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AIDS in South Africa: a household analysis of fertility and HIV rates

"The AIDS epidemic in sub-Saharan Africa may well constitute the greatest public health challenge of our time." (Caldwell, Caldwell, & Quiggin, 1989: 185)

I. Introduction

Acquired Immune Deficiency Syndrome (AIDS) is caused by the Human Immunodeficiency Virus (HIV). As its name implies, HIV wreaks havoc on the human body by attacking the immune system, leaving patients open to attack by opportunistic infections. There is no known cure for HIV or AIDS, though some drug therapies exist which slow the progression of the disease. The best treatment is prevention.

In Africa, the disease has proven to be most devastating. In South Africa alone, over 5,000,000 people are HIV^+ or have full blown AIDS. The share of the total adult population with HIV is over 20%, with women accounting for over half of the total number of cases (WHO, 2002). The survival rate in Africa as a whole is similar to that in developed countries before drug therapies were available. The limited availability of anti-retroviral drugs (ARVs) in poor countries makes it particularly difficult to combat the disease and its symptoms (de Walque, 2003). The largest demographic group in Africa infected with HIV is 20 to 24 year olds (South African Regional Poverty Network, 2003), the very people who could contribute the most in the long term to the economy and labor force, creating the potential for future economic devastation on top of existing poverty. Furthermore, government resources are being hopelessly drained in an effort to combat the disease and to care for those left behind, specifically HIV^+ orphans, by

deceased patients. This increases the need for more concrete studies to evaluate the data. Thus, the problem of AIDS in Africa is significant and deserves more attention.

The goal of this paper is to assess the relationship between HIV rates and risky sexual behavior, or unprotected sexual intercourse, in light of the risk of contracting HIV. To evaluate this relationship, the correlation between HIV rates and fertility rates in South Africa during 1994 is evaluated. Data pertaining to fertility decisions was used in conjunction with HIV rates to attempt to estimate the impact of these various factors on the actual decisions made. By using fertility rates as a proxy for unprotected heterosexual intercourse, the level of risky behavior with regards to the threat of HIV could be assessed. Using economic data from the World Bank's 1994 Living Standards Measurement Survey in South Africa and South African HIV data from the U.S. Census Bureau, the paper finds that the probability of being pregnant and the provincial HIV rate had statistically significant negative correlation. The marginal effect of the provincial HIV rates was -0.8%, meaning that for a unit increase in the HIV rate, there was a -0.8% decrease in the probability of being pregnant.

The remainder of the paper proceeds as follows: section II provides pertinent background information about HIV, particularly in Sub-Saharan Africa, as well as economic information on fertility theory compliment the use of pregnancy rates as a proxy for unprotected sex in the regression; section III gives insight into the datasets and methodology; and section IV explains results followed by concluding statements in section V.

II. Background Information

There is a considerable spread in the information about HIV from the pertinent literature, however some facts are clear. In sub-Saharan Africa, the most frequent method of HIV transmission is heterosexual intercourse, followed by blood transfusions, and then viral transmission from mother to child (when breastfeeding, before birth, or during birth). Since unprotected heterosexual sex accounts for most AIDS cases, an equal number of men and women are infected. This is in contrast to most developed countries where homosexual intercourse and intravenous drug use account for most HIV transmission. Social and cultural practices in Africa may hinder the prevention of AIDS. A lack of openness towards sex and discussions about sex, as well as a significant amount of both extra-marital sex and polygamy, may contribute to the spread of HIV.

In South Africa, the AIDS rates have been climbing steadily since 1990 (see Chart 1 of AIDS Rates). One aspect of HIV that makes it difficult to detect, and therefore to prevent transmission, is its lengthy latency period. Drug therapies can extend this latency period, but the rapidly mutating HIV virus can overcome even the most potent ARVs eventually. In countries where access to healthcare is low, HIV^+ patients may not be diagnosed with the virus until they have full blown AIDS, at which point there is generally too much damage to the immune system to recover (Society, Culture, and Disease Class Notes, 2003).

A. Economic Factors

A variety of economic factors influence the transmission of HIV. Though many of these factors are shared throughout the world, there are several aspects of HIV

diffusion that are unique to developing countries. One such paradox that Tomas Philipson and Richard A. Posner point out is that, "…the likelihood of being infected with the AIDS virus is positively rather than, as in the United States and other developed countries, negatively related to income, at least in urban areas," (Philipson & Posner, 1995: 836).

One economic barrier to increasing safe sex in Africa is the high price of condoms, both in real terms and in relative terms. With a very small per capita income, as is the case in most sub-Saharan countries, money spent on condoms is money not spent on food or other necessities (Philipson & Posner, 1995).

Rural South Africans have been migrating to avoid the poverty of living and working on a farm. Urbanization has increased through the use of family networks that draw additional family members into growing small cities from rural townships. Cities are attractive to farmers because of the increased level of stability, increased community feel in cities (versus rural communities), and better infrastructure, especially schools and hospitals, all of which have become increasingly important since the rise in expectations for South Africa as a whole (Manona, 1988; Eklund, 2003). Seasonal migration, specifically, is a large contributing factor to extra-marital sex. This increase in migration has lead to an increase in city populations, and thus greater opportunity for HIV to spread because of the increased population density. Additionally, migration has increased the rate of AIDS in rural settings by bringing the disease out of the cities (Desgrées du Loû, 1999; Caldwell & Caldwell, "Nature and Limits", 1993).

There is a disparity between the incidence of AIDS in urban and rural settings, with the urban incidence generally being higher. The mere fact that there are more

people in cities contributes to the epidemiology because there are more people that can get and spread the disease. Furthermore, the commercial sex markets in rural communities are very limited, on both the supply and demand side. This is partly due to the fact that in rural communities family structure influences men into having less extra-marital sex and women into being prostitutes less frequently (Caldwell & Caldwell, "Nature and Limits", 1993).

Interestingly, in parts of rural South Africa, there is a surprisingly high number of women who use contraception, mostly the pill or injectables. One likely cause of this rural revolution is the fact that migrants leave farmlands to seek alternative labor. Women are left behind and are more likely to have extramarital sex. Additionally, social norms have eased, and women who have children out of wedlock are not stigmatized as they were before (Chimere-Dan, 1996). Though this finding is a positive step in terms of development, women's autonomy, and reproductive choice, hormone based birth control cannot protect against STDs, so these women are not protected against HIV.

B. Taking Risks

In Mali, though there was evidence that peer pressure and culture played a role in the decision to have sex among adolescents, more important was adolescents' psychological characteristics, as these were most likely to influence their decisions both to have sex and to use contraception. Those who were confident and had high self-esteem were more likely to use contraception, and thus protect their health, and to have a positive first sexual experience (Gueye, Castle & Konate, 2001).

Similarly, in Caldwell's 2000 paper, Ghanaian teenagers were characterized by their risk-taking nature, particularly with regard to sexual risks. Both teenage boys and girls were likely to succumb to peer pressure to have sex, as it added to a feeling of community within their group of friends. Specifically, boys pressured their girlfriends to have sex by claiming that sex was a way of maintaining a close, loving relationship. These findings could add an important element to AIDS education in Africa (Caldwell, 2000).

C. The Social Context in which HIV is Spread

1. Prostitution

One major source of risky sexual behavior in Africa stems from prostitution. As Philipson & Posner discuss, since many women are poor and do not have many opportunities to work, the number of prostitutes in Africa is quite high. Since female prostitutes are a major source of transmission of the virus, and there are a particularly high number of extramarital affairs and sexual encounters with prostitutes in Africa, the combination of the two significantly contributes to the spread of the disease. Furthermore, if there is a high chance that a prostitute if infected with HIV, there is less incentive for that prostitute to demand safe sex, so it becomes the responsibility of the customer to demand safe sex, so there is another reason that prostitutes are more likely to spread the virus. With more money, men can travel more and pay for more prostitutes. This is one explanation as to why there is a positive correlation between AIDS and income (Philipson & Posner, 1995).

In Nigeria, long-haul truck drivers have an average of six sex partners at any given time (one in each overnight stop), though over three-quarters of them are married. The percentage of married truckers who were in a polygamous relationship is approximately 75%, while the national average is closer to 41%. Contributing to the spread of HIV along the highways are the female hawkers who usually turn to prostitution to supplement their income. Most of the time, these sexual encounters do not include the use of a condom. These interactions are an integral part of the culture, thus they are unlikely to stop, despite the threat of AIDS. The truckers view the women they meet as part of an extended family on the lonely roads, and the women and their communities appreciate the money that the truckers bring. Though the trucking and hospitality industries in Nigeria are important parts of the economy, truckers spread HIV to immobile populations and perpetuate the AIDS epidemic (Orubuloye, Caldwell & Caldwell, "High-Risk Occupations", 1993).

A study in Mexico looked at female sex workers and their clients' responses to condom use. The sex workers would only have unsafe sex if they were paid more. The amount they were paid was usually determined in a proportion relative to their attractiveness, or bargaining power. Similarly, men who wanted to use condoms when the prostitutes did not want to had to pay the prostitutes more. This shows both supply and demand side education programs that could be implemented to make condom uses not only acceptable but a regularly occurring event for sex workers and their clients (Gertler, Shah, & Bertozzi, 2003).

2. Family Decisions

It is important to realize, however, that not all HIV transmission is a result of high-risk behavior. Many cases of HIV turn up in pregnant women who have decided, with their partners, to have a family. Women sacrifice their safety in order to have children, in what would be considered low-risk activity, as far as HIV is concerned. One reason for the increased danger is that polygamous and extra-marital relationships are highly prevalent in Africa. In studies summarized by Annabel Desgrées du Loû, between 10-50% of men and 0-20% of women reported having extra-marital sex. Also, there are more marriages and divorces than in the past, most likely because of a perception that the divorcees will easily get remarried. After a live birth, women are likely to abstain from sexual intercourse during breastfeeding which lasts an average of two years (Desgrées du Loû, 1999). During this time, men are more likely to go outside of the home or to other wives to have sex, increasing the number of sexual partners and therefore the risk of getting or transmitting HIV/AIDS. These practices are contradictory as many men want more children than their wives (Bankole and Singh, 1998).

Indeed, many women are infected by their husbands. Furthermore, there is generally little discussion within households regarding safe sex practices, and it is difficult for women to convince their husbands, faithful or not, to use condoms. Though women can refuse sex with their husbands by citing social norms (i.e. no sex after giving birth, during breastfeeding, or during menstruation), the men frequently ignore the women's requests and/or seek sex elsewhere. These factors likely contribute to the high prevalence rates of HIV/AIDS in South Africa (Desgrées du Loû, 1999).

When one member of a couple is infected, the reactions vary widely. Some of couples always used a condom, while some never used a condom (based on the assumption that the healthy spouse was probably already infected), and some chose to abstain entirely with each other and the uninfected partner sought sex elsewhere. Even though the response to hearing that a partner was HIV positive was generally accepting and understanding, some patients continued to keep their HIV status from their spouse. The partners who chose not to disclose their HIV status to their spouses frequently found other reasons to use condoms, though many chose to proceed with the relationship as before (usually without condoms). One of the reasons that married couples chose not to use condoms is that campaigns to increase condom use specifically targeted condom use with "partners you don't know", leading to the sense that it is safe to not use condoms with a spouse (Desgrées du Loû, 1999).[1]

In Africa there has been an increase in the age at which men are getting married (approximately seven years later), and a decrease in the age at which people have sex for the first time. Furthermore, most Africans believe that men are programmed for sex, making it acceptable for men to be involved in polygamous relationships (Caldwell, 2000). Together, these factors indicate that there is more pre-marital and extra-marital sex, which again increases the risk for STD transmission (Desgrées du Loû, 1999). However, women, too, are marrying later and having sex for the first time at a younger

[1] Evidence from Zimbabwe indicates that men tend to use condoms more outside of marriage than they do with their wives, and that they use it specifically for birth control. With the increasing prevalence of STDs, specifically AIDS, the perceptions about condom use need to be changed (Adetunji, 2000).

age. Interestingly, this phenomenon in women has been associated with higher use of contraception than their married cohorts (Blanc & Way, 1998).[2]

Men who used condoms for marital and extra-marital intercourse were more likely to have extra-marital intercourse. However proving cause and effect is difficult, because the groups most at risk for AIDS tended to be the best informed. They could either believe that they are protected by condoms and thus participate in risky sex, or they could understand that they are taking part in a risky activity and therefore protect themselves (Desgrées du Loû, 1999).

Preliminary data from South Africa revealed that married people with early initial sexual encounters are less likely to use condoms. Women have no impact on men in terms of getting them to use condoms. However, if men know that they are HIV^+, they are more likely to use condoms. If women simply know their HIV status, positive or negative, they are more likely to use condoms. Availability of condoms at desired times also had a significant impact on whether or not they were used (Kelly & Vencatachellum, preliminary findings, 2003).

3. Tradition

Historically there have been low fertility rates in South Africa. Under apartheid there were laws which were aimed at lowering population growth so that the government would be able to sustain the entire population in the future. There was increased contraception in South Africa, mostly hormonal, that lead to lowered fertility rates in the early 1980's. These levels have remained fairly constant since then (Lucas, 1992).

[2] Even though the use of contraception is higher in unmarried women, the study found that overall use of birth control was still very low.

Another study showed potential effects of a shift in fertility. There is a high chance that 15-20 years after the onset of AIDS in Africa, the population would begin to show changes. These changes included a shift in age of when dependents become providers (younger age) and the age at which people become economically active. Essentially, people are becoming economic providers at a younger age. Also, there is an expected shift in the male to female ratio, with the number of males increasing, because females are more likely to contract HIV and become ill. This shift would be accompanied by an increase in the number of orphans, as well. These shifts are likely to occur regardless of the level of population growth (Gregson, Garnett, & Anderson, 1994).

The increase in use of birth control has decreased fertility in South Africa even more. Interestingly, however, the rate of premarital births in the youngest female demographic (ages 12-26) increased over the time period from 1992-1997. This finding was coupled with a decrease in fertility for older, married women, yielding a net drop in the fertility rate from 6.0 births per woman from 1970-1974 to 3.3 births per woman during the study period from 1992-1997.[3] It was also found that women who had children at a young age and before being married were more likely to use contraception after the first birth than women who had their first child after getting married. This was likely due to the enrollment in the health care system, and subsequent contraceptive counseling, upon giving birth. Most of the older women, on the other hand, were likely married and wanted children. Their use of birth control depended on their desire to have more children. These findings imply higher levels of risky behavior in adolescents, which increase the risk of contracting HIV/AIDS (Garenne, Tollman & Kahn, 2000).

[3] The study indicated that the fertility rate at the beginning of the study in 1992 was 4.1 and at the end of the study in 1997 it was 2.8 (Garenne, Tollman &Kahn, 2000).

D. The Importance of Education

The lengthy incubation periods of both HIV1 and HIV2 make it more difficult to see visible cause and effect relationships between unsafe sex and the disease state. Desgrées du Loû states that 71-88% of those who had heard about AIDS knew that it could be transmitted by a seemingly healthy person (Desgrées du Loû, 1999). Therefore, there should be increasing returns to education about the disease because information about the disease would be more likely to change behavior than simply observing the disease without being able to note the specific cause. Theoretically, increasing general education will improve HIV rates because the cost of information about HIV/AIDS specifically will be lower, specifically increasing the demand for safe sex (Philipson & Posner, 1995).

This point was explored even further using data from Uganda. There was a significant decrease in the number of HIV infections in educated people who became sexually active after major HIV/AIDS educational campaigns began. Also, it was discovered that there were increased returns to schooling because general education aided in assimilation of information about the prevention of HIV transmission (de Walque, 2003).

Though education may not be stopping the seemingly uncontrollable AIDS virus, most Africans are aware of its existence, the fact that HIV is transmitted through sexual contact, and that it kills most people that it infects. Since most Africans know about AIDS, more needs to be done in the education arena, to create a more dramatic change in attitudes (Caldwell, 2000).

The largest group of infected people is adolescents and young adults, a group at which educational programs are specifically targeted. For this demographic, there are many factors that go into the decision as whether or not to use contraception, particularly for adolescents, one of the target groups for AIDS education. The perceived costs and benefits are influenced by peers and parents/adults, but they are also significantly influenced by cultural values, perceived power, both within a relationship and within the community, and perceived poverty. Again one major barrier to adolescents using contraception and condoms is the availability of knowledge regarding their existence and use (Gage, 1998).

In Zimbabwe, there was a tremendous response to a multimedia sexual responsibility campaign. Males and females aged 10-24 who were exposed to the campaign were more likely to discuss AIDS and STDs, whether to have sex or not, the pressures to have sex, where to obtain contraceptives, and issues associated with puberty when compared to cohorts who remained unexposed to the education program. More participants were likely to have taken some action (mostly discussion) based on exposure to the program. Though there was a shift in attitudes about sex, there was little change in attitudes with regards to gender issues. Acknowledging the current state of women's roles, and trying to empower young women may help them to feel more confident in asserting their rights, specifically when it comes to interacting with their partners in regards to sex and contraception (Kim et al., 2001). Similar results were found with a broader population in Zambia when a radio program dealing with AIDS was broadcast throughout the country (Yoder, Hornik & Chirwa, 1996).

Part of the reason that there has not been wide success in stopping the transmission of HIV is the under-reaction and silence on the part of most African governments. The lack-luster response of most sub-Saharan governments prevented the appropriate educational response from occurring for many years. Even today there are mixed messages leaving governments about the nature of the AIDS epidemic, and many governments do not want to take action against AIDS for fear of exposing themselves to greater problems than those already created by AIDS. For this reason, most anti-AIDS work has been funded for and supplied by foreign nations and nongovernmental organizations (NGOs). Fear of losing followers by "intruding" on their sexual affairs was a major cause for inaction. Strong leadership is needed to combat the AIDS epidemic (Caldwell, 2000).

Despite several success stories, one almost surprising observation is that there is little discussion about AIDS in many African countries. In spite of the educational programs, few government officials discuss the epidemic, and there is little discussion outside of specifically designated arenas. Government officials are not the only ones keeping quite, however. Men do not talk about their extra-marital affairs, though nearly everyone knows that these affairs occur. Fathers do not talk to their sons about sex, nor do mothers with their daughters. Religion could play a role in the silence, as many religions are not in favor of polygamy, and many claim that AIDS is a divine punishment. Therefore, admitting to having AIDS is analogous to admitting to having sinned. Also, the Catholic Church, for example, is against birth control, thus the distribution and use of condoms creates a moral issue for some people. Another reason for the silence could be the long latency period of the virus, since a leap from the cause, sexual intercourse

frequently years before, to the onset of symptoms is required. The biggest reason, though, is likely cultural, as sex is not something that is or was frequently discussed. Regardless of the reason for it, silence has been a major contributor to the spread of the virus (Caldwell, 2000; Caldwell, Caldwell & Orubuloye, "Networking", 1992).

E. Fertility Theory

There are several factors which contribute to parents' decisions regarding family size. Over the past century, particularly in Western countries and urban areas, family size has dwindled. Gary Becker argues that the cause for this decline is an increase in parents' investments not in a high number of children, but in a higher "quality" of children as income increases. Using this theory, families decide how many children to have by maximizing a utility function consisting of the expenditure on each child ("quality" of children) and the quantities of other goods and services (Becker, 1991).

Starting with Darwinian arguments, Becker suggests that fewer children can actually increase the fitness of the parents' genes. This is because parents could invest more in each child in areas of education, training, etc. and therefore make their children more attractive to potential mates. This would increase the fitness of the parents' genes by ensuring the successful mating of their children (Becker, 1991).

Though factors such as child productivity, especially in farming and rural households, and the increase in availability and effectiveness of birth control methods certainly contribute to fertility decisions, Becker maintains that the interaction between the quality and quantity of children impacts household size the most. Also entering into the decision as to how many children to have is the relative price of children and full

income. Some of the most significant contributing factors to fertility decisions include the education and potential earnings for the mother (specific opportunity costs of bearing a child). Specifically, it takes time to "enjoy" a child.[4] Thus, the costs of having a child are not only the direct costs of raising it, but also the opportunity costs associated with spending time with the child. In this way, the price effect might outweigh the income effect, creating the correlation between decreasing fertility with increasing wealth. Since families, particularly mothers, have very different opportunity costs associated with producing and raising children, these costs are not constant and must be evaluated on an individual level (Becker, 1991; Macunovich [interpretation of Becker], 2003).

Richard Easterlin presents a different model to explain trends in fertility theory, one which focuses on relative income[5] and desired standards of living as significant determinants of fertility decisions. Easterlin asserts that there is a negative correlation between the relative cohort size[6] and the relative income because the demand for workers from a given cohort will decrease when that cohort is larger than the competing cohort. Members of large cohorts have decreased work opportunities because they are the "oversupplied" work group. Since cohort size is determined by the fertility rate, with high fertility rates creating larger cohorts, members of large cohorts are more likely to change fertility behaviors to adjust to decreased work opportunities. Essentially, couples are more likely to have more children if they have a higher disposable income relative to their parents' generation because they will be able to attain their own personal goals

[4] The assessment works when viewing children in the same realm as market goods.
[5] Relative income is "…young men's earnings relative to material aspirations of young adults" (Macunovich 112). Young men's earnings are used because they reflect what most young couples view the man's income as the primary contributing factor to total income (Macunovich, 2003).
[6] Relative cohort size is the ratio of one cohort group to the size of the parents' generations' cohort group.

while at the same time providing for their children (Macunovich [interpretation of Easterlin], 2003).

The decision to engage in risky sexual behavior is driven by several factors. These factors can be broken down into perceived costs and benefits. Economic aspects play a role in the decision in both tangible (e.g. the price of condoms, etc.) and theoretical ways (e.g. fertility decisions, opportunity costs, etc.), and influence both the costs and benefits. Additionally, social and cultural norms and pressures influence individuals' decisions to engage in risky behavior, again, in both positive and negative ways. The desire to have children, willingness to put oneself at risk for contracting HIV and/or any STD, expected pleasure, and concern for partner's emotional and physical health all contribute to an individual's decision. The final decision as whether or not to engage in risky sexual behavior rests on the individual's analysis of these costs and benefits in light of his/her own opinions and values.

III. Data

The data come from two major sources, the US Census Bureau HIV/AIDS Surveillance Database and the Living Standards Measurement Study (LSMS) of the World Bank.

The HIV/AIDS Surveillance Database is a compilation of data collected from around the world on HIV and AIDS prevalence rates. The data come for various scientific studies, government projects, as well as from the mass media. The data include country, region, date, population subgroup (i.e. pregnant, race, etc.), gender, prevalence rate, sample size, virus type (HIV1 or HIV2), and type of test. Though not all of these

categories are available for all of the data sets, the most important ones for my research, region, prevalence rate, and demographic indicators, are present (US Census Bureau HIV/AIDS Surveillance Database, 2003).

More specifically, the data used in the regression come from a series of cross-sectional studies conducted by the Republic of South Africa Department of Health, in which pre-natal care facilities in the South African public health system collect information about HIV/AIDS rates (and syphilis rates) in pregnant women throughout the country. The fact that the data is specific to pregnant women is important because pregnant women are sexually active. Furthermore, they have had unprotected sex, which is the largest method of HIV transmission in sub-Saharan Africa. Since the data were collected at public health facilities, there is some bias against non-African race groups. However, the data are broken down by race within each province's data set, simply indicating that the sample size for non-Africans was smaller than that of Africans (RSA Department of Health, 2003).

The LSMS Household Surveys were undertaken by the World Bank in an effort to understand the nature of developing countries' situations so that appropriate measures could be implemented to improve the standard of living in those respective countries. One important feature of the LSMS data is that it includes many different aspects of economic welfare and household behavior. Furthermore, one of the World Bank's goals in producing the LSMS data sets was to provide information to researchers so that more studies could be conducted about the selected regions and populations of the world. The surveys are paid for by the World Bank and other international groups, as well as individual governments. Since the quality of data from developing countries is frequency

called into question, the World Bank takes many precautions with the LSMS surveys to ensure that high quality data is obtained. These precautions include extensive training for interviewers and explicit wording of the questions in the surveys so as to maximize consistency across interviewers (Grosh & Glewwe, 1998; Deaton, 1997). The LSMS survey tries to sample a representative sub-group of the entire population; however they do include variables for each specific region (Grosh & Glewwe, 1995, 1998; Deaton, 1997). This information was important for merging regional HIV data with the LSMS household data.

The major South African LSMS survey was published in 1994 (data collection began in 1993) and includes approximately 9000 households. Additionally, community level information was collected. The data for South Africa contains detailed information about each household, including a breakdown of the household's members, consumption, education, land access, income and employment, agriculture, perceived quality of life, and health. Each of these variables is evaluated in great depth to attain as complete a picture of each household as it possible.

The 9,000 households in the survey combined to produce over 51,000 individuals who participated in the survey. To create the final dataset, datasets from the LSMS were merged to one another. Men were eliminated from the data set because pregnancy rates were used as the proxy for unprotected sex, leaving approximately 25,000 respondents who were female. The size of the sample was reduced to include only women between the ages of ten and 50, as women outside of this range are biologically unlikely to be able

to become pregnant. The final sample size was 459 women.[7] Summary statistics for this sample can be found in Table 1.

IV. Methodology

Ideally the effects of HIV rates on the occurrence of unsafe sexual intercourse would be measured. Ideally, data from a minimum of two points in time would be used to measure changes in risky behavior due to changes in HIV rates. This method could also control for unobservable regional fixed effects. Unfortunately, the LSMS survey is a cross-sectional dataset. Though there is no way of measuring changes over time with the LSMS data, several regional variables are included to help eliminate regional variations.

Additionally, there are several problems with using unsafe sex as the dependent variable. One problem with using unprotected sex as the dependent variable is the high probability that there is underreporting of both sexual encounters and unsafe sex. This is evidenced by the fact that there is a wide variety of reported sexual encounters, both extra-marital and intra-marital, and a wide variety of reported condom use (Desgrées du Loû, 1999).[8] Also, in a study at the Universities of Alabama and Zambia, biological tests were compared with self-reported condoms use. The results of this study suggested that at least 50% of unprotected sexual intercourse goes unreported (Carter, 2003).[9]

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[7] Respondents with missing or irrational answers (e.g. negative distances, negative ages, etc.), were removed from the final dataset.

[8] Reported percentages varied based on different studies of the same question. One constant is that men report more extra-marital sex than women do.

[9] Of the 51,510 respondents to the LSMS survey, approximately 15,000 individuals reported being sick in the two weeks before the survey. However, only 13 of these individuals claimed to be ill due to HIV/AIDS in the two weeks prior to the survey. This suggests that underreporting of HIV infections may be a problem as well.

Unfortunately, there is a lot of misunderstanding in Africa surrounding AIDS, thus the health data collected by the LSMS cannot be considered an accurate indicator of the actual HIV prevalence rate. This is why the regional data from the US Census Bureau HIV/AIDS Surveillance Database makes for a more

Though there is a current trend towards increasing fertility control in many developing areas, due mostly to the increasing availability of modern contraception, this was not the case in the mid 1990's when the LSMS survey took place. If a woman is pregnant, she clearly had unprotected sex, therefore fertility rates avoid some of the problems posed by unprotected sex surveys. Thus, fertility can serve as a fairly reliable proxy for unsafe sex.

Fertility rates and HIV prevalence rates are the two most important variables in the regression; however there are other explanatory variables that may help to explain the fertility rates in South Africa. Community characteristics will be included because of different levels of economic prosperity in the South African provinces. Race is an important control variable because of cultural and language differences that may be associated with different levels of desired fertility. Race may be correlated with both AIDS rates and risky behavior. Additionally, it could also reflect differential ability to obtain information about AIDS rates from government documents or the media. Income and other measures of economic welfare have been found to be negatively correlated with fertility levels; however in the African context, they have also been found to be positively correlated with HIV/AIDS rates. Education would be expected to have a negative correlation with HIV prevalence because information and education is one of the key variables. Also, the level of education of the parents (soon to be grandparents) may have some bearing on the self-esteem and education level of the pregnant individual. There is

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accurate analysis. The LSMS health data, specifically the HIV data, could provide interesting insight into the perceptions and opinions about HIV and related illnesses, specifically whether people believe that they are infected and whether or not that matches up with actual HIV prevalence rates. An interesting comparison would involve using the reported HIV rates from the LSMS data and comparing it with the actual HIV rates from the Census data. This would give and indicator as to the perceptions about HIV.

likely a relationship between wealth and education, so an interaction variable was needed to control for this, and was in fact statistically significant.

Additionally, a proxy for wealth was needed. Income is a poor measure of wealth because it is highly vulnerable to shocks and is likely to be endogenous. Perhaps the best measure of wealth is an amalgamation of asset holdings and combinations of proxies for wealth, as they can break down the true wealth of the household into smaller pieces. Unfortunately, it is difficult to assign missing values, and thus many variables and wealth proxies are required to determine the general wealth variable. Instead, wealth was estimated using total consumption, based on the theory that households smooth consumption and thus consumption serves as a fairly constant estimator of wealth. This eliminates the problems of income shocks and creates a clean measure of wealth (Deaton, 1997; de Brauw).

Pregnancy information was used to analyze the effects of the HIV rate on fertility rates. This served as the dependent variable in a logistic regression. The question, "are you pregnant now," was posed during the 1994 LSMS study in South Africa. "Yes" responses were coded as 1 and "no" responses as 0 to create the dependent variable "preg_now_yes". A logistic regression (logit) model was used because the responses were discrete variables. The logit created a log regression of the odds-ratio of the event "pregnant now" occurring. Equation (1) shows the general model:

$$P(preg_{ijk}) = L\{\alpha + p_1 X_i + \beta_2 Z_j + \gamma(HIV_{93k})\} \quad (1)$$

The variable "$Preg_{ijk}$" is an indicator for whether $woman_i$ living in $community_j$ within $province_k$ was pregnant at the time of the 1994 LSMS survey. X_i is a vector of individual or household level factors that may contribute to the probability of a woman being pregnant or engaging in risky sexual behavior. Similarly, Z_j is a vector of community level data that may contribute to the probability of a woman being pregnant in 1994. HIV_{93k} is the HIV rate in $province_k$ in 1993. Gamma (γ) is the independent variable coefficient of interest, as it is the coefficient of the 1993 HIV rates variable. This means that γ shows the effect that the HIV rate has on the probability of being pregnant.

V. Results

Results from the logit regression, along with the marginal effects, appear in Table 2. The marginal effect of an independent variable is a useful tool for evaluating a logit model because the result of a marginal effect calculation, a partial derivative of the function with respect to that variable, shows the percentage rate of change rather than a log-odds ratio. The marginal effects were calculated at the mean of each variable, with the exception of dichotomous variables, for which the partial derivatives were taken for the "yes" case, where X = 1 (StataCorp, 2003). The results section of this paper utilizes marginal effects for ease of interpretation.

The total consumption variable was significant at the 5% level with a negative coefficient. This result means that poorer families in South Africa are more likely to be pregnant, a finding that is consistent with Becker (1991). This result suggests that the negative relationship between wealth and fertility is greater than the positive relationship

between wealth and HIV rates. The sum of these two effects is an overall negative correlation between wealth and pregnancy rates in South Africa.

Similarly, the education level of the mothers was statistically significant at the 5% level. As predicted by Becker, as years of maternal education increased, the probability of being pregnant decreased. For each additional year of education, the probability of being pregnant decreased by 3.9%.

Another factor that was taken into account was the subjective wealth of the family as compared to the wealth one generation back. Households that felt they were in a better financial situation than their parents had been were more likely to be pregnant. This result is consistent with Easterlin's relative income theory (Macunovich, 2003) and is indicative of people being willing to raise children in better conditions than those in which they themselves were raised. Similarly, household that were very satisfied with the new government of 1994 were more likely to be pregnant, again showing that families cared about the environment in which their children would be raised.

Families that had members who were looking for work, specifically the potentially pregnant women, were more likely to be pregnant. Again, this follows Becker's model because looking for a job suggests that wealth is lower, thus fertility is higher.

The age of the mother was positive and statistically significant at the 5% level. Though not statistically significant, the age of the mother squared followed an expected pattern and was negative, indicating that the probability of being pregnant increases at a decreasing rate at the age of the mother increases. In the sample, the minimum age was 11 and the maximum age was 46, with a mean age of just over 19 years of age. At this

mean, the probability of being pregnant increased by 0.8% for one additional year of age for the mother.

The number of previous pregnancies was positively and significantly correlated with the current pregnancy state. However, the number of births was significantly and negatively correlated with the probability of being pregnant. The difference between these two variables is that the number of pregnancies includes miscarriages and stillborns. Through hypothesis testing, the values were determined to be statistically different (χ^2 (1) = 6.33; Prob. > χ^2 = 0.0119). Though they nearly cancel out, the difference between these two effects is likely capturing an unobservable health difference in the sample of women. Other proxies for health, including sanitation, water quality, and access to healthcare, were evaluated, but they played a negligible role, if any at all, and were removed from the regression. The negative correlation between the number of births and the pregnancy rate and the positive correlation between the number of pregnancies and the birth rate both suggest that there is a target number of children that households strive to attain, but not exceed.

At a community level, the number of primary schools was negatively correlated with the pregnancy odds-ratio. This could be related to the desire to have more opportunities for children, thereby improving the quality of children rather than the quantity. Having a literacy program was positively and significantly correlated with increased pregnancy rates.

When evaluating race, African and white were used as the primary race groups, with other (including Coloured, Indian, and others) as the omitted category. If the household was white, there was a slightly higher chance that the woman was pregnant.

Interestingly, pregnant white women have much lower HIV rates than pregnant African women, so the risk of transmission would be higher for African women, and the probability of being pregnant for African women was smaller than for white women. However, it would be reasonable to assume that the overall probability of being white and being pregnant would be less because of the overall wealth of white South Africans with respect to their African cohorts. While individual whites are less likely to be infected with HIV, and therefore face fewer risks to having unprotected sex, as a whole, white wealth is relatively high, so it would be expected that their level of fertility would be lower.

Finally, the estimate of γ, the coefficient of HIV prevalence rates, is significant at the 5% level and is negative. For a one percentage point increase in the HIV rate evaluated at the mean of 4.31 percent, the probability of being pregnant decreased by approximately 0.8%. To the extent that being pregnant is a proxy for risky sexual behavior, this is good news from a public health perspective, as it indicates that people are having fewer children, and by inference, less unprotected sex when HIV rates are higher.

Two additional regressions were run to evaluate the impact of race to ensure that the independent variables did not differ across racial groups. The first regression was run only for white households. Though white is the second most prevalent race in South Africa[10], the number of women in the final dataset who were white was fairly small, accounting for only 77 of the 459 total observations. Because of the small number of observations, several of the remaining variables perfectly predicted the success or failure

[10] White is also the second most prevalent race in the LSMS survey.

of the model, so they were dropped by Stata. In a similar regression run only for African households the only statistically significant variable was "richer", which indicates that the household was richer than their parents. Since there was a positive coefficient for this variable, Easterlin's theory of relative income is likely playing a role (Macunovich, 2003).

A correlation does not imply causation, particularly in the case of HIV and pregnancy rates, where the relationship is highly intertwined with one another. For comparison purposes, pregnancy rates were included as independent variables and the provincial HIV rates from 1993, 1994, and 1995 were used as the dependent variables in three additional regressions (results appear in Tables 4, 5, and 6, respectively). Because of the latency period the HIV virus, HIV rates from later years were used in this regression. Since HIV rates are continuous variables, an OLS linear regression was used to evaluate this relationship.

As was the case in the first regression, these regressions are based on the theory that pregnancy rates act as a proxy for unprotected sex. However, these models differ in that a positive correlation here would imply that higher levels of unprotected sex predict higher HIV rates. These models would not predict a behavioral model, but rather an epidemiological model. It is difficult to determine a causal relationship between the pregnancy rates and HIV rates. Additionally, there may be an unobservable region fixed effect that impacts both values. Unfortunately the absence of time series data prevents an effect of this nature from being observed.

The results of the regressions using 1994 and 1995 HIV rates were very similar. The magnitudes and signs of the coefficients were similar in both of the regressions.

Additionally, as discussed earlier, HIV rates have been increasing over time (see Chart 1). The coefficient of interest in this set of regressions was the pregnancy dummy variable coefficient. In both 1994 and 1995, HIV rates were negatively correlated with the woman being pregnant at the time of the survey. Generally, the same household level variables were significant in these regressions as were in the original regression.

Perhaps the most noticeably different factor in these regressions was the significance of more of the community level variables. The positive correlations between immunization campaigns and literacy programs, indicate that these are could be acting as measures of wealth, as the HIV rate increases when these factors are present. The positive correlation between the distance to the nearest hospital and HIV rates is expected. If the hospital was closer to the community, the HIV rate was lower. The presence of migrants was also significant and positively correlated with HIV rates, as predicted by the relevant literature.

VI. Conclusion

Data from the World Bank and the U.S. Census bureau was used to investigate the relationship between pregnancy (as a proxy for unprotected sexual intercourse) and HIV prevalence rates in South Africa. A logistic regression was used to evaluate the probability of a woman being pregnant in 1994 with respect to several household and community level variables. After evaluating South African economic, fertility, and HIV data for 1994, HIV rates were determined to be a statistically significant factor in the positive probability of a South African woman being pregnant. For a one percentage point increase in the HIV rate evaluated at the mean of 4.31 percent, the probability of

being pregnant decreased by approximately 0.8%. In addition, the education level of mothers was strongly statistically significant, indicating that policies to increase both general education and education about HIV and AIDS may help to reduce the amount of unsafe sex in South Africa. Though two effects, one of relative prices of children and the other relative income, are at work, findings that overall wealth contributed negatively to pregnancy rates suggests that an increased overall economic welfare would improve the amount of unprotected sex.

One problem with interpretation of the results presented here is that it is difficult to disentangle the effects of the independent variables on fertility decisions from the effects on risky sexual behavior. Though it is fairly clear that increased wealth has positive benefits beyond the realm of HIV and risky behavior, mixed effects similar to those with wealth and fertility make it difficult to determine appropriate policies.

Another example of intertwined effects that compound the analysis of the results is the relationship between the number of pregnancies, the number of births, and the pregnancy rate. If survivability of fetuses were to increase, the number of children born would increase, and the probability of being pregnant would decrease. However, this would be slightly offset by the likelihood that pregnancy rates would increase if the number of pregnancies were to increase. If pregnancy is a good proxy risky sexual behavior, more live births would translate into less unprotected sexual intercourse.

Urbanization produces similarly intertwined results. Urbanization increases wealth because of the increased opportunities and wages; however increased urbanization has also been linked with increased HIV rates in previous research. Disentangling these two conflicting effects is difficult given the data constraints.

A cursory look at the reverse relationship (i.e. HIV rates dependent upon pregnancy rates), shows a similarly negative and statistically significant result when compared to the regression of interest. Though it is difficult to conclusively prove a causal relationship from the established correlation, a causal relationship in either direction would lead to many important conclusions and further policies to improve the HIV situation in South Africa.

Future research could expand on these results by adding more points in time to help control for regional fixed effects and to compare pregnancy decisions at different points in time. Community level, rather than provincial level, HIV data could be helpful in flushing out some of the uncertainty in the model due to large, diverse areas being grouped together with a single HIV rate. Another suggestion for future study would be to develop a method to determine causality, perhaps by using more direct approaches to obtain information about risky sexual behavior.

The most important conclusions to draw from this research are that increasing wealth and education may help to decrease the amount of unsafe sex in South Africa. Furthermore, educating people about HIV and the HIV prevalence rate may help to lower the amount of unsafe sex.

VII. Appendix

Biological Background

Since HIV is a virus, it is extremely difficult to counteract its effects. Viruses lack the cellular machinery and most of the enzymes needed to replicate, so viruses must have a host so that they can use the hosts' machinery to replicate. Therefore, it is extremely difficult to kill a virus without killing the cells that it has infected. In the case of HIV, the virus is specifically designed to only attach to (and subsequently infect) certain proteins on certain immune cells, T-helper cells with CD4+, due to cell tropism. This means that cells that become infected with HIV are the very cells that are needed to stop the infection. When T-helper cells are infected, they are not able to function correctly. T-helper cells are responsible for triggering many immune responses, so when are impaired, the entire immune response chain begins to fall apart. Germs that the immune system can usually fight with ease begin to take control because the infected T-helper cells are no longer useful. People with AIDS die of secondary infections that they cannot fight rather than the actual HIV virus (Mims et al., 1998; Immunology Lecture Notes, 2003; Society, Culture, and Disease Class Notes, 2003).

Especially in Western Africa, where the less virulent HIV-2 is more prevalent, patients can live asymptomatically for years, all the while passing the disease on unknowingly to sexual partners.

Also, there is some correlation between males being uncircumcised and an increased risk of contracting HIV on the sex market, however there a causal link cannot be proven because there may be cultural differences between cultures which promote circumcision and those that do not. There is conclusive evidence that uncircumcised

males are at greater risk for developing ulcerative STDs, thus is would seem reasonable that HIV/AIDS could also be transmitted more easily.[11] Circumcision is less prevalent in many African countries and cultures than it is in the west, perhaps contributing to AIDS transmission (Caldwell & Caldwell, "Nature and Limits", 1993).

[11] If for no other reason, broken skin from one ulcerative STD leaves the individual far more susceptible to STDs, specifically HIV because of the potential for mucous membrane contact with bodily fluids.

Chart 1 - South African HIV Rate Trends from 1990-2001

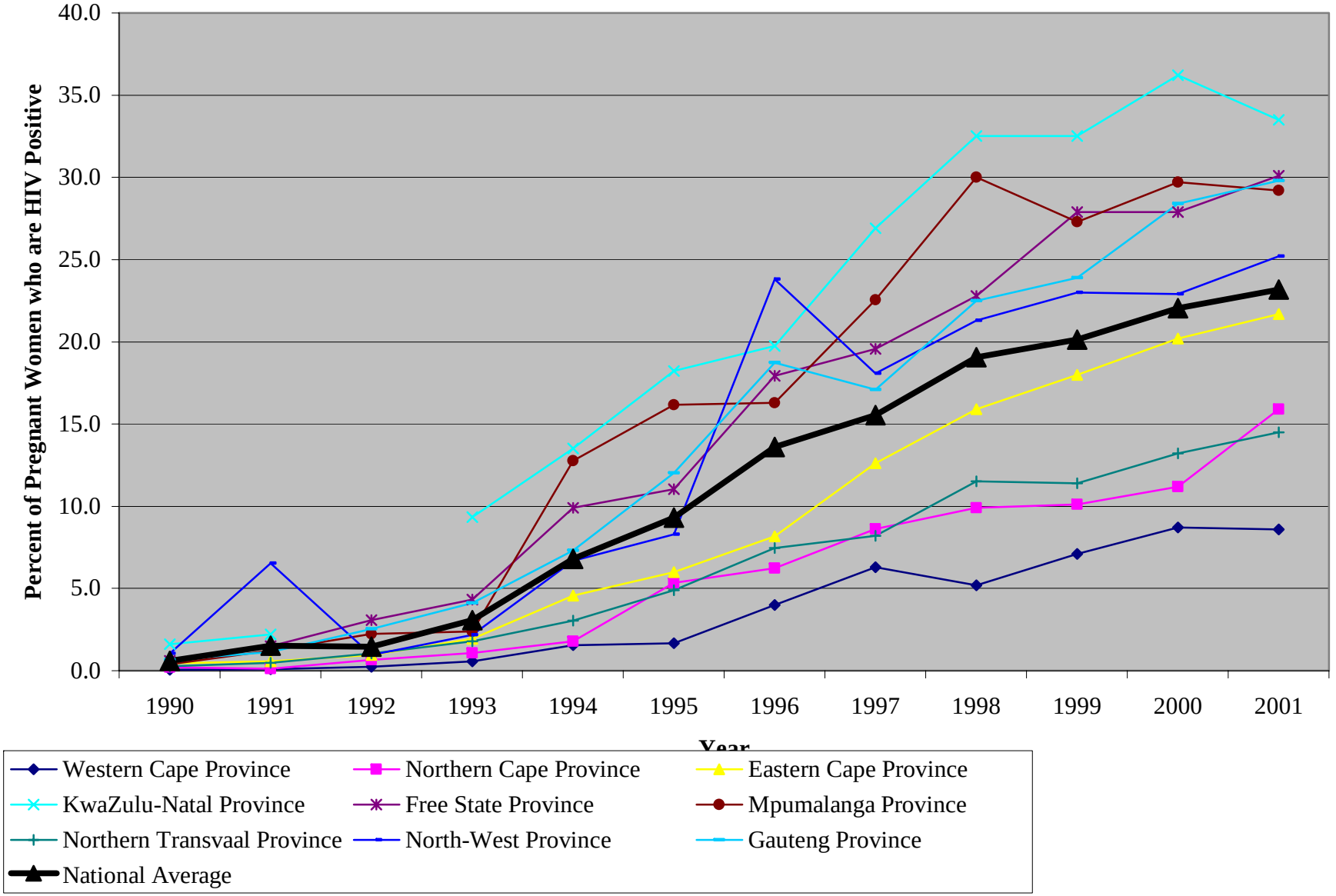

Table 1 – Summary Statistics for Variables in Regression

Variable Name	Variable Description	Observations	Mean	Std. Dev.	Min.	Max.
	Dependent Variable					
preg_now_yes	Pregnant at Time of Survey	459	0.0631808	0.2435534	0	1
	Provincial Level Data					
hiv_93	HIV Rates for 1993	459	4.318039	3.204244	0.56	9.34
	Household Level Variables					
totcons	Total Consumption	459	3578.523	6839.987	0	46000
edu_totcons	Education/Wealth Interaction	459	31731.44	101678	0	787528
edu_length	Length of Education	459	4.614379	11.43643	0	61
preg_no	Number of Pregnancies	459	2.474946	1.825619	1	12
no_birth	Number of Births	459	2.3878	1.803061	1	10
agem	Age of Children in Months	459	28.48148	21.11802	0	77
age	Age of Mother	459	19.23747	6.812382	11	46
agesq	Age of Mother Squared	459	416.3878	314.1504	121	2116
hhrace_african	Household Race is African	459	0.795207	0.4039906	0	1
hhrace_white	Household Race is White	459	0.167756	0.3740572	0	1
c_hh_a_race	Community Race and HH Race are the Same	459	0.9389978	0.2395955	0	1
metro_rural	Household is Rural	459	0.577342	0.494521	0	1
very_satis	HH is Very Satisfied with New Government	459	0.0566449	0.231415	0	1
richer	Houshold is richer than parents	459	0.1699346	0.3759852	0	1
look_work	Want to work (if unemployed)	459	0.0958606	0.2947212	0	1
	Community Level Variables					
distance	Distance to Hospital	459	10.46078	12.92908	0.5	160
imm_camp_1	Immunization Campaign (Yes/No)	459	0.4575163	0.4987355	0	1
tba_dist	Distance to Traditional Birth Attendant	459	11.90087	15.84736	0.1	160
psch_num	Number of Primary Schools in Cluster	459	2.002179	2.395865	0	12
lit_prog_yes	Literacy Program (Yes/No)	459	0.1938998	0.3957827	0	1
newpeple	People Moving to or Away from Community	459	1.893246	1.136694	1	4
pop_a_african	Primary Population is African	459	0.7864924	0.4102301	0	1
pop_a_white	Primary Population is White	459	0.1699346	0.3759852	0	1

Table 2 – Effects of HIV Rates on Pregnancy Probability and Marginal Effects

Variable Name	Variable Description	Coefficient.	Std. Err.	z	P>z		dy/dx	X	
	Dependent Variable								
preg_now_yes	Pregnant at Time of Survey								
	Provincial Level Data								
hiv_93	HIV Rates for 1993	-0.796898	0.338857	-2.35	0.019	*	-0.008488	4.31804	
	Household Level Variables								
totcons	Total Consumption	-0.002566	0.000930	-2.76	0.006	*	-0.000027	3578.52	
edu_totcons	Education/Wealth Interaction	0.000071	0.000026	2.76	0.006	*	0.000001	31731.4	
edu_length	Length of Education	-0.395172	0.168626	-2.34	0.019	*	-0.004209	4.61438	
preg_no	Number of Pregnancies	3.655253	1.410485	2.59	0.010	*	0.038932	2.47495	
no_birth	Number of Births	-4.633852	1.566613	-2.96	0.003	*	-0.049355	2.3878	
agem	Age of Children in Months	0.026057	0.029203	0.89	0.372		0.000278	28.4815	
age	Age of Mother	0.749389	0.484476	1.55	0.122	*	0.007982	19.2375	
agesq	Age of Mother Squared	-0.008096	0.008211	-0.99	0.324		-0.000086	416.388	
hhrace_african	Household Race is African	1.510282	5.779634	0.26	0.794		0.036202	1	†
hhrace_white	Household Race is White	28.137710	12.803610	2.20	0.028	*	0.989233	1	†
c_hh_a_race	Community Race and HH Race are the Same	9.531196	6.831836	1.40	0.163		0.982611	1	†
metro_rural	Household is Rural	-1.649145	2.496227	-0.66	0.509		-0.008679	1	†
very_satis	HH is Very Satisfied with New Government	8.557176	4.120253	2.08	0.038	*	0.971884	1	†
richer	Household is richer than parents	4.070619	1.410364	2.89	0.004	*	0.378635	1	†
look_work	Looking for work (if unemployed)	3.261669	1.459206	2.24	0.025	*	0.210418	1	†
	Community Level Variables								
distance	Distance to Hospital	0.188891	0.123306	1.53	0.126		0.002012	10.4608	
imm_camp_1	Immunization Campaign (Yes/No)	1.033070	1.727189	0.60	0.550		0.018907	1	†
tba_dist	Distance to Traditional Birth Attendant	0.018690	0.101142	0.18	0.853		0.000199	11.9009	
psch_num	Number of Primary Schools in Cluster	-4.540146	1.755009	-2.59	0.010	*	-0.048357	2.00218	
lit_prog_yes	Literacy Program (Yes/No)	7.695771	3.229415	2.38	0.017	*	0.949128	1	†
newpeple	People Moving to or Away from Community	1.285431	0.691308	1.86	0.063		0.013691	1.89325	
pop_a_african	Primary Population is African	-7.613990	6.216029	-1.22	0.221		-0.010762	1	†
pop_a_white	Primary Population is White	-27.086290	12.896690	-2.10	0.036	*	-0.010767	1	†
_cons	Constant	-16.049240	9.079423	-1.77	0.077	*			

* Indicates significance at the 5% level

(†) dy/dx is for discrete change of dummy variable from 0 to 1

Number of Obs. = 459

Pseudo R^2 = 0.7301

Table 3 – Effects of HIV Rates on Pregnancy Probability conditional upon Household Race being African

Variable Name	Variable Description	Coefficient	Std. Err.	z	P>z
	Dependent Variable				
preg_now_yes	Pregnant at Time of Survey				
	Provincial Level Data				
hiv_93	HIV Rates for 1993	-2.297164	1.525281	-1.51	0.132
	Household Level Variables				
totcons	Total Consumption	-0.009945	0.006626	-1.50	0.133
edu_length	Length of Education	-3.797461	2.635563	-1.44	0.150
preg_no	Number of Pregnancies	14.726420	10.580910	1.39	0.164
no_birth	Number of Births	-20.649840	14.052550	-1.47	0.142
agem	Age of Children in Months	0.037986	0.046333	0.82	0.412
age	Age of Mother	0.055125	0.838821	0.07	0.948
agesq	Age of Mother Squared	0.010202	0.017878	0.57	0.568
metro_rural	Household is Rural	-10.798140	11.247450	-0.96	0.337
richer	Household is richer than parents	6.034906	2.142512	2.82	0.005 *
look_work	Looking for work (if unemployed)	4.455476	2.366919	1.88	0.060
	Community Level Variables				
distance	Distance to Hospital	0.263374	0.181974	1.45	0.148
imm_camp_1	Immunization Campaign (Yes/No)	-7.880489	7.822141	-1.01	0.314
tba_dist	Distance to Traditional Birth Attendant	0.027465	0.343409	0.08	0.936
psch_num	Number of Primary Schools in Cluster	-13.140190	8.874196	-1.48	0.139
lit_prog_yes	Literacy Program (Yes/No)	20.501370	14.604680	1.40	0.160
newpeple	People Moving to or Away from Community	0.313790	1.340240	0.23	0.815
pop_a_white	Primary Population is White	-22.839650	32.039360	-0.71	0.476
_cons	Constant	21.485720	26.823920	0.80	0.423

Number of Obs. = 279

* Indicates significance at the 5% level

Pseudo R^2 = 0.6728

Table 4 – Reverse Effects: The Effect of Pregnancy Rates on 1994 HIV Rates

Variable Name	Variable Description	Coefficient.	Std. Err.	z	P>z	
	Dependent Variable					
hiv_94	HIV Rates for 1994					
	Household Level Variables					
preg_now_yes	Pregnant at Time of Survey	-3.120942	0.7957332	-3.92	0.000	*
totcons	Total Consumption	0.0000756	0.0000504	1.5	0.135	
edu_totcons	Education/Wealth Interaction	5.41E-06	3.29E-06	1.65	0.101	
edu_length	Length of Education	0.0557309	0.0309579	1.8	0.073	
preg_no	Number of Pregnancies	1.417126	0.4913375	2.88	0.004	*
no_birth	Number of Births	-1.649429	0.5025931	-3.28	0.001	*
agem	Age of Children in Months	0.0209912	0.0075996	2.76	0.006	*
age	Age of Mother	-0.0921331	0.1167159	-0.79	0.430	
agesq	Age of Mother Squared	0.000093	0.0025328	0.04	0.971	
hhrace_african	Household Race is African	5.927685	1.69009	3.51	0.000	*
hhrace_white	Household Race is White	4.347715	1.463729	2.97	0.003	*
c_hh_a_race	Community Race and HH Race are the Same	1.353004	0.9803093	1.38	0.168	
metro_rural	Household is Rural	1.647507	0.429365	3.84	0.000	*
very_satis	HH is Very Satisfied with New Government	1.129178	0.831969	1.36	0.175	
richer	Household is richer than parents	0.8451915	0.4606171	1.83	0.067	
look_work	Looking for work (if unemployed)	-0.153716	0.531818	-0.29	0.773	
	Community Level Variables					
distance	Distance to Hospital	0.0990226	0.0236077	4.19	0.000	*
imm_camp_1	Immunization Campaign (Yes/No)	2.053334	0.4819721	4.26	0.000	*
tba_dist	Distance to Traditional Birth Attendant	-0.0729605	0.0203514	-3.59	0.000	*
psch_num	Number of Primary Schools in Cluster	-0.1445907	0.0871264	-1.66	0.098	
lit_prog_yes	Literacy Program (Yes/No)	4.157094	0.4946764	8.4	0.000	*
newpeple	People Moving to or Away from Community	1.868321	0.1616094	11.56	0.000	*
pop_a_african	Primary Population is African	1.080712	1.402969	0.77	0.442	
pop_a_white	Primary Population is White	-2.204057	1.467992	-1.5	0.134	
_cons	Constant	-4.04587	2.040556	-1.98	0.048	*

* Indicates significance at the 5% level

Number of Obs. = 459

R-Squared = 0.4819

Table 5 – Reverse Effects: The Effect of Pregnancy Rates on 1995 HIV Rates

Variable Name	Variable Description	Coefficient.	Std. Err.	z	P>z	
	Dependent Variable					
hiv_95	HIV Rates for 1995					
	Household Level Variables					
preg_now_yes	Pregnant at Time of Survey	-4.001607	1.051839	-3.80	0.000	*
totcons	Total Consumption	0.000073	0.000067	1.09	0.277	
edu_totcons	Education/Wealth Interaction	0.000006	0.000004	1.37	0.172	
edu_length	Length of Education	0.093658	0.040922	2.29	0.023	*
preg_no	Number of Pregnancies	1.851052	0.649474	2.85	0.005	*
no_birth	Number of Births	-2.203109	0.664352	-3.32	0.001	*
agem	Age of Children in Months	0.023295	0.010046	2.32	0.021	*
age	Age of Mother	-0.171620	0.154281	-1.11	0.267	
agesq	Age of Mother Squared	0.000952	0.003348	0.28	0.776	
hhrace_african	Household Race is African	6.235829	2.234042	2.79	0.005	*
hhrace_white	Household Race is White	5.299515	1.934828	2.74	0.006	*
c_hh_a_race	Community Race and HH Race are the Same	2.017322	1.295820	1.56	0.120	
metro_rural	Household is Rural	2.120820	0.567556	3.74	0.000	*
very_satis	HH is Very Satisfied with New Government	1.794956	1.099737	1.63	0.103	
richer	Household is richer than parents	1.186121	0.608866	1.95	0.052	
look_work	Looking for work (if unemployed)	-0.077736	0.702983	-0.11	0.912	
	Community Level Variables					
distance	Distance to Hospital	0.128843	0.031206	4.13	0.000	*
imm_camp_1	Immunization Campaign (Yes/No)	2.100127	0.637094	3.30	0.001	*
tba_dist	Distance to Traditional Birth Attendant	-0.100843	0.026902	-3.75	0.000	*
psch_num	Number of Primary Schools in Cluster	-0.152382	0.115168	-1.32	0.186	
lit_prog_yes	Literacy Program (Yes/No)	5.705213	0.653887	8.73	0.000	*
newpeple	People Moving to or Away from Community	2.613665	0.213623	12.23	0.000	*
pop_a_african	Primary Population is African	1.198644	1.854513	0.65	0.518	
pop_a_white	Primary Population is White	-2.417139	1.940464	-1.25	0.214	
_cons	Constant	-3.095682	2.697306	-1.15	0.252	

* Indicates significance at the 5% level

Number of Obs. = 459

R-Squared = 0.4844

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