosalba Tuseo, 2006, "Labor Market and Wage Impacts of HIV/AIDS in Rural Malawi," *Review of Agricultural Economics,* 28(3): 429-439.

10. Fortson, Jane, 2008, "The Gradient in Sub-Saharan Africa: Socioeconomic Status and HIV/AIDS," *Demography*, 45(2): 303-322.

11. Fortson, Jane, 2008, "Mortality Risk and Human Capital Investment: The Impact of HIV/AIDS in Sub-Saharan Africa," *Under Review*.

12. Habyarimana, James, Bekezela Mbakile and Christian Pop-Eleches, 2007, "HIV/AIDS, ARV Treatment and Worker Absenteeism: Evidence from a Large African Firm," *Draft*.

13. Haddad, Lawrence and Stuart Gillespie, 2001, "Effective Food and Nutrition Policy to HIV/AIDS: What we know what we need to know," *International Food Policy Research Institute, Food Consumption and Nutrition Division Discussion Paper No 112.*

14. Imbens, Guido W., 2004, "Nonparametric Estimation of Average Treatment Effects under Exogeneity: A Review," *Review of Ecnomics & Statistics*, 86(1): 4-29.

15. Lesotho Clothing & Allied Workers' Union, 2006, "Highlights of current labor market conditions in Lesotho," *Global Policy Network*.

16. Levinsohn, Jim, 2008, "HIV status and Labor Market Participation in South Africa," *Working Paper*.

17. Lisk, Franklyn, 2002, "Labor market and employment implications of HIV/AIDS,"*Working Paper, ILO Programme on HIV/AIDS and the World of Work.*

18. McKelvey, Christopher, 2007, "Circumcision and the Labor Market Consequences of HIV in Developing Countries, " *Preliminary draft*.

19. Montgomery, Catherine M., Victoria Hosegood, Joanna Buszam and Ian M. Timaeus, 2006, "Men's involvement in the South Africa family: Engendering change in the AIDS era," *Social Science and Medicine*, 62: 2411-2419.

20. Murray, Jill, Pam Sonnenberg, Gill Nelson, Stuart Shearer, Andre Bester, Arther Begley, and Judith R. Glynn, 2005, "Effect of HIV on work-related injury rates in South African gold miners," *AIDS*, 19:2019-2024.

21. Rosenbaum, Paul R. and Donald B. Rubin, 1983, "The central role of the propensity score in observational studies for causal effects," *Biometrika*, 70 (1): 41-55.

22. Schrecker, Ted and Ronald Labonte, 2004, "Taming the Brain Drain: A Challenge for Public Health Systems in Southern Africa," *International Journal of Occupational and Environmental Health*, 10: 409-415.

23. Smith, Mohga Kamal, 2002, "Gender, poverty, and intergenerational vulnerability to HIV/AIDS," *Gender & Development,* 10(3): 63-70.

24. Strauss, John and Duncan Thomas, 1998, "Health, Nutrition, and Economic Development," *Journal of Economic Literature*, 36: 766-817.

25. Terza, Joseph V., Anirban Basu, and Paul J, Rathouz, 2008, "Two-stage residual inclusion estimation: Addressing endogeneity in health econometric modeling," *Journal of Health Economics*, 27: 531-543.

26. Thirumurthy, Harsha, Joshua Graff Zivin, Markus Goldstein, 2007, "The Economic Impact of AIDS Treatment: Labor Supply in Western Kenya," *Journal of Human Resources*, 43(3): 511-552.

27. Werker, Eric, Amrita Ahuja and Brian Wendell, 2006, "Male Circumcision and AIDS: The Macroeconomic Impact of a Health Crisis," *Working paper*.

28. World Bank, 2000, "Swaziland; Reducing Poverty Through Shared Growth," *Human Development Group, Eastern and Southern Africa Report No 19658-SW*.

29. Young, Alwyn, 2005, "The Gift of the Dying: The Tragedy of AIDS and the Welfare of Future African Generations," *Quarterly Journal of Economic*, 120: 423-466.

30. Young, Alwyn, 2005, "In Sorrow to Bring Forth Children: Fertility amidst the Plague of HIV," *Working Paper, University of Chicago Graduate School of Business*.