GONE IN SIX SECONDS:
HIV/AIDS and Poverty in Sub-Saharan Africa

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Abstract

Every six seconds, someone in world contracts HIV. Every ten seconds, someone in the world loses their life to AIDS. Sub-Saharan Africa bears the majority of the burden posed by the HIV/AIDS pandemic, as well as suffering the effects of decades of overwhelming and unrelenting poverty rates. This paper investigates the effect of individual and country-level characteristics on the determination of HIV-status, in an attempt to understand the complex relationship between HIV/AIDS and poverty in sub-Saharan Africa. Using linear probability models with a variety of measures of poverty and inequality, this study finds individual characteristics to be more jointly significant in the determination of HIV-status than country characteristics. Access to a toilet with running water and a reduction in the Human Poverty Index are found to be the most statistically significant variables in the reduction of an individual's probability of being HIV-positive. These findings suggest that poverty-reduction strategies aimed at mitigating the effects of HIV/AIDS in sub-Saharan Africa should be directed at increasing the welfare of the region's poorest individuals through increased access to resources in an effort directly decrease the number of individuals at a high risk for contracting the virus.

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Introduction

Every six seconds, someone in the world contracts the Human Immunodeficiency Virus (HIV). Every ten seconds, someone in the world loses their life to the Acquired Immune Deficiency Syndrome (AIDS). Sixty-three percent of all people living with HIV, or the infection it causes, AIDS, live in sub-Saharan Africa. Why has the virus spread so rapidly through this region and what can be done to mitigate the devastating mortality rates caused by HIV/AIDS are topics of vital importance in today's society, as the disease claimed 2 million African lives during 2006. Aside from being a major health issue, HIV/AIDS poses a severe threat to the future of the African population, the stability of the labor supply, the sustainability of the agricultural sector, the advancement of education, and the ability of the continent's leaders to fight poverty and inequality in the affected nations. While HIV/AIDS prevalence rates vary greatly across the region, with some countries experiencing infection in only 2% of the population while other face rates of up to 33%, the impact of the virus is cause for significant concern throughout sub-Saharan Africa (Avert 2007).

A specific aspect of the causes and consequences of the AIDS pandemic in sub-Saharan Africa that remains relatively unstudied is its relationship to the overwhelming levels of poverty that a majority of the region faces. This paper seeks to investigate the relationship between HIV/AIDS and poverty and inequality in sub-Saharan Africa. How are measures of poverty and inequality correlated with individual HIV-status and which aspects of national and individual living standards are the greatest contributors to an individual's probability of contracting the virus?

Sub-Saharan Africa remains both the region most affected by the HIV/AIDS pandemic and a region plagued by devastating levels of poverty and inequality. Poverty and health are variables that are known to be highly correlated and thus the interplay between the spread of HIV/AIDS and the region's unrelenting levels of poverty is of particular importance. Before progress can be made, the exact relationship between these variables and the extent to which they are related and interconnected must be understood. By exploring the correlation between these two extremely important social problems, this paper seeks to shed light on the role that different measures of poverty and inequality play in the determination of individual HIV-status in sub-Saharan Africa. This information will provide insight into how policy initiatives should be focused in order to curtail the spread of the disease and promote health and equity throughout the region.

Regression analysis is used to discern important patterns and provide insight into the exact impact of different measures of poverty on an individual's probability of being HIV-positive. Linear probability models allow one to observe the relative importance of individual versus national measures of poverty in the determination of individual HIV-status. The results of the analysis contained in this paper are surprising in a number of ways. While individual measures of poverty are found to have a greater joint significance on individual HIV-status than country-level factors, some of the findings are strikingly counterintuitive. A 1% increase in GDP per capita is found to increase an individual's probability of being HIV-positive by 17.5%. Similarly, a 1% increase in the national literacy rate results in a 1.6% increase in an individual's probability of being HIV-positive.

This is not to say, however, that poverty is not correlated with HIV prevalence or that there are not poverty-reducing policy changes that could improve the current status of the HIV/AIDS crisis in sub-Saharan Africa. The study does find statistically significant

relationships between individual access to a toilet with running water and the Human Poverty Index and HIV prevalence. Improvements in these areas could begin to control the overwhelming levels of HIV/AIDS in the most affected areas of the world. Access to flushable toilet is found to decrease an individual's probability of being HIV-positive by 1%. Similarly, a decrease in the percentage of deprived individuals within a nation, as measured by the HPI, is proven to be significant in decreasing an individual in that country's probability of being HIV-positive. These findings underscore the importance of focusing policy initiatives on improving the welfare of sub-Saharan Africa's poorest individuals. Providing resources that will decrease relative levels of deprivation for the region's neediest people is potentially the best option available to fight the HIV/AIDS pandemic. Focusing on improvements in individual, rather than national, welfare is vital to prospects for future development in the region in the face of rapidly increasing HIV mortality rates.

Literature Review

The rapid spread of HIV/AIDS since its discovery in the early 1980s has made it a topic of important and extensive research in a number of disciplines. An economic evaluation of the impact of the pandemic has been no exception. In order to understand the motivation for the research at hand, it is important to contextualize the research question in the studies and conclusions that have preceded it. Additionally, because of the complexity of the focus of this study, one must look at not only the previous research in the specific area of interest, i.e. the relationship between HIV/AIDS and poverty, but also at other related areas of study. What follows is a review of the literature pertinent to this study beginning with past investigations of poverty and inequality in sub-Saharan Africa (SSA), the link between poverty and health, the socioeconomic implications of the HIV/AIDS pandemic, and a concluding review of the specific research on the interactions of HIV/AIDS and poverty in SSA.

Understanding African Poverty

Income and per capita GDP are poor measures of individual and national poverty and inequality. These measurements fail to capture the standard of living that individuals and households experience on a day-to-day basis. Because of this, the definition of poverty has been rethought by the United Nations Development Programme (UNDP) in recent years.

> …it has come to be seen as the result of the deprivation of basic capabilities, which leads to reduced life expectancy, health, participation, person security, degradation of the environment, as well as the absence of real opportunities to lead to a valuable and valued life. (Arimah 2004, 400)

In similar vein, in 1992, the UNDP developed the Human Development Index (HDI) in order to evaluate poverty in its broadest terms (Moser and Ichida 2001). The HDI measures

poverty in terms of development by calculating a weighted average of life expectancy, the standard of living as measured by per capita gross domestic product, and access to education as measured by the adult literacy rate and the gross primary, secondary, and tertiary school enrollment ratios (Human Development Report 2006).

In 2004, the World Bank determined that Africa was home to fifteen of the twenty poorest countries in the world. In the wake of failed structural adjustment and economic stabilization programs proposed by international financial institutions during the last two decades of the twentieth century, African nations have had to look elsewhere for poverty-alleviation tactics. The UNDP has, therefore, been pushing an agenda of human development, which, "seeks to enable people to lead full, productive, satisfying and worthwhile lives by raising their incomes and improving other components of their standard of living such as life expectancy, health, literacy…" (Arimah 2004, 400). The World Bank has also focused on the relationship between social welfare and poverty, finding there to be a causal relationship between income and education such that the quality of education is known to improve with increases in income (Moser and Ichida 2001).

"Poverty in SSA amounts to an overwhelming state of deprivation of some of the most basic human survival needs-- food, water, clothing, shelter, and minimal health care and education" (Lopes 2005, 9). Before the idea of poverty was rethought to include social indicators of welfare, it was often overlooked that improved social conditions could be beneficial in decreasing poverty rates. Social equity, however, is becoming a growing world concern especially in the face of unrelenting poverty and increasing levels of inequality across continents. These indicators present a stark reality when examining the devastating implications of these problems in SSA specifically-- Africa's poverty levels,

compared to worldwide poverty levels, substantially grew during the 1980s and 1990s despite major efforts to curtail African poverty (Lopes 2005).

Notwithstanding the fact that infant mortality rates have declined over this period and life expectancies increased, these changes have been minimal compared to global changes, and the continent remains plagued with the highest infant mortality rates and lowest life expectancy rates in the world (Moser and Ichida 2001). Human poverty measures, as captured by the Human Poverty Index (HPI), alert one to the fact that human poverty levels are greater than 50% in seven African nations. Perhaps even more striking are regional income poverty rates. Many African nations experience upwards of 20% of their population living below the $1/day poverty line, with some experiencing rates of more than 70%, such as Mali and Nigeria (Arimah 2004, 403). Most calculations of national poverty levels are based on this minimum threshold of $1/day and any individual not meeting this standard is considered poor. Despite the narrowness of this definition, in many African countries, more than half the population is defined as living in poverty.

Three different studies have been conducted to assess the different aspects of poverty in SSA. Moser and Ichida (2001) use panel data from 46 SSA nations over a twenty-five year period, 1972-97, in an attempt to understand the relationship between economic growth and poverty reduction in the region. Using the broadened definition of poverty, including the specification of low income and/or low health, they find there to be a strong, positive relationship between economic growth and non-income poverty reduction in SSA. More specifically, they find that in low-income countries the impact of economic growth on life expectancy and primary school enrollment is significantly stronger than in high-income countries. Additionally, the study concluded that reducing income inequality and providing basic social services were especially significant in the

reduction of poverty. They hold that sustained poverty reduction in Africa requires economic growth, and while this condition is not sufficient for decreased poverty, it is necessary.

Using the aforementioned UNDP definition of human development, Arimah (2004) investigated whether human development policies in Africa have been successful in their attempts to reduce poverty. Using cross-national data, he investigates variations in poverty levels across African nations in order to determine the efficacy of human development strategies. The study finds that, "inter-country differences in poverty levels [*are*] accounted for by variables indicative of the different facets of human development" (411-412). Specifically, education, health expenditure, good governance (as defined by voice and accountability), and a country's commitment to human development objectives all significantly reduce a nation's level of poverty.

One final study worth mention is Lopes' (2005) investigation of the accuracy of past measurements of poverty and inequality and assessment of the pyramids that have been used to represent these indicators. The pyramids are an analogy that seeks to compare regional income estimates from the past thirty years, which have experienced falling medians and increasing variance, to pyramids that widen and shift at the base over time. Lopes' research notes that while regional economic growth began to be successful in the mid-1990s, the simultaneous onset of the HIV/AIDS pandemic was a major setback for social indicators and prospects for future economic growth. He emphasizes the need for improvements in the most important social indicators, those that measure suffering and survival prospects, in order for poverty and inequality to be legitimately declining in SSA. In the face of HIV/AIDS, however, such indicators have been moving in the opposite direction and prospects for future improvements face major challenges.

Poverty and Health

It is common knowledge in international developmental theory that income and health status are positively correlated. It is most often assumed that income leads to better health through one of two mechanisms. While some individuals will use marginal increases in income to visit more healthcare providers, other individuals will invest in goods associated with health, such as nutritious food or improved housing (Case 2000). Either investment, however, directly leads to improvements in overall health status. A World Health Organization (WHO) declaration written in 1979 defines health as, "a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity" (Bloom and Canning 2003, 48). The document declared health a "fundamental human right" and noted it to be the foremost worldwide social goal. National health status is most commonly measured by life expectancy rates, which increased in 163 of 184 surveyed countries between 1975 and 1995, indicating a general improvement in global health. Over the same period, global health expenditure was a growing proportion of gross domestic product (GDP). In 2000, health spending accounted for 8% of global GDP (Bloom and Canning 2003).

Bloom and Canning (2003) discuss the impact of the 1979 WHO declaration and explain the three rationales for an increased use of resources towards the improvement of global health—it is a human right, a social goal, and vital to the development of emerging economies. They address the question of why health is so important to the poor by underscoring that ill health disproportionately affects the poor, fueling the "poverty trap" by inhibiting individuals' ability to access opportunities for education and political freedoms. The "poverty trap" is the cycle of ill health and lack of resources that impoverished families battle. Poor households cannot afford the cost of illness yet this

population is at highest risk for incurring disease and becoming ill. Additionally, poor health often causes reduced income by making individuals less productive or, in some cases, completely unable to be part of the labor force. Consequently, the individual lacks the resources to treat the illness and regain the initial standard of living. The poverty trap can be observed at the regional, as well as the household level, and thus can affect the economic abilities of an entire area.

Different policy objectives have been proposed for how to use knowledge of the correlation between health and income to positively affect global health. One economist notes that,

> Within countries, income is strongly correlated with health outcomes and policy recommendations that provide for income transfers to the poor, or the promise of increased earnings capacity, may prove to be as important for health outcomes as those calling for additional funds for service provision, especially in settings where the capacity to deliver health services is weak. (Case 2000, 1)

Other economists complement this idea by arguing that effective policy requires partnerships between the public, private, and civil society sectors. International actors, national governments, and non-governmental organizations are all seen as vital to the creation of successful policy to move health to the head of important factors surrounding poverty alleviation. Because of the relationship between health and income, health-led development is believed to be the key to meeting the WHO's declared goal of providing everyone with "a level of health that will permit them to lead a socially and economically productive life" (Bloom and Canning 2003).

Case (2000) set out to investigate the relationship between health and income and to determine the mechanisms fueling the increases in health status that result from increased income levels. Using data from South Africa, the study confirms the positive correlation between income and health and finds that income is, in fact, a strong factor in

the determination of health status. She notes the difficulty of quantifying the causality of income on health, especially in developing countries, and in light of this, aims her study at understanding the mechanisms of the causality. It is determined that money can generate health in four ways—medical care, water and sanitation, nutrition, and psychosocial stress. Money allows people access to improved healthcare and to make household improvements that contribute to more sanitary living conditions. Additionally, with increased income, individuals can purchases healthier foods, which are often more expensive. Finally, having more money reduces individual stress levels, which essentially lowers the probability of an individual becoming depressed. The aforementioned channels through which income leads to improved health are important in reinforcing the finding that income promotes health.

Until the turn of the century, the casual link from income to health remained unquestioned. The reverse relationship, however, that health is an important factor influencing income, is a plausible idea that merits examination. Bloom and Canning (2000) explore this relationship and note four mechanisms through which this relationship could exist. As opposed to the mechanisms Case uses to explain the way income fuels health, Bloom and Canning attribute the improvements of income that result from improved health to productivity, education, increased saving for longer retirement, and the "demographic dividend". They argue that healthier populations live longer and are thus more productive and that healthier people have more incentive to invest in education thus contributing to a greater level of human capital with which to earn higher levels of income. Furthermore, increased life expectancy creates a greater need for retirement savings as well as an increased number of people who can work and remain in the labor force, both fueling increases in income. The economists compare two countries identical in all respects except that one country has an additional five years of life expectancy. They find that, "real

income per capita in the healthier country will grow .3 to .5% faster per year than in its less healthy counterpart" (1207).

Health improvements, as measured by average life expectancy, lead to economic improvements and stimulate a decrease in poverty levels. Health improvements and economic growth are mutually reinforcing, contrary to the prior belief that the relationship only existed in one direction. Similarly, declining health status has important implications for economic stagnation. Commenting on the current health situation in SSA, Canning and Bloom shed light on the fact that health burdens, such as the HIV/AIDS pandemic, slow the pace of economic growth and inhibit a society's ability to promote overall general health and prevent the incidence of other diseases. They conclude that, "poor health is more than just a consequence of low income; it is also one of its fundamental causes" (1209). When proposed by Canning and Bloom, this notion was innovative, and as a result, a great deal of research has been conducted on the impact of HIV/AIDS on poverty in sub-Saharan Africa. These studies motivated the direction of the research question addressed in this paper, investigating the opposite relationship— how measures of poverty affect HIV/AIDS prevalence in sub-Saharan Africa.

The Socioeconomic Implications of HIV/AIDS

In 2001, the UN General Assembly adopted a Declaration of Commitment on HIV/AIDS, and noted that, "while HIV/AIDS must be seen as an emergency of the highest order, steady progress in reducing poverty is still the long-term and sustainable solution to the health crisis in the developing world" (On the Socioeconomic 2001, 619). The socioeconomic context of the pandemic was so far reaching at the time of this declaration that it seemed necessary to assess long-term prevention strategies. HIV/AIDS affects both the economic and social fabrics of developing countries and places these nations in

extreme predicaments due to reduced life expectancy, declining levels of overall education, stagnant economic growth, and a declining labor force that is particularly affecting rural areas. Almost all available literature on the socioeconomic implications of HIV/AIDS pinpoint poverty reduction techniques as the backbone of policy to combat the disastrous effects of the disease on society and economy.

HIV/AIDS primarily affects individuals in the most productive age group, those ages 15-49. Because the disease is fatal, it poses a greater threat to development than more common diseases. The size of the African labor force, therefore, is inversely correlated with the spread of the epidemic and this relationship has significant implications for the future of African economies. Life expectancy is on the decline and, "in the 35 highly affected countries in Africa, life expectancy at birth is estimated at 48.3 years in 1995-2000, 6.5 years less than it would have been in the absence of AIDS" (On the Socioeconomic 2001, 620). As a result, the labor force is predicted to be 10 to 30% smaller by 2020 than it would have been without AIDS. The problem of child labor has been exacerbated in the face of a declining labor supply and a rapidly increasing number of AIDS orphans who now rely on themselves for survival (On the Socioeconomic 2001).

The labor supply shortage that will result from the AIDS epidemic will especially affect the agricultural sector, the backbone of most African economies. Rural areas have been particularly hard hit by the epidemic and Freedman and Poku (2005) predict that by 2020 the total loss to the rural African population will be at least 16 million, 10 and 25% of the total agricultural labor force. To date, 7 million people from this population have lost their lives to AIDS. Because this situation hinders the ability of farming knowledge to be transmitted to younger generations, many farms are currently being led by individuals who have no farming experience (Freedman and Poku). Studies have also shown that, "the cost

of the disease relative to household income is twice larger in rural than in urban areas, which means that the lowest deciles are bearing disproportionately larger expenses" (Salinas and Haacker 2006, 4). It is clear, therefore, that the stronghold of many African economies, the agricultural sector, is significantly impacted by the spread of AIDS.

Just as AIDS is presenting problems for the intergenerational oral transmission of farming knowledge, AIDS is also hindering general education continentally. In 2000, an estimated 1 million children in sub-Saharan Africa had lost a teacher to AIDS, causing a major disruption in the learning process. The turnover of teachers affects not only the quality of education that children are receiving, but also has implications for national economies' wellbeing. Not only are orphaned children dropping out of school but those children that stay in school are suffering from sub-par education. "If AIDS continues to kill teachers and prevent children from attending school due to illness, the circumstances of orphanhood, or simply because they are kept out of school… the previous gains in educational attainment will, ultimately, decline and national development will be constrained" (Freedman and Poku 2005, 669). If the educational impact of the AIDS epidemic is not addressed, national development will be especially hard as a large portion of the population will not be properly educated (Salinas and Haacker 2006).

Crafts and Haacker (2003) conducted a study to assess the welfare impact of HIV/AIDS from a non-GDP per capita standpoint. Using mortality rates and the value of statistical life method (VSL), a technique used to assess the impact of health, and data from the International Programs Center of the US Bureau of the Census, from several particularly affected countries across the world, they attempt to develop new indicators to gauge the welfare effects of HIV/AIDS and to provide a new perspective on studies focusing on output and income. The VSL method assumes that an individual values both

higher income and longer life and uses these assumptions to estimate the change in real income adjusted for changes in life expectancy. The study finds welfare losses in the highest HIV/AIDS infected countries to be of a tenfold greater magnitude than the estimates of the impact of HIV/AIDS on output and income per capita. They conclude that, "the estimated changes in per capita GDP (while valuable in some other regards) not only give an incomplete picture of the welfare effects of HIV/AIDS; as far as welfare is concerned, they appear negligible compared with the direct effect of increased mortality" (16).

Poverty-reducing policy initiatives have been noted as the strongest hope for a nation's ability to deal with those already infected with the virus and to prevent the spread of the epidemic. Freedman and Poku (2005) note that, "although the proximate cause of Africa's AIDS crisis is HIV, the underlining societal causes are much broader and more familiar. Across the continent, poverty structures not only the contours of the pandemic but also the outcome once an individual is infected with HIV" (684). Even before the disastrous toll of the epidemic could fully be understood, Ainsworth and Over (1994) pointed to poverty alleviation as the most sound strategy for combating the macroeconomic effects of the disease. HIV/AIDS and poverty are intertwined in such a complex way that until their exact relationship is fully understood, it will be difficult to assess exactly how to attack one in a way that will positively impact the other. "Poverty reduction strategy papers need to be formulated in such a way that they take into account the current and expected impact of the epidemic" (On the Socioeconomic 2001 2001, 623). For example, Burkina Faso and Kenya have seen success in their attempts to combine poverty-alleviation and AIDS-reduction techniques through the allocation of debt relief savings towards HIV care and prevention policy (On the Socioeconomic 2001 2001).

HIV/AIDS and Poverty

HIV/AIDS has both direct and indirect impacts on household income. The disease is extremely costly because it both increases unavoidable household expenditure and reduces household income due to diminished productivity, morbidity, and/or mortality (Salinas and Haacker 2006). Simultaneously, household poverty increases an individual's vulnerability to HIV/AIDS by increasing the risk of contracting the virus and by decreasing an individual's ability to deal with the consequences of infection (Haacker 2004). These situations, "…combine to create a vicious cycle of poverty and HIV/AIDS in which affected households are caught up" (Booysen 2004, 523). This "poverty trap" is extremely difficult to overcome and can have devastating effects on the households it overtakes. HIV/AIDS, therefore, is not only a cause of poverty, but also has a much stronger effect on already impoverished households, which are financially less likely to be able to cope with the illness and/or resulting death(s).

A number of studies have investigated the relationship between poverty and HIV/AIDS and attempted to determine the effects of HIV/AIDS on poverty. It is known, for example, that AIDS-related deaths cause a greater financial burden on the family than other deaths and that the epidemic has a tendency to increase the national income-dependency ratio (Epstein 2004). The exact magnitude of these changes, however, is not as clear and is a focus of a great deal of recent research, both about the epidemic overall and about its effects in specific regions and countries.

Haacker (2002) studied the impact of the change in labor force composition that results from HIV/AIDS on per capita income in southern Africa. Knowing that HIV/AIDS affects productivity and human capital, which in turn have a direct impact on per capita income, Haacker produced a theoretical framework with which the disease's effects on

productivity could be modeled and estimates could be produced. The model attempts to measure the extent to which death and illness have an adverse impact on productivity, the labor force growth rate, and the growth rate of GDP. Using a Cobb-Douglas production function, Haacker measures the labor supply in terms of efficiency (output per worker) while allowing for two different forms of human capital, education, and experience. Assuming prevalence and mortality rates are the same across skill categories in the labor force, the model predicts that a 1% prevalence rate in the workforce reduces total factor productivity by .5%. This decline in productivity eventually leads to a decline in the capital-labor ratio, which is reinforced by a fall in productivity and experience (the direct result of the disease). In turn, this causes per capita output to fall by 4-10%. Since per capita output and income are highly correlated, this produces a glum reality for countries with high HIV/AIDS prevalence rates.

A similar empirical study, Greener (2004), uses the Botswanan Household Income and Expenditure Survey (HIES) to estimate the impact of HIV/AIDS status on labor force variables. Treating HIV/AIDS as a mortality shock that affects household wage and income distributions, Greener simulates the effect of HIV/AIDS on members of the Botswanan population. The study finds that HIV/AIDS leads to an 8% decrease in the unemployment of unskilled workers, as skilled workers lose their lives to the disease. Simultaneously, the wages of skilled workers (who now represent a smaller proportion of the labor force) are found to increase by 12-17%. The overall population also suffers because a 1% HIV prevalence rate is found to reduce per capita income by 10% and drastically reduce the size of the labor force. While no increase in the level of national inequality is found, the income-dependency ratio increases by 20% from 5.4 to 6.4, indicating that on average every income earner will acquire one new dependent during the

next decade. Not surprisingly, this situation is exacerbated for the poorest households. Even more disturbing, "the analysis predicts that many small households will be wiped out by AIDS. Approximately 6.9 percent of households disappear altogether because all of the household members are infected" (176).

Booysen (2004) conducted a case study in one of the particularly HIV/AIDS infected provinces of South Africa, which has one of the highest regional prevalence rates in the world, focusing on the experience of infected households in terms of chronic poverty and income mobility. The longitudinal study surveyed both infected households and a control group of HIV/AIDS-free households in the Free State Province to assess whether HIV/AIDS-infected homes experience chronic poverty more frequently than non-infected households do. Booysen defines chronically poor as households whose average per capita household income was below R250 (approximately $40) over the three periods studied. Additionally, the term "transient poor" is used to classify households whose incomes place them on the poverty line but who are not classified as "poor" by national standards. The study finds that HIV-affected households experience chronic poverty significantly more than non-infected households (25% versus 10%) with a similar, but much smaller effect, for the classification of transient poor. Evidence was also found to suggest that HIV/AIDS-affected households are more income-mobile than unaffected households, indicating that,

> …not only conventional determinants of poverty (e.g. demographics, access to labor markets, and physical capital) but also HIV/AIDS-related determinants (e.g. mortality, morbidity, and the orphaned crisis) play a role in explaining why some households remain poor while other households are upwardly mobile and can escape poverty. (542)

Although the study was conducted over a sample that is representative of only a very specific population, the results are important for understanding how HIV/AIDS directly affects household poverty.

Finally and most recently, an IMF-funded project set out to determine the specific impact of HIV/AIDS on poverty and inequality. In the experiment, Salinas and Haacker (2006) used data from the Demographic and Health Surveys to simulate the impact of AIDS status on income in four sub-Saharan African countries with varying prevalence rates—Ghana (2.1%), Kenya (6.7%), Swaziland (31.4%), and Zambia (15.6%). Instead of using actual household data on HIV-status, the researchers randomly assigned status to individuals based on socioeconomic characteristics and national prevalence rates by category (e.g. sex, age, income, profession, urban v rural residence). It was determined that the large socioeconomic dimension of the AIDS crisis leads to underestimates of income and poverty measures when only household data is used. Nonetheless, the study found that in three of the four countries studied, the incidence of poverty and the increase in the poverty gap in AIDS-infected households was greater than would be predicted on the basis of decreases in average per capita income levels alone because of varying HIV prevalence levels and the differing size of the portion of the population at risk of contracting the virus in each country (Salinas and Haacker 2006). This study underscores the fact that decreases in per capita income levels may underestimate the true extent to which AIDS may be affecting household poverty levels. Although this study uses simulated HIV-status, it is the closest to the research at hand, as it uses the DHS data and seeks to explore poverty and inequality in relation to the HIV/AIDS pandemic in sub-Saharan Africa.

It is clear that poverty and HIV/AIDS are important areas of research. Many studies have produced significant results that have motivated the direction of this paper. While it is indubitable that there is a strong link between HIV/AIDS and poverty in sub-Saharan Africa, the intricate relationship between these variables, using individual-level data with actual HIV-status, has yet to be explicitly studied and discussed. Additionally, while many

studies have looked at the impact of HIV/AIDS on various economic and socioeconomic indicators, there has been little research on how measures of poverty affect the probability of an individual contracting the virus. The goal of this paper is to begin to understand the complexity of the relationship between HIV/AIDS and poverty and to shed light on the most vital aspects of their interplay.

Data Description

The data used for this study comes primarily from two sources-- the Demographic and Health Survey (DHS) and the United Nations Development Programme's Human Development Report (UNDP- HDR). Using both individual- and country-level data allows for both the microeconomic and macroeconomic implications of the HIV/AIDS pandemic, with respect to poverty and welfare, to be discerned.

Sponsored by the United States Agency for International Development (USAID), the DHS is a nationally representative survey that has been conducted in 75 countries since 1984 to assess worldwide health and nutrition patterns. The most recent phase of the survey included the collection of HIV-specific information for some countries, which allows this study to be an actual empirical study of the impact of HIV/AIDS on individuals, as opposed to previous studies that estimated the effects of the pandemic based on simulated HIV-status. Currently, there are eleven countries in sub-Saharan Africa whose most recent DHS surveys are publicly available with data on HIV-status. Each of these countries was included in the sample to generate as large of a sample as possible of the general sub-Saharan African population. The countries that this study uses are Burkina Faso(2003), Cameroon (2004), Ethiopia (2005), Ghana (2003), Kenya (2003), Lesotho (2004), Malawi (2004), Mali (2001), Senegal (2005), Tanzania (2003), and Zambia (2000/2001). The combined data from these samples consists of 65,202 observations.

The DHS surveys collect data on marriage, fertility, family planning, reproductive health, child health, and HIV/AIDS, and are conducted on both an individual and household-level. For the purpose of this study, the individual-level data will be used to establish the impact of number of different variables on individual HIV-status. The DHS data is collected and recorded in a standard way in order to facilitate cross-country

comparisons. The dataset includes both demographic and general health/nutrition information for each individual surveyed. Variables include background characteristics such as age, education, type of residence (urban v rural), access to resources (electricity, water, etc), and health information regarding nutrition, anemia, and most importantly HIV-status, among other things. The residential data, as well as variables about access to resources, provide non-income measures of well-being to be studied.

In order to assess the accuracy of the DHS data, once the data was cleaned and compiled into one large dataset, the prevalence of HIV/AIDS as reported by the UNDP, who obtains their statistics from UNAIDS, was compared to the HIV-positive percentage of individuals in the sample. With a correlation of .9953, it is clear that the DHS data provides an almost perfectly accurate sample that is truly representative of the population of interest. Figure 1 shows the comparison of reported and sampled prevalence rates in each of the eleven countries.

Although the DHS data provides myriad information about the individuals surveyed, it lacks a variable that can be used to assess monetary poverty. With the focus of this study being the relationship between HIV/AIDS and poverty, the DHS data does not provide everything necessary to attack the research question. Country-level indicators were therefore added to the dataset to provide general information about poverty, well-being, and inequality within countries. Statistics from the UNDP Human Development Report in 2004 are used to supplement the DHS data where it is lacking, i.e. income and social-welfare measures.

The inclusion of social indicators that provide insight into the well-being of individuals in a country allows a broader concept of poverty to be studied. The indicators that are most important for analysis and used as controls across countries are: Gross

Domestic Product (GDP) per capita, share of GDP held by poorest 20%, GDP per capita in poorest 20%, combined gross enrolment ratio for primary, secondary and tertiary schools, life expectancy, infant mortality, national literacy rate, female literacy rate, percentage of parliament seats held by women, the Human Development Index (HDI), and the Human Poverty Index (HPI). The HDI, "measures the average achievements in a country in three basic dimensions of human development: a long and healthy life, knowledge and a decent standard of living" (UNDP). It is weighted average of life expectancy, GDP per capita, and literacy rates that produce a value between 0 and 1 for each country, with 1 representing the zenith of development. The HPI, "measures human deprivation in the same aspects of human development as the HDI" (UNDP). Similar to the HDI, the HPI is a weighted average that accounts for the probability at birth of not living to age forty, the adult literacy rate, and the percentage of the population without access to water.

One important problem that complicates this study is the two-way causality between the main variables of interest, HIV prevalence and poverty. Because HIV/AIDS clearly affects a nation's ability to grow and develop, using only current GDP and poverty levels is insufficient for understanding the relationship between HIV/AIDS and poverty, as HIV/AIDS may be the cause of declining measures of welfare in today's society. In order to deal with this problem, some poverty measures from 1980, the approximate year of the recognition of the HIV/AIDS epidemic, have been added to the dataset so that the complexity of the relationship can be better understood. These variables are the 1980 Human Development Index and the 1980 $1/day poverty rate for each of the countries included in this study.

To enhance the study further, a few additional country-level indicators, not collected by the UNDP, have been included in the dataset to supplement the DHS and

UNDP data. The Gini coefficient, a measure of the level of wealth inequality within a nation, as published in the CIA World Factbook, has been included in order to assess the relationship between HIV/AIDS and national income inequality. The coefficient is a number between 0 and 100, with 0 representing perfect income equity and 100 representing perfect inequality. Additionally, two variables that account for the level of political freedom within a country have been included. Using data collected by Freedom House, an organization that works to promote free institutions globally, two variables have been added to the data. The first is a measure from 1-7 that indicates the level of civil liberties that a country affords its citizens. Similarly, the second variable is a measure of political rights within a nation that also takes a value from 1-7. For both variables, the lower the measure, the more "free" a society is considered to be. When the civil liberties and political rights variables are averaged, countries with a 1-2.5 rating are considered "free", while countries rating 3-5 are considered "partially free" and those rating 5.5-7 "not free".

Initial Analysis

A number of important characteristics about the sample, patterns within the data, and the relationship between the two social indicators of focus, HIV/AIDS and poverty, can be identified by a close initial look at the data using descriptive statistics. Understanding patterns within the data provide a better overall view of the portion of the sample that is of interest, HIV-positive individuals, and of the relationships between the other variables of importance. These patterns motivate the structure of the regression model that this study uses in its attempt to better understand the relationship between HIV/AIDS and poverty and inequality in sub-Saharan Africa.

Who are HIV-positive individuals and how do they differ from HIV-negative individuals? Are HIV-positive individuals more or less likely to have toilets and electricity in their place of residence? What is the relationship between HIV/AIDS prevalence rates and national school enrollment levels? How do country-level measures of welfare relate to prevalence rates? Is HIV/AIDS related to national gender equity? Each of these questions is important to answer before trying to tackle the larger question at hand— what is the correlation between HIV/AIDS and poverty and which aspects of poverty and inequality are most important in the determination of individual HIV-status.

Demographic Characteristics

The dataset includes 65,202 observations from 11 different countries and contains 4,477 observations of HIV-positive individuals, producing an overall prevalence rate of 6.86%. Country-level prevalence rates are: Burkina Faso- 2.01%; Cameroon- 6.77%; Ethiopia- 2.40%; Ghana- 2.61%; Kenya- 6.59%; Lesotho- 23.19%; Malawi- 12.54%; Mali- 1.66%; Senegal- .83%; Tanzania- 6.59%; and Zambia- 17.85%. As noted earlier, the

prevalence rates within the data are extremely close to the national prevalence rates published by the UNDP (see Figure 1).

One problem with the data, however, is that 76.3% of the total observations and 68.6% of the HIV-positive observations are male. The dataset did contain a variable for sample weight and even when weighted, the mean value for the male dummy variable did not change. Thus, unfortunately the data is heavily over-sampled for males. Fortunately, though, the dataset is adequately large so that some other important demographic characteristics about the HIV-infected population, in relation to those without the virus, can easily be observed despite the overwhelming number of males sampled (see Figure 2). For example, the average age of HIV-negative individuals is 28.19, which is found to be statistically insignificantly different from the average age of HIV-positive individuals, 28.14.

Looking at type of residence, upon first glance there does not appear to be a drastic difference between the residential locations of HIV-positive and HIV-negative individuals. In the HIV-negative population, 60.6% of individuals described their residence as rural while 59.5% of affected individuals described their homes similarly. Surprisingly, though, this difference was found to be statistically significant at the 1% level, indicating that in fact more HIV-positive individuals live in urban locations than their HIV-negative counterparts. These numbers, however, vary by country and some countries do appear to have a larger portion of rural HIV-positive individuals than HIV-negative individuals. For Example, Kenya, Lesotho, and Senegal all have higher proportions of HIV-positive rural residents than HIV-negative rural residents, as seen in Figure 3. Intuitively, one might think that HIV would be more prevalent in urban rather than rural areas and the majority of the data, the samples from 8 of the 11 countries studied, confirm this intuition. This pattern

has been supported by research on the diffusion of AIDS across Africa that has determined that the virus was mostly likely spread via truck routes and thus urban areas serve as the "nodes for spreading the infection" (Wood 1988, 268).

On the other hand, there does initially appear to be a considerable difference between the marital status of HIV-positive and HIV-negative individuals. While 54.3% percent of the HIV-negative population are married, only 47.2% of the affected population noted being in a contractual relationship. Although marital status is similar to the case of rural residence, where differences can be seen across countries, in only one country, Malawi, were more HIV-positive people than HIV-negative people married, and only by an extremely small differential (see Figure 4). Data on marital status was not collected in Tanzania and therefore does not appear in the graph.

Figure 5 shows one of the most fascinating results about the population being studied. There exists a strong positive relationship between HIV prevalence and years of education. Although this relationship does not hold across all countries, as shown in Figure 6, the pattern shown in figure 5 warrants attention, as it appears counter to the respected notion that income, education, and health are all positively related. There is a statistically significant difference between the average level of education of the HIV-negative population, 3.94 years, and the average level of education of the HIV-positive population, 5.47 years. The relationship can be better understood, however, by looking at the variance in years of education for rural versus urban residents. As just discussed, the prevalence of HIV/AIDS is generally greater in urban rather than rural areas. Similarly, the amount of education an individual receives is greater for urban than for rural residents. In the sample, rural residents had a mean level of education of 3.00 years while urban residents had a mean level of education of 5.26 years, a statistically significant difference. Thus, it makes

sense that the HIV-positive portion of the sample has a higher overall level of education than the HIV-negative portion, as more HIV-positive individuals are urban rather than rural residents. This relationship will be explored further with the country-level indicators as well as through the regression model.

One final demographic variable worth mention is whether an individual engaged in premarital sex. Surprisingly, only a little more than half the population admitted engaging in premarital sex while a little less than half were either still not sexually active or had waited until marriage to engage in sexual intercourse. There is, however, a statistically significant difference between the percentage of HIV-negative (51.6%) and HIV-positive (63.41%) individuals who noted engaging in premarital sex. This relationship is intuitive as people who engage in premarital sex often have multiple partners and thus are at a higher risk for contracting the virus.

Individual Access to Resources

Because the dataset lacks information on income, wealth, and employment, individual access to resources can serve as a proxy for individual welfare. For the purposes of this study, poverty is measured by both individual and national indicators and this section seeks to determine the relationship, at the most basic level, between access to resources, such as toilets and electricity, and HIV prevalence. An individual is considered to have a toilet if s/he has a flushable toilet, while a pit latrine is not considered a toilet, i.e. a toilet must have running water. Presence of electricity is merely defined as whether individual has electricity in his/her home.

In the sample, 11.9% of individuals noted having a toilet with running water in their home, while only 7.0% of HIV-positive individuals responded similarly. The percentage of HIV-positive individuals with a toilet is statistically significantly different

from the 12.2% of HIV-negative individuals with a flushable toilet. Excluding Tanzania from analysis, due to difficulties with interpretation of the recording of this variable in the data, there appears to be a vague negative relationship between the number of individuals with a toilet and HIV prevalence rates across the countries in the sample (see Figure 7). A Person's chi-squared test confirms this relationship by showing that HIV-status and access to toilets are not independent variables and thus are related in some way (see Figure 8).

Examining figure 7 and noting the relative weakness of the relationship, sparks the question of who, in each country, has a toilet. Do more HIV-positive or HIV-negative individuals have access to a toilet with running water? Breaking the data down by country and by HIV-status, there appears to be no certain answer to this question. As seen in Figure 9, in 5 of the countries—Burkina Faso, Cameroon, Ethiopia, Mali, and Zambia—more HIV-positive individuals have toilets while in the other 5 countries—Ghana, Kenya, Lesotho, Malawi, and Senegal—more HIV-negative individuals have toilets. Thus, the relationship between access to a toilet with running water and HIV-status remains ambiguous.

A similar relationship can be observed between access to electricity and HIV-status, as seen in Figure 10. While 25.19% of the HIV-negative sample has electricity in their household, only 18.9% of HIV-positive individuals in the sample noted having access to electricity, a statistically significant difference at the 1% level. Examining the relationship between electricity and HIV-status when the data is broken down by country produces somewhat ambiguous results similar to that found between access to a toilet with running water and HIV prevalence. In four of the ten countries (there was no data collected on electricity for individuals in Tanzania) HIV-positive individuals had electricity more

frequently than HIV-negative individuals while the reverse was the case in the remaining six countries (see Figure 11).

The negative relationship that appears to exist between being HIV-positive and having access to a toilet (see Figure 7) and between being HIV-positive and having access to electricity (see Figure 10) make sense as the relationship between access to a toilet and access to electricity is positive for all countries in the sample (see Figure 12). A Pearson's chi-squared test confirms that access to a toilet and access to electricity are a pair of variables that are not independent (see Figure 13). This relationship is sensible since people who can afford access to one amenity are most likely the people who will be able to access the other resource.

Because of the varying results produced by the data during this primary analysis, it remains unclear whether personal welfare, as measured by access to a toilet and electricity, is, in fact, related to HIV-status. This leaves us with the question of whether a relationship exists and, if one does, what the extent and direction of this relationship is. These questions will be addressed through the regression models, which will hopefully provide insight into the role that personal welfare plays in the probability of being HIV-positive.

Country-Level Patterns

An initial look at the individual data provided no concrete answers to the question of whether individual factors are significantly related to HIV/AIDS in sub-Saharan Africa. While some patterns were observed, the extent to which individual poverty, as measured by access to resources, is related to HIV-status remains unclear. Therefore, exploring the research question further requires a look at some other indicators that will hopefully provide more concrete information about the relationship between HIV-status and measures of poverty and inequality. Because poverty encompasses more than just income

and wealth, an analysis of national poverty requires that one look at indicators from three broad subcategories—income and poverty statistics, development and education indices, and measures of social justice.

Income and Poverty Statistics

As mentioned earlier, it is vital to not only examine current income and poverty statistics but to look at these measures before they were subject to the impact of the HIV/AIDS pandemic in an effort to reduce problems of two-way causality. The $1/day poverty rate from 1980 was available for nine of the eleven countries in the sample. Plotting this variable against HIV prevalence, as seen in Figure 14, shows that aside from two outliers, Ghana and Senegal, there is a fairly strong negative relationship with HIV prevalence. Thus, contrary to what one might initially think, it appears that countries with higher poverty rates in 1980 face lower HIV prevalence rates today. It does not, therefore, appear upon first glance to be the case that poverty is fueling the spread of HIV/AIDS in sub-Saharan Africa. Looking at more recent data on income and poverty, one other interesting and surprising pattern can be observed. Figure 15 shows there to be no distinct relationship between GDP per capita and HIV prevalence for the countries in this sample.

It is important, however, to look not only at income and poverty as measured by poverty rates and GDP per capita but to also consider income inequality within countries. Two measures of inequality that serve to give some sense of how equitable a society is are GDP per capita for the poorest 20% of the population and Gini coefficient. Figure 16 shows a weak negative relationship between GDP per capita for the poorest 20% of the population and HIV prevalence. This indicates that in countries where the poorest quintile of people have an extremely low per capita income, in Lesotho for example, HIV prevalence tends to be extremely high. Looking at the Gini coefficient, an extremely strong

relationship can be observed between the index and HIV prevalence (see Figure 17). This relationship suggests that countries with high levels of inequality are plagued by high levels of HIV/AIDS as well. Lesotho and Malawi serve as the prime examples of this relationship with Ethiopia representing the opposite extreme, low HIV prevalence and a reasonable level of equality.

Development and Educational Indices

Looking back again to the year 1980, a relationship of distinct importance can be observed. Although the Human Development Index (HDI) from 1980 was only available for eight of the eleven countries in the sample, there appears to be a reasonably strong relationship between the index and HIV prevalence in the countries for which the statistics were available (see figure 18). This relationship is striking because it indicates that countries that were more developed in 1980, experience higher rates of HIV/AIDS today, which seems counterintuitive. One usually associates infectious diseases, such as HIV/AIDS, to underdeveloped countries, but this relationship appears to indicate just the opposite—that countries that face high rates of HIV/AIDS were actually more developed a quarter of a century ago than some countries that today have relatively low incidences of HIV/AIDS.

Given the distinct relationship between the HIV prevalence rate and the 1980 HDI, it is surprising that the relationship between the current HDI and HIV prevalence is not only weaker but opposite in direction. Figure 19 shows a weak positive relationship between the HDI and HIV prevalence rates, indicating that today, countries with a high incidence of HIV/AIDS are less developed than those with lower infection counts. What cannot be determined, however, is the extent to which the HIV/AIDS pandemic has inhibited the ability of affected nations to develop at a pace similar to that of their less

affected counterparts. A similar, weak, but positive, relationship can be observed between the Human Poverty Index (HPI) and HIV prevalence rates (see figure 20). Although this relationship appears positive, the correlation between these variables is -.13 indicating that this relationship is actually weakly negative. The deceptiveness of Figure 20 could be due to the fact that there are three major outliers—Ethiopia, Burkina Faso, and Mali—where poverty rates are extremely high while HIV prevalence is extremely low. This disparity, however, warrants more attention and therefore the relationship will be examined more closely through the regression models.

Development can also be measured by the infant mortality rate and average life expectancy. There appears, however, to be no identifiable relationship between infant mortality and HIV prevalence (see figure 21). On the other hand, the relationship between HIV prevalence and life expectancy is one of the strongest observed thus far (see figure 22). There exists a strong, negative relationship between these variables, which is exactly what one would expect, as countries with high rates of HIV/AIDS will obviously face lower life expectancies as a result of the pandemic. Thus, the strong correlation of -.89 between these variables is a result of the fact that HIV prevalence is fueling the decline in life expectancies in the countries in which the disease is rapidly claiming lives.

Measures of education provide additional information about the level of development within a nation and are therefore more important to analyze. The combined level of gross enrollment in primary, secondary, and tertiary school provides a general statistic on the number of people being educated over the total number of people who are of the age to be enrolled in such programs. Figure 23 shows an extremely strong, positive relationship between gross educational enrollment and HIV prevalence. This result is striking as it is incredibly counterintuitive that countries with higher levels of education,

which can be taken as a measure of higher levels of development, also face a higher incidence of HIV/AIDS. This result matches what was observed in the individual-level data, that HIV-positive individuals tend to have more years of education than HIV-negative individuals. As expected, an almost identical pattern can be observed for the relationship between a nation's literacy rate and incidence of HIV/AIDS, reaffirming this unexpected result (see Figure 24).

Measures of Social Justice

Social justice can encompass any number of measures that capture the distribution of advantages and disadvantages within a society. For the purposes of this study, political sovereignty and gender equity will be used to examine the relationship between HIV/AIDS and national social justice in order to determine weather political openness plays a role in the spread of the pandemic.

The measures of civil liberties and political rights, as determined by Freedom House, provide differing results. Whereas there appears to be almost no relationship between the level of civil liberties granted to citizens in a country and HIV prevalence (see Figure 25), a vague negative relationship can be observed between the amount of political rights granted to citizens and HIV prevalence (see Figure 26). This relationship indicates that relatively "freer" societies, those who score a low number for the measure of political freedom, are more likely to face higher prevalence rates. One would think that these measures would have a similar relationship to HIV prevalence, but in fact, they have correlations with opposite signs. Both correlations are extremely weak, .09 for civil liberties and -.07 for political rights, but the opposite sign is disconcerting. How do two measures that seek to explore political freedoms in the broadest way produce differing

outcomes with respect to the prevalence of HIV/AIDS. The regression model will hopefully shed some light on the role that these variables play in relation to the pandemic.

Finally, we explore the relationship between national gender equity and HIV prevalence. The female literacy rate and the percentage of seats in parliament held by women are two indicators that are used to measure national gender equity. Almost analogous to the relationship between individual years of education, national education rates, and literacy rates to HIV prevalence, the female literacy rate has a strong positive relationship to HIV prevalence (see Figure 27). This one again confirms the striking result that more educated countries tend to have higher infection rates. Similarly, but to a lesser extent, the percentage of seats in parliament held by women appears to be positively related to HIV prevalence rates (see Figure 28). Although Senegal and Tanzania are outliers in the distribution, there does seem to be some indication that societies that are more equitable towards women tend to experience more cases of HIV/AIDS. This may be because as women are granted an increasing number of rights in society, they become more sexually active and thus may be at an increased risk for contracting the virus.

Regression Analysis

After looking closely at the data and obtaining a basic understanding of the general patterns within, regression analysis is useful at providing a closer look at the details of the complex relationship between HIV/AIDS and poverty. Regression models were therefore developed in order to examine the exact effect that each measure has on the probability of an individual being HIV-positive, while controlling for other factors influencing HIV-status. Two main models were used to look at both individual and national poverty indicators in order to determine which measures play the largest role in the determination of individual HIV-status. The first model looks specifically at individual factors while controlling for country-specific characteristics. Similarly, the second model examines the effect of national measures of poverty while controlling for characteristics of specific individuals.

The data is incredibly rich, however, and only a select number of variables could be included in the regression models in order to avoid problems of multicollinearity. As can been seen in Figure 29, a number of the variables in the dataset are very highly correlated and thus it is important to determine which measures to keep in the model and which to omit but account for using closely related variables. Conventionally, variables that have correlations of .8 or greater are considered to be too closely related to both be included in a model. Because of the immense number of variables included in this study, however, this cutoff mark was widened to .75 for some pairs of variables. For example, the combined gross enrollment ratio for primary, secondary, and tertiary schools, the overall literacy rate, and the female literacy rate are all highly correlated variables with correlations of greater than .87 for each pair of variables. It was determined, therefore, to include the literacy rate in the regression models rather than either of the other variables as it is the broadest

measure of education of the three, since it accounts for both genders and individuals who can read but may not have ever been formally educated.

Similarly, the Human Development Index was found to be extremely highly correlated with the 1980 HDI, the HPI, the literacy rate, the 1980 $1/day poverty rate, and GDP per capita. It seemed to be more important to include some of the variables that are highly correlated with the HDI in the regression models, rather than the HDI itself, as these measures would more or less pick up the effects of the HDI while providing information about more specific measures of poverty. The variables chosen to be included are the HPI, GDP per capita, and the 1980 poverty rate, which serves as an extremely important control for pre-HIV crisis conditions in each country. The 1980 HDI was not included in the model since this measure was only available for 8 of the 11 countries in the study and was found to be highly correlated with the literacy rate, which was already determined to be an important variable to include in the model.

Because of the vitality of including the 1980 poverty rate as a control variable, the variable for political rights within a country was omitted. When both variables were included, the statistical package automatically dropped one of the variables noting a problem of collinearity. This was somewhat surprising since the correlation between the two variables was only .742. Fortunately, however, the -.835 correlation between the 1980 poverty rate and GDP per capita did not appear to pose the same problem. This allowed for inclusion of both variables in the models, which was important since GDP per capita was used as the main independent variable in the country-level regression model and the 1980 poverty level as used as a vital control variable.

The measure for civil liberties was included in the model as it was found to only be highly correlated with the measure of political rights, which was decidedly omitted from

the model because of its collinearity with the 1980 poverty level. The civil liberties variable, which is highly correlated with the measure of political rights but surprisingly only slightly correlated with the 1980 poverty level, was important to include because it allows the impact of a nation's political climate and amount of freedoms within a society to be measured and its impact to be assessed. Similarly, the variable that measures the percentage of women in parliament was included to control for differences in women's rights across countries and to understand how these differences affect HIV prevalence. This measure was particularly important in light of the fact that the female literacy rate was dropped from the model due to its strong correlation with the overall literacy rate.

Regression Models and Findings

Once all of the variables had been examined and it was determined which variables to include and which to omit, the two main regression models were formulated. The model used to determine the impact of individual characteristics on HIV-status took the initial form:

Regression 1a: $P(\text{HIV-positive})_i = \beta_0 + \beta_1(\text{toilet})_i + \beta_2(\text{electricity})_i + \beta_3(\text{eduyrs})_i + \beta_4(\text{male})_i + \beta_5(\text{rural})_i + \beta_6(\text{age})_i + \beta_7(\text{sexbe4mar})_i + \varepsilon$

Regression 1a produced some interesting results (see figure 30) but after examining the model, it was determined that the model needed to be modified in order to control for the different HIV prevalence rates in each of the countries. Regression 1a was therefore amended to include dummy variables for each of the countries in the sample. For example, a resident of Cameroon would be coded as "1" for the variable "cam" and "0" for each of the other country dummy variables. The regression took on the new form:

Regression 1b: $P(\text{HIV-positive})_i = \beta_0 + \beta_1(\text{toilet})_i + \beta_2(\text{electricity})_i + \beta_3(\text{eduyrs})_i + \beta_4(\text{male})_i + \beta_5(\text{rural})_i + \beta_6(\text{age})_i + \beta_7(\text{sexbe4mar})_i + \beta_8(\text{burk})_i + \beta_9(\text{cam})_i + \beta_{10}(\text{ethi})_i + \beta_{11}(\text{ghan})_i + \beta_{12}(\text{kenya})_i + \beta_{13}(\text{leso})_i + \beta_{13}(\text{malawi}) + \beta_{14}(\text{mali})_i + \beta_{15}(\text{sen})_i + \varepsilon$

Because no toilet or electricity data was collected in Tanzania, the country dummy for Tanzania was not included in the sample. Zambia was also omitted from the model due to the fact that the country dummy variables are bucket variables and thus one must be omitted in order for the model to produce results. The model's estimates (see Figure 31), therefore represent the country fixed effects of each individual variable as compared to Zambia.

In order to determine if regression 1b produced coefficients that were applicable to all countries in the sample, a Chow test was performed. Yielding an F-statistic of 20,257.72 it was determined that the null hypothesis, that the coefficients were the same across all subsets of the population, could be rejected. Regression 1b, therefore, did not yield estimates that are useful to analyze, as it was determined that the coefficients were not proper estimates for each of the countries in the sample. The model was then further modified and the original regression, regression 1a was re-estimated for each country in the sample separately. For example, for Burkina Faso, the following model was estimated:

Regression 1c: $P(\text{HIV-positive})_i = \beta_0 + \beta_1(\text{toilet})_i + \beta_2(\text{electricity})_i + \beta_3(\text{eduyrs})_i + \beta_4(\text{male})_i + \beta_5(\text{rural})_i + \beta_6(\text{age})_i + \beta_7(\text{sexbe4mar})_i + \varepsilon$ if burk= = 1

Regression 1c was estimated for each of the ten countries of interest and the estimates produced by this model provide insight into the effects of each of the individual variables on the probability of being HIV-positive in that country (see figures 32-41).

The regressions for each of the countries individually produced some interesting results. There were two variables that proved statistically insignificant in a majority of countries in the sample and there were two countries, Kenya (see figure 36) and Zambia (see figure 41), where none of the individual characteristics were found to be statistically significant in the determination individual HIV-status. While an additional year of

education was estimated to have a .7% increase in the probability of being HIV-positive in the unconstrained model, regression 1a, it was found to only be statistically significant in Cameroon, actually increasing an individual's probability of being HIV-positive by a mere .3%. Similarly, having a toilet proved to only be strongly statistically significant in Malawi, lowering an individuals probability of being HIV-positive by 6.8%, and was only weakly statistically significant (at the 10% level) in Burkina Faso, but having an opposite effect of increasing an individuals probability of being HIV-positive by 2.7%. An almost identical impact was observed for electricity. In Ethiopia, electricity was found to be highly statistically significant, making an individual 2.5% more likely to be HIV-positive. On the contrary, in Mali, electricity was found to be statistically significant at the 5% level, resulting in 1.3% decrease in an individual's probability of being HIV-positive.

While the male dummy variable was found to be highly statistically significant in affecting individual HIV-status in a number of countries, because of the overwhelming proportion of males in the sample, these estimates must be interpreted with caution. In every country where the variable was found to be significant-- Cameroon, Ethiopia, Ghana, and Lesotho-- being male was estimated to decrease an individual's probability of being HIV-positive by 1-4%. Rural residence was estimated to have a comparable effect on HIV-status. In Burkina Faso, Cameroon, Ethiopia, and Mali, rural individuals were estimated to be 1-3% less likely to be HIV-positive than their urban counterparts, a relationship that was expected after the strong negative relationship between HIV-status and rural residence was observed during the initial analysis.

Both the completely unconstrained model, regression 1a, and the country fixed effects model, regression 1b, found no statistically significant relationship between an individuals age and their probability of being HIV-positive. When broken down by

country, however, this variable was highly statistically significant in two countries and a weakly statistically significant in another three. The coefficients on each of these variables were extremely small indicating that even when age is found to have an effect on HIV-status, the impact is extremely small, in all cases, producing less than a 1% change. Nonetheless, age was seen to increase the probability of being HIV-positive in Burkina Faso, Cameroon, Ethiopia, and Ghana while only being found to decrease this probability in Senegal. The positive relationship found in these four countries can easily be understood because as an individual ages they are likely to have an increased number of sexual partners and thus be at a higher risk for contracting HIV.

Finally, these models show that pre-martial sex plays an important role in the determination of individual HIV-status, both in the unconstrained model, the country fixed effects model, and in four individual country models. In all cases, an individual who engages in premarital sex is more likely to be HIV-positive than an individual who refrains from such action. The largest impact of pre-martial sex was estimated in Cameroon, where an individual who has sexual intercourse before marriage was estimated to be 4.4% more likely to be HIV-positive than an individual who waits until marriage to engage in sexual intercourse. A similar effect, but to a decreased magnitude of approximately 1.7-1.8%, was observed in Burkina Faso, Ethiopia, and Ghana. In each country where pre-martial sex was found to be statistically significant, this relationship held at the 1% level, making these numbers extremely noteworthy.

Taking the analysis in a different direction, it was necessary to look at how the country-level indicators that were added to the DHS data affect the determination of individual HIV-status. Initially, the following model was estimated in order to address this question:

Regression 2a: $P(\text{HIV-positive})_i = \beta_0 + \beta_1(\text{gdpcap})_i + \beta_2(\text{HPI})_i + \beta_3(\text{ginicoeff})_i + \beta_4(\text{litrate})_i + \beta_5(\text{parl})_i + \beta_6(\text{civlib})_i + \beta_7(\text{eightypov})_i + \varepsilon$

This model is extremely basic, however, and although it does produce many highly statistically significant results (see Figure 42), it is important to strengthen the model by incorporating individual characteristics in order to control for cross-country differences. Regression 2a was re-worked into the following form:

Regression 2b: $P(\text{HIV-positive})_i = \beta_0 + \beta_1(\text{gdpcap})_i + \beta_2(\text{HPI})_i + \beta_3(\text{ginicoeff})_i + \beta_4(\text{litrate})_i + \beta_5(\text{parl})_i + \beta_6(\text{civlib})_i + \beta_7(\text{eightypov})_i + \beta_8(\text{toilet})_i + \beta_9(\text{electricity})_i + \beta_{10}(\text{eduyrs})_i + \beta_{11}(\text{male})_i + \beta_{12}(\text{rural})_i + \beta_{13}(\text{age})_i + \beta_{14}(\text{sexbe4mar})_i + \varepsilon$

The estimates produced by this model (see figure 43) provide some fascinating results that warrant extensive discussion and provide the basis for important policy recommendations. Looking at the model as a whole, GDP per capita, the Gini coefficient, the literacy rate, the measure of civil liberties, and electricity all have surprising coefficients. Each of these variables seems to be indicating that poverty may not be as major a factor in the determination of HIV-status as previously thought. On the contrary, they seem to be indicating that individuals living in richer countries with higher levels of inequality are actually *more* likely to be HIV-positive than individuals living in more equitable societies with lower per capita incomes.

The regression model estimates that a 1% increase in GDP per capita increases an individual residing in that country's probability of being HIV-positive by 17.5%, with statistical significance at the 1% level. This result was drastically different than what one would expect and thus warrants asking the question of weather the result would be the same if the variable was changed to GDP per capita for the poorest quintile of each country's population. In order to address this concern, regression 2b was re-estimated (see Figure 44) using the variable for GDP per capita for the poorest 20% of the population

rather than GDP per capita across all individuals. The coefficient on the variable of interest had the sign we expected to see, that an increase in GDP per capita for the poorest 20% percent decreases an individual's probability of being HIV-positive, but the coefficient lacked statistical significance. Thus, although statistically insignificant, the sign on the coefficient for this variable alerts one to the fact that efforts to curtail HIV/AIDS through increases in income should be focused specifically on the poorest individuals rather than on increases for the population as a whole.

Similar to GDP per capita, a one-unit increase in the Gini coefficient, or a one-unit increase in inequality, decreases an individual's probability of being HIV-positive by 3.3%. Enhancing these shocking results is the estimation that a 1% increase in the national literacy rate of a country increases a citizen's probability of being HIV-positive by 1.6%. Additionally, the model indicates that an individual with electricity is in fact 1% more likely to be HIV-positive than an individual without electricity.

By and large, the coefficient with the greatest magnitude that is statistically significant in the model is that on the measure of civil liberties within a country. As noted earlier, this index is a measure from 1-7 based on the number of freedoms granted to citizens within a society with 1 representing "free" societies. The model predicts that a one-unit increase in this measure, such as a change from 4 to 5, indicating a decrease in the number of civil liberties granted to citizens, actually decreases an individual's probability of being HIV-positive by 21.6%. While this indicator may not be a measure of poverty, it certainly has important political implications. Individuals residing in "less free" countries are found to be significantly less likely to be HIV-positive, a result that is obviously not what one would expect, or hope, to find. This result may, unfortunately, encourage dictatorships and limited political freedoms within a country as it finds the granting of a

reduced number of civil liberties to significantly decrease an individual's probability of being HIV-positive. This result should not discourage the processes of democratization, but rather note that it will not be beneficial at reducing HIV prevalence rates within a nation.

More in tune with what one would expect the model to predict, that poverty does in fact play a positive and significant role in the determination of individual HIV-status, are the estimates for the effect of the HPI and the presence of a toilet in an individual's place of residence. The model estimates that a change from a country with no deprivation (i.e. a nation whose HPI=0) to a country with absolute deprivation and extreme poverty (a nation whose HPI=1), causes a 3.2% increase in an individual in that country's probability of being HIV-positive. While obviously no country is going to drastically change from one that has no poverty to one with extreme destitution, this result alerts one to the fact that this measure of relative deprivation can affect how susceptible an individual is to contracting the virus. The regression also predicts that individuals with a toilet are 1% less likely than their counterparts without a toilet with running water in their residence to be HIV-positive, a highly statistically significant result.

Despite the fact that the 1980 $1/day poverty rate was mainly included in the model as a control variable, the large coefficient on this variable warrants discussion. The coefficient indicates that countries with a 1% higher poverty rate in 1980, today are home to citizens who are 54.3% more likely to be HIV-positive than relatively richer countries a quarter of a century ago. Thus, while the model may indicate that currently richer countries experience higher prevalence rates, it appears that poorer countries in 1980 face significantly higher prevalence rates today than countries that were relatively richer in 1980. This is counter to what the initial analysis had indicated, but controlling for

measures of poverty within a country today drastically changed the observed relationship between these variables. One may loosely conclude from this that while HIV/AIDS may not be as highly correlated with measures of poverty today as one might initially predict, the current crises facing sub-Saharan Africa may be worse today because of extreme poverty in pockets of the region at the time of the onset of pandemic in 1980.

Finally, similar to what was concluded from regression 1c, regression 2b predicts rural residents and males to be less likely to be HIV-positive by .5% and .9%, respectively. Additionally, as expected, the model finds pre-marital sex to be a significant factor in the determination of individual HIV-status, such that individuals who engage in premarital sex are .4% more likely to be HIV-positive. While this coefficient may not be large in magnitude, its relative statistical strength emphasizes its importance and indicates that increased safe sex education may potentially be beneficial in curbing the spread of HIV/AIDS.

Policy Implications

In order to better understand how to direct policy initiatives to combat the spread of HIV/AIDS in sub-Saharan Africa using the findings of this study, it is important to determine the relative importance of the three different groups of variables assessed by the regression models. That is, it is necessary to ask which group of variables-- individual factors, country-level indicators, or the country dummy variables-- plays the largest role in the determination of individual HIV-status. This question requires that the various models developed in this paper be compared using the chi-squared test statistic to analyze the incremental value added by each group of variables to the main regressions. The chi-squared statistic is computed using the log-likelihoods of a constrained and unconstrained model using the following formula:

X^2=-2(LogLikelihood$_{constrained}$ – LogLikelihood$_{unconstrained}$).

The value obtained from this formula can then be compared to the value obtained from computing the statistic from two other models. The models being compared are usually two variations of the same model where one set of variables is used in the constrained model and a second set added to the unconstrained model with the reverse use of the sets of variables in the second pair of regressions. The pair of regressions that yields the higher value indicates that the set of variables added to the unconstrained model has a more significant effect on the dependent variable than the set of variables added the unconstrained model in the pair of regressions with the lower chi-squared.

To begin this analysis, a comparison of the incremental value added by individual characteristics versus the value added to the model by country dummy variables is necessary. The chi-squared yielded by a constrained model with only individual characteristics and an unconstrained model with individual characteristics and country dummy variables is compared to the chi-squared yielded by a constrained model including only country dummy variables and an unconstrained model with both country dummy variables and individual characteristics. The first pair of regressions, regression 1a and 1b, were previously estimated and the output from these regressions yielded a X^2=2682.61 (see Figure 45). In order to compare the second set of regressions, a new regression, estimating just the impact of country of residence on individual HIV-status, needed to be created:

Regression 3: $P(\text{HIV-positive})_i = \beta_0 + \beta_1(burk)_i + \beta_2(cam)_i + \beta_3(ethi)_i + B_4(ghan)_i + \beta_5(kenya)_i + \beta_6(leso)_i + \beta_7(malawi) + \beta_8(mali)_i + \beta_9(sen)_i + \varepsilon$

The results of this regression (see Figure 46) were then compared to the results of regression 1b, yielding a X^2=97.108. The relative strength of the chi-squared that was computed for the model where country dummy variables were added to the unconstrained

regression, indicate that country dummy variables are more jointly significant in the determination of individual HIV-status than the joint significance of individual factors. In other words, an individual's country of residence plays a larger role in the determination of an individual's probability of being HIV-positive than do individual characteristic themselves. With this finding in mind, it is necessary to compare the joint significance of individual characteristics to the incremental value added to a regression model estimating the probability of being HIV-positive by country characteristics.

To analyze the incremental value added by individual characteristics versus the value added by country characteristics, a constrained model with only individual characteristics and a unconstrained model with individual and country characteristics must be compared to a constrained model with only country characteristics and an unconstrained model with both country and individual characteristics. The first pair of regressions is the initial regression, 1a, with just individual indicators (the regression was re-estimated using only the observations for which all country-level indicators were available, see Figure 47) and the final regression, regression 2, which contains variables for both individual and country characteristics. These regressions yield a X^2=2397.488 (see Figure 48). The other set of regressions, the regression containing only country characteristics, regression 2a, and the model containing country characteristics and individual characteristics, regression 2b, yield a X^2=5327.32, a value much greater than the chi-squared that resulted from the addition of country-level characteristics to the individual model. It can therefore be concluded that individual characteristics play a more significant role in the determination of HIV-status than country characteristics. This is not to say that country characteristics are unimportant but rather to note the heightened importance of individual factors in the determination of individual HIV-status.

It is now clear that an individual's country of residence plays a more important role in the determination of HIV-status than individual characteristics and that individual characteristics play a greater role than country characteristics. So, how should policy be directed in light of these findings? Clearly, individual countries must focus on the specific problems within their countries, as country of residence was determined to have the largest impact on the determination of HIV-status. The output produced by the country-constrained regressions (regressions $1c_1$-$1c_{10}$, see Figures 34-43) might be useful in determining the direction of policy for individual countries. For example, it was determined that in Mali, electricity was a statistically significant factor reducing an individual's probability of being HIV-positive by 1.3%. Similarly, in Malawi, individuals with toilets were 6.8% less likely to be HIV-positive than those without toilets. The Malian and Malawian governments, therefore, might wish to make an effort to increase access to electricity and toilets, respectively, for the poorest individuals in the country, in an effort to curtail growing HIV prevalence rates. Because of the relatively small samples sizes for each country, future research may seek to re-examine the relationships determined by these models and to estimate the regressions for a larger number of countries and across a larger number of observations, in order to obtain results that could better direct individual country policy in the future.

On a regional level, however, a lot can be gained from the regression models developed in this paper. Since individual factors play a large role in the determination of HIV-status, using the results of regression 2b, we see that access to a toilet is a statistically significant factor in the determination of HIV-status. Increasing the number of citizens with toilets could begin to help stop the rapid spread of the virus. Combined with increasing education about the risks associated with sexual activity and encouraging

individuals to engage in sexual intercourse with fewer partners are also policies that might reduce HIV prevalence rates, as pre-marital sex was found to be a statistically significant factor in the determination of individual HIV-status.

Although country characteristics were found to be the least jointly significant group of variables in explaining HIV-status, these variables are still jointly statistically significant and do play an important role in the determination of individual HIV-status and thus cannot be completely overlooked. Because of the positive coefficient on GDP per capita, it is clear that efforts to increase GDP per capita will most likely not be helpful in fighting the spread of AIDS. What this underscores, however, is the importance of working with the poorest individuals in the country to improve their welfare, therefore decreasing the Human Poverty Index, which in turn will hopefully be useful in reducing the number of individuals who are at a high risk for contracting HIV.

What can be gained from the analysis contained in this paper is not that poverty is not an important factor in the determination of HIV-status, but rather that certain measures of poverty play a more significant role in explaining HIV-status than others. Increasing the number of households with flushable toilets and decreasing the relative levels of deprivation within a nation have been shown to be measures that, if incorporated into future policy, possess the potential to significantly affect the spread of HIV/AIDS throughout the region. The individual welfare of the poorest individuals in sub-Saharan Africa must be the focus of future policy initiatives, in light of the finding that individual characteristics play a large role in the determination of HIV-status, if there is any hope of fighting the pandemic that annually claims millions of lives.

Conclusion

Twenty-four million Africans are currently living with the Human Immunodeficiency Virus. It is estimated that 3 million individuals on the continent contracted the virus during 2005. In some sub-Saharan African countries, one in every four individuals is HIV-positive. These numbers are too severe to be ignored and the impending consequences of the extreme number of individuals and households both directly and indirectly affected by HIV/AIDS poses a serious threat to the future of economic and social development on the continent. Determining the causes and factors involved in the determination of individual HIV-status is necessary in order for policy to be effective at combating the disastrous effects of the pandemic and ensuring the health of the continent's youngest generation.

This paper investigates the impact of individual and country-level measures of poverty on the determination of individual HIV-status in sub-Saharan Africa, the region plagued by the highest HIV rates and most devastating levels of poverty worldwide. Using individual-level data from eleven sub-Saharan African countries, as collected by the Demographic and Health Survey, linear probability models are estimated in an effort to determine which measures of poverty play the most significant role in the determination of HIV-status and thus play the most significant role in the determination of national prevalence rates. The study finds individual country of residence to be the most important factor influencing the probability of an individual contracting the virus and finds individual characteristics, such as access to resources, type of residence, and engagement in pre-marital sex, to be jointly statistically significant in determining an individual's likelihood of becoming part of the shocking statistics about HIV/AIDS in the region.

The fact that individual characteristics are found to be more important than national measures of poverty alerts policymakers to the extreme importance of increasing the welfare of the regions poorest individuals. The regression models developed in this paper find having a toilet with running water to be a statistically significant factor decreasing an individual's probability of being HIV-positive by 1.2%. While the impact of access to resources, specifically having a flushable toilet and electricity in an individual's household, varies across countries, as shown by the country-constrained regression models, individual factors are nonetheless found to be jointly significant in influencing an individual's HIV-status.

Country characteristics are found to be the least important group of variables affecting HIV-status, however, they are nevertheless vital to acknowledge if policy is to be successful at reducing the devastating effects of HIV/AIDS in sub-Saharan Africa. Despite the surprising coefficients on a number of important variables—GDP per capita, the Gini coefficient, and the literacy rate—the statistical significance of these variables indicate that poverty reduction must be focused on more than national income levels and overall equity within a country. Rather, they must be aimed at decreasing the number of impoverished individuals and providing poor individuals with access to the resources that they need to bring themselves out of poverty. Decreasing the Human Poverty Index is shown to be a statistically significant way to reduce an individual in that country's probability of being HIV-positive. Focusing on the welfare of a nation's poorest individuals, rather than on the population as a whole, is essential to effective poverty-reduction strategy aimed at reducing the prevalence of HIV/AIDS throughout sub-Saharan Africa.

It was previously determined that, "steady progress in reducing poverty is still the long-term and sustainable solution to the health crisis in the developing world" (On the

Socioeconomic 2001, 619). While this study finds GDP per capita and literacy to be ineffective at reducing HIV prevalence rates, it finds reductions in the Human Poverty Index and increased access to flushable toilets to be significant in the reduction of an individual's probability of being HIV-positive. Future research must look more carefully at the effects of individual characteristics in specific countries in order for national policy to be as effective as possible at using poverty-reduction strategies in an effort to reduce HIV prevalence. Focusing on the indicators that have been shown to play a significant role in the determination of HIV-status is the only hope for the rejuvenation of the African population through decreased prevalence rates and restrained transmission of the virus. The strong link between HIV/AIDS and poverty in sub-Saharan Africa is undeniable and must be targeted if HIV-related deaths are to decline. The world, and specifically the African continent, cannot afford to continue lose the 8,640 lives claimed daily by the HIV/AIDS pandemic and therefore, focusing on the welfare of the poorest individuals is absolutely vital in order to stop the transmission of HIV to a new individual every six seconds.

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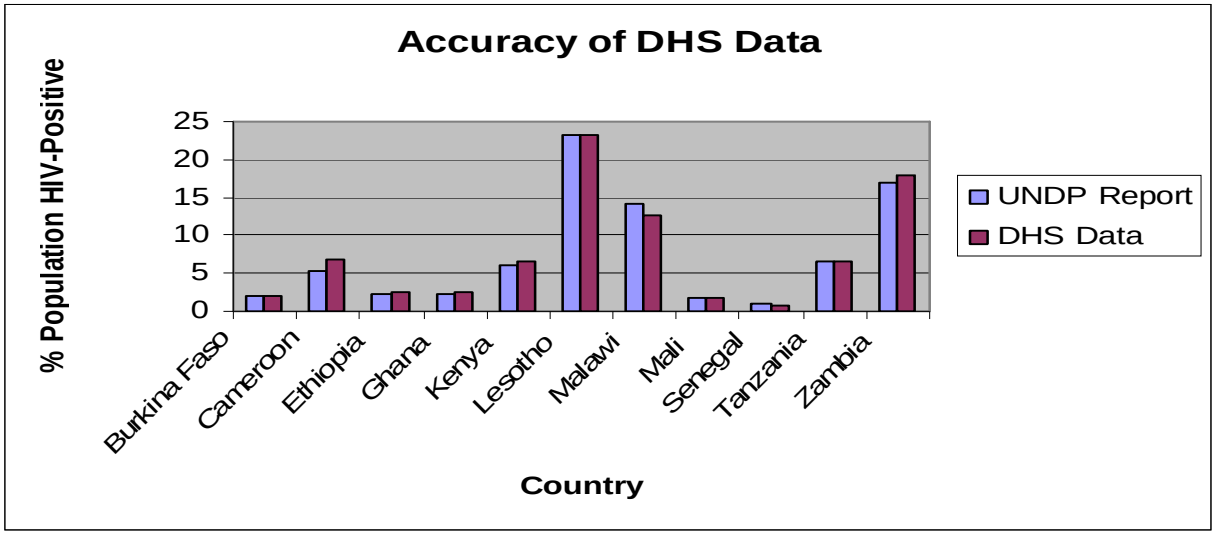
Figures

FIGURE 1



	Entire Sample	HIV-Positive Individuals	HIV-Negative Individuals
% Male***	75.94%	68.96%	76.45%
Mean Age	28.18	28.14	28.19
% Rural**	60.55%	59.46%	60.63%
% Married***	53.85%	47.20%	54.34%
Means Yrs of Education***	3.95	5.47	3.83
% Pre-Marital Sex***	52.45%	63.41%	51.64%
% With Toilet***	11.90%	8.20%	12.18%
% With Electricity***	24.76%	18.95%	25.19%

FIGURE 2

**denotes statistically significant difference at the 5% level

*** denotes statistically significant difference at the 1% level

FIGURE 3

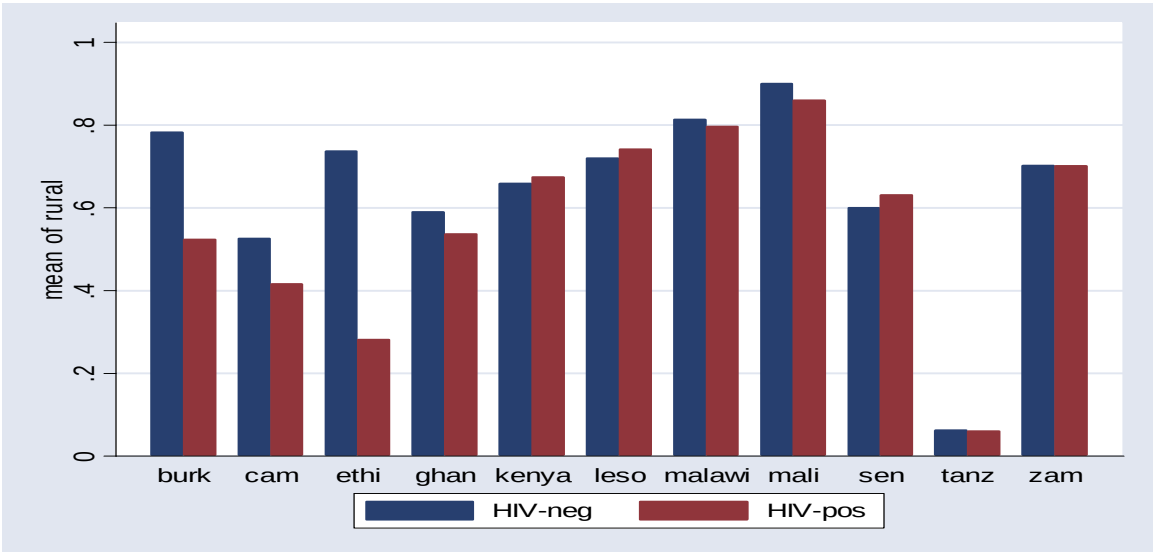


FIGURE 4

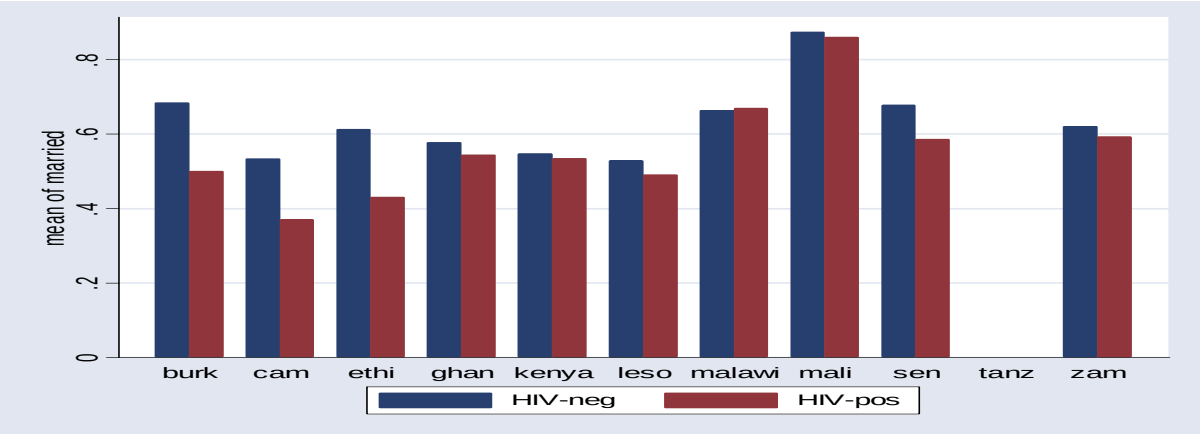


FIGURE 5

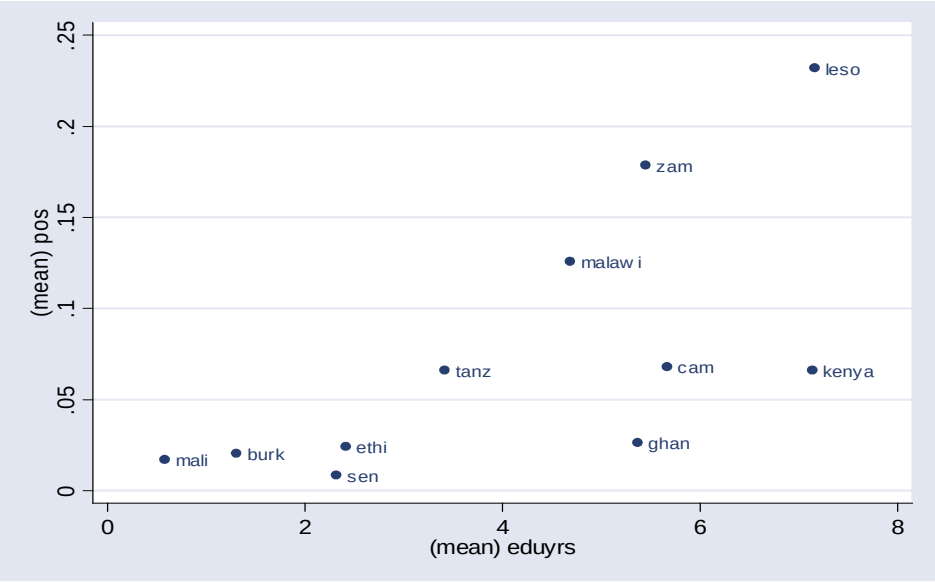


FIGURE 6

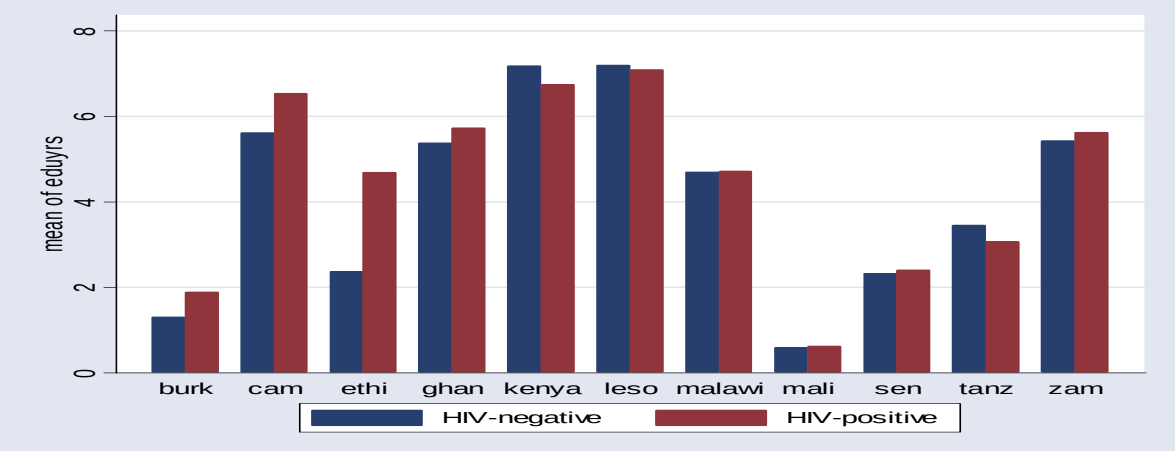


FIGURE 7

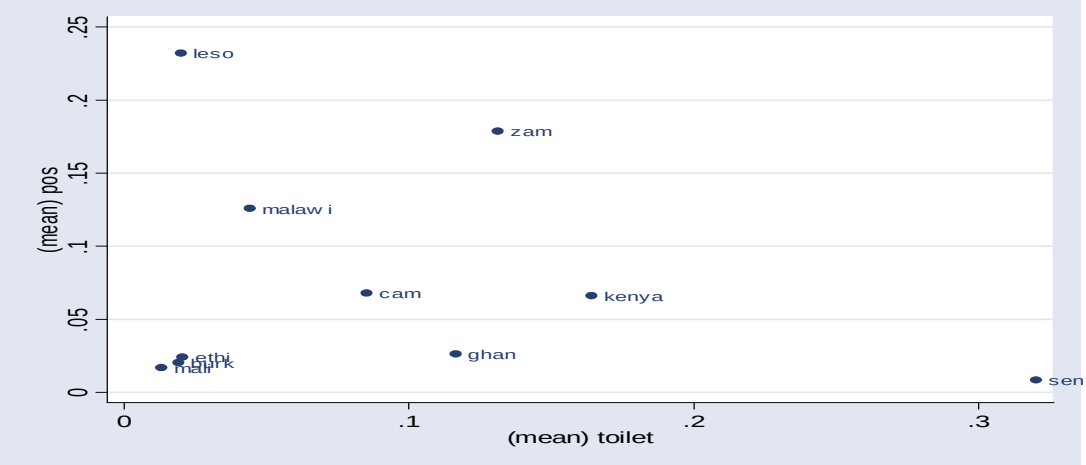


FIGURE 8

Key			
	frequency		
	row percentage		
	column percentage		
	cell percentage		

pos	toilet 0	toilet 1	Total
0	44,942	5,230	50,172
	89.58	10.42	100.00
	92.85	95.25	93.10
	83.39	9.70	93.10
1	3,459	261	3,720
	92.98	7.02	100.00
	7.15	4.75	6.90
	6.42	0.48	6.90
Total	48,401	5,491	53,892
	89.81	10.19	100.00
	100.00	100.00	100.00
	89.81	10.19	100.00

Pearson chi2(1) = 43.9567 Pr = 0.000

FIGURE 9

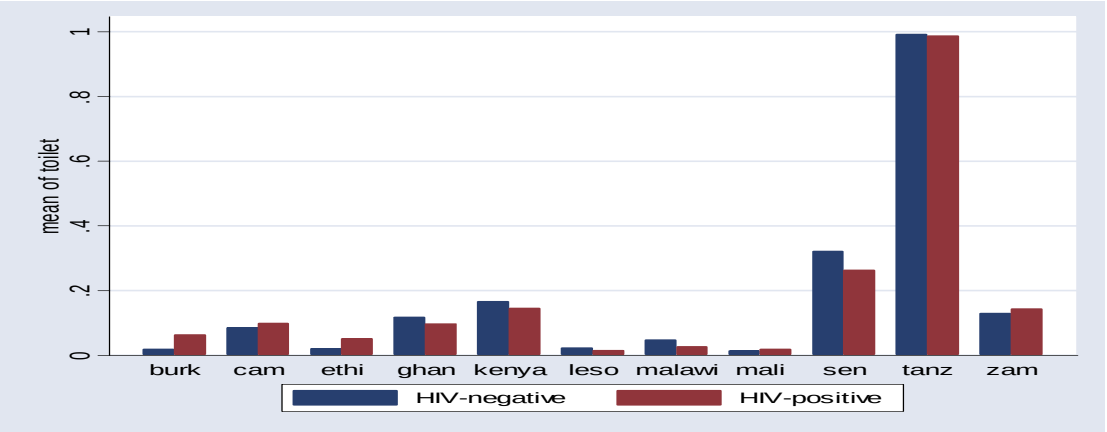


FIGURE 10

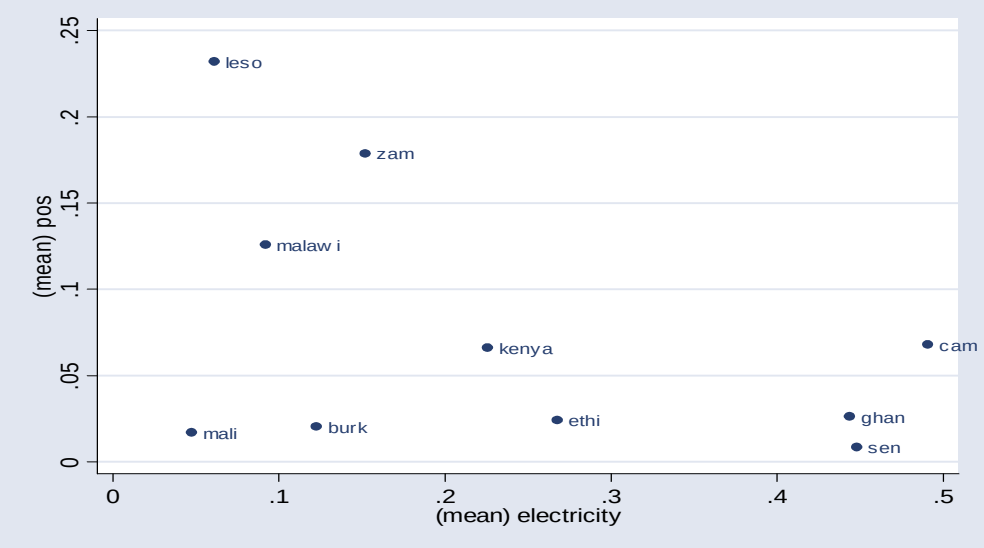


FIGURE 11

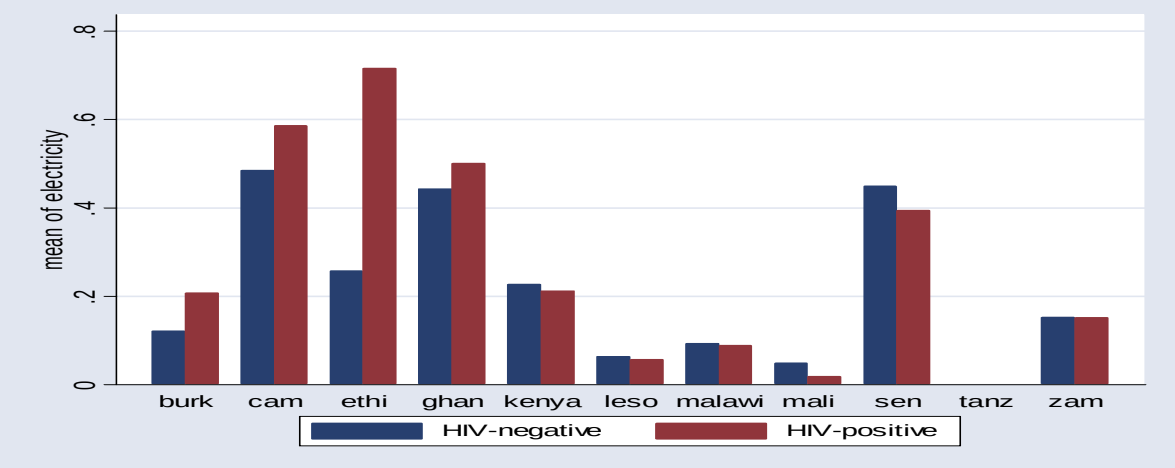


FIGURE 12

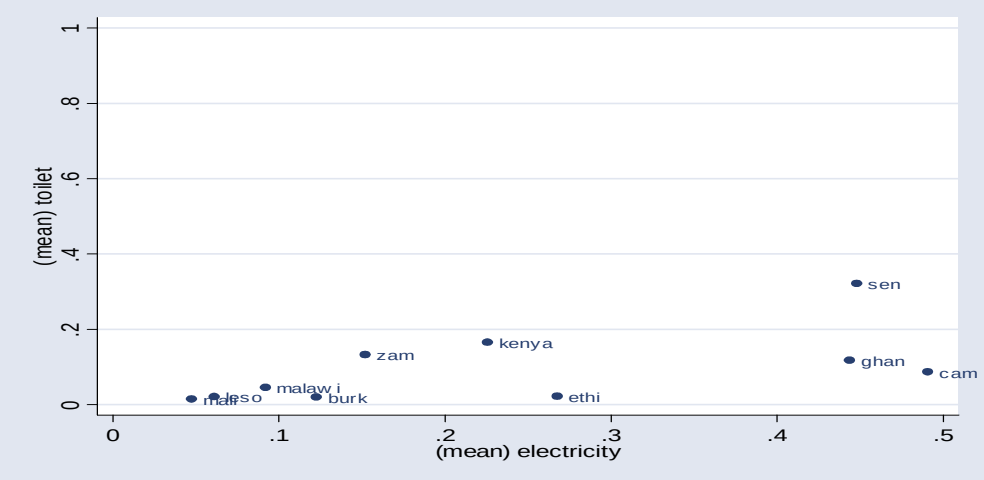


FIGURE 13

Key		
frequency		
row percentage		
column percentage		
cell percentage		

toilet	electricity 0	1	Total
0	39,939	8,396	48,335
	82.63	17.37	100.00
	98.03	64.17	89.80
	74.20	15.60	89.80
1	801	4,689	5,490
	14.59	85.41	100.00
	1.97	35.83	10.20
	1.49	8.71	10.20
Total	40,740	13,085	53,825
	75.69	24.31	100.00
	100.00	100.00	100.00
	75.69	24.31	100.00

Pearson chi2(1) = 1.2e+04 Pr = 0.000

FIGURE 14

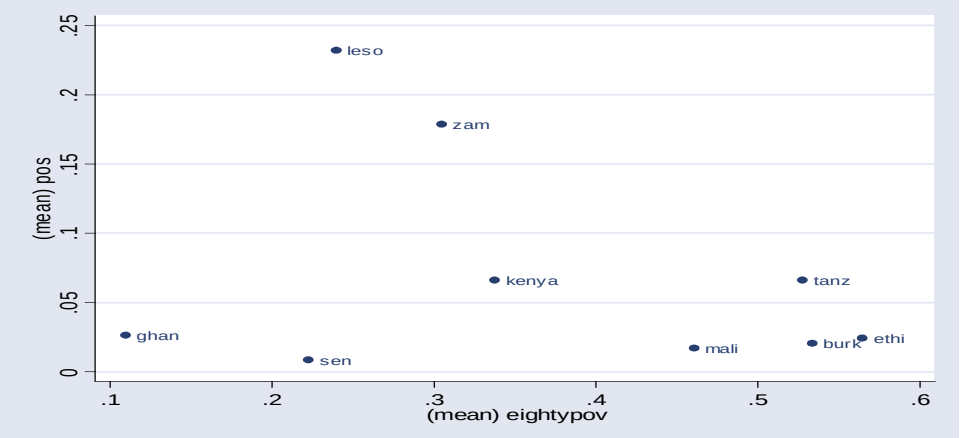


FIGURE 15

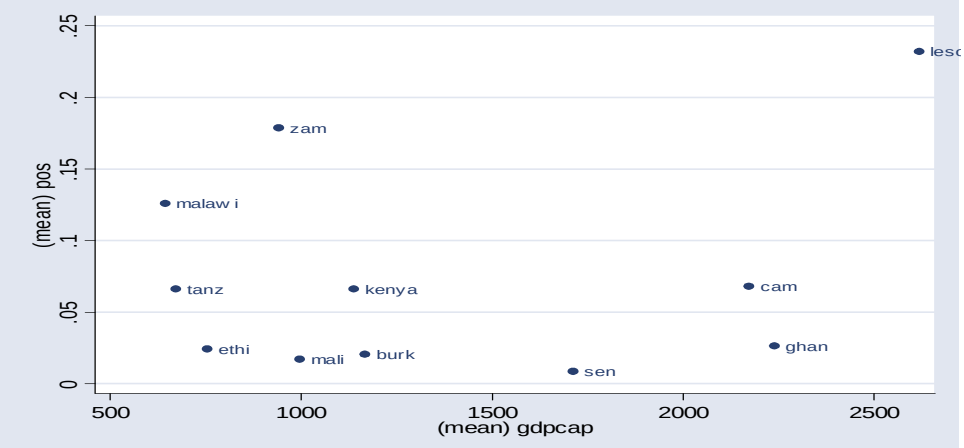


FIGURE 16

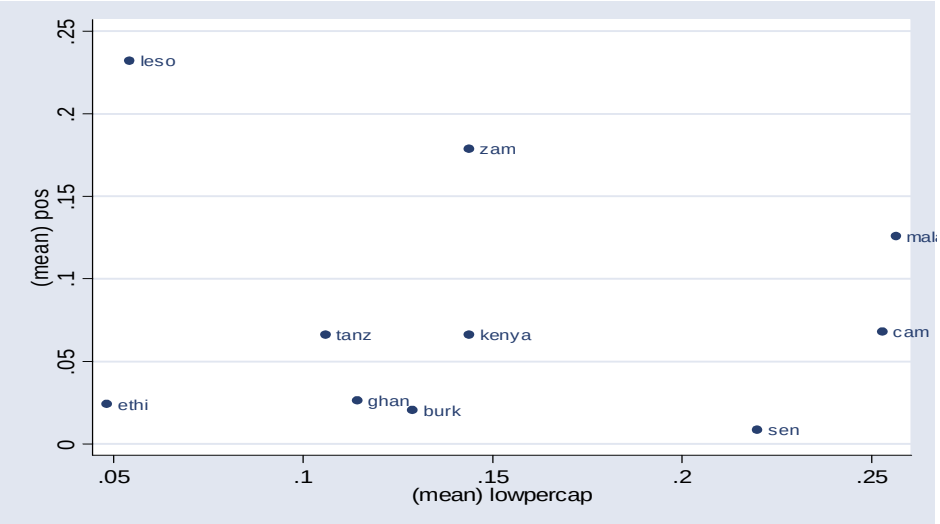


FIGURE 17

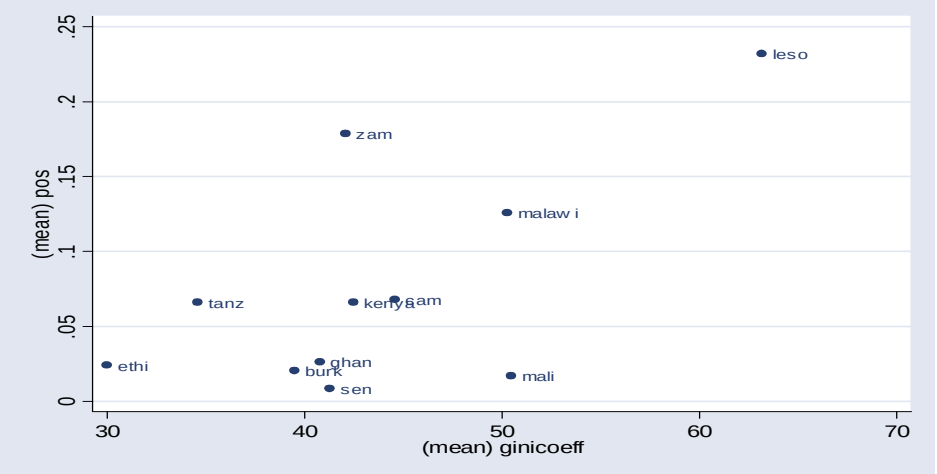


FIGURE 18

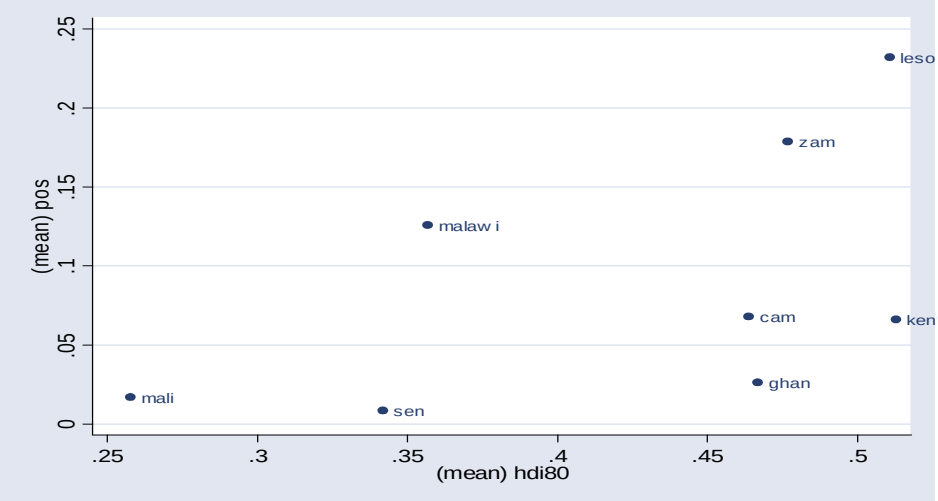


FIGURE 19

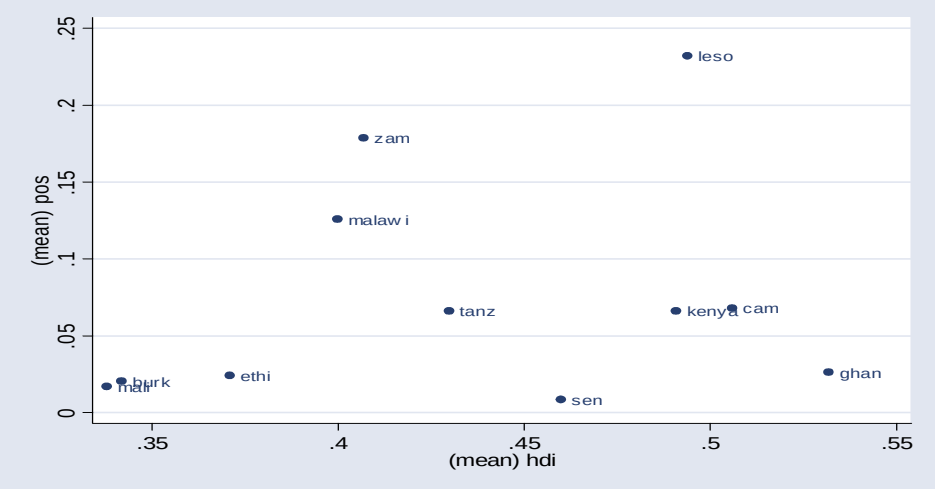


FIGURE 20

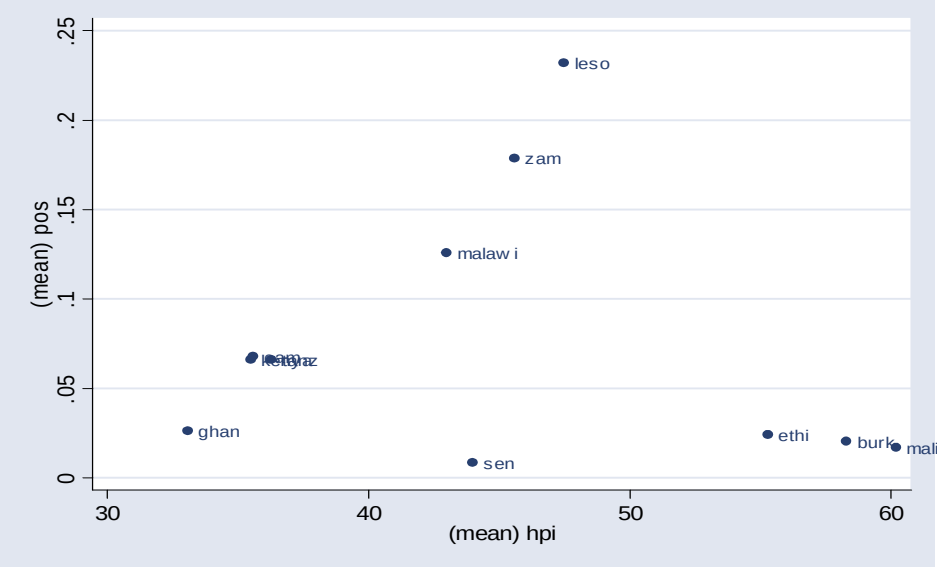


FIGURE 21

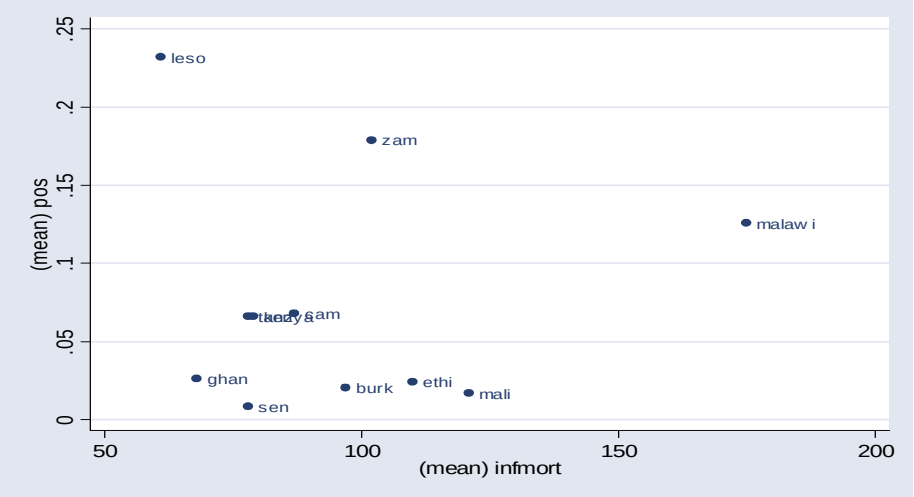


FIGURE 22

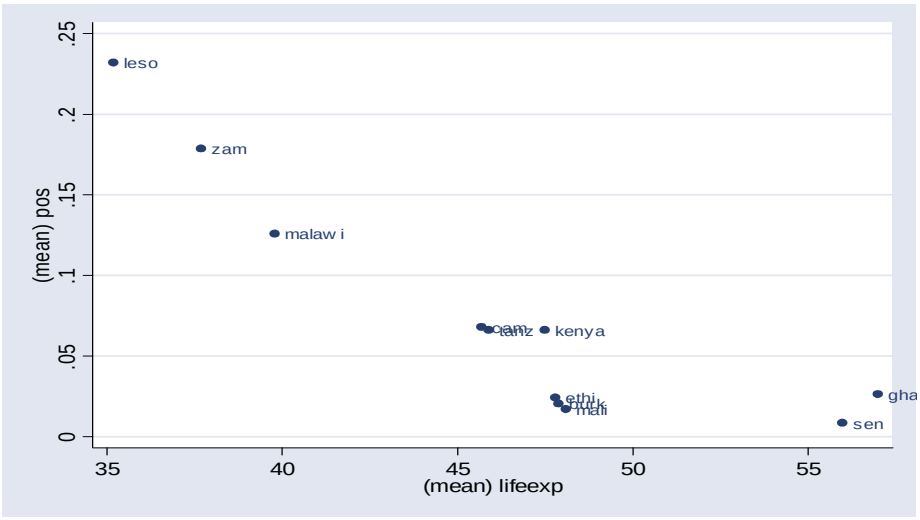


FIGURE 23

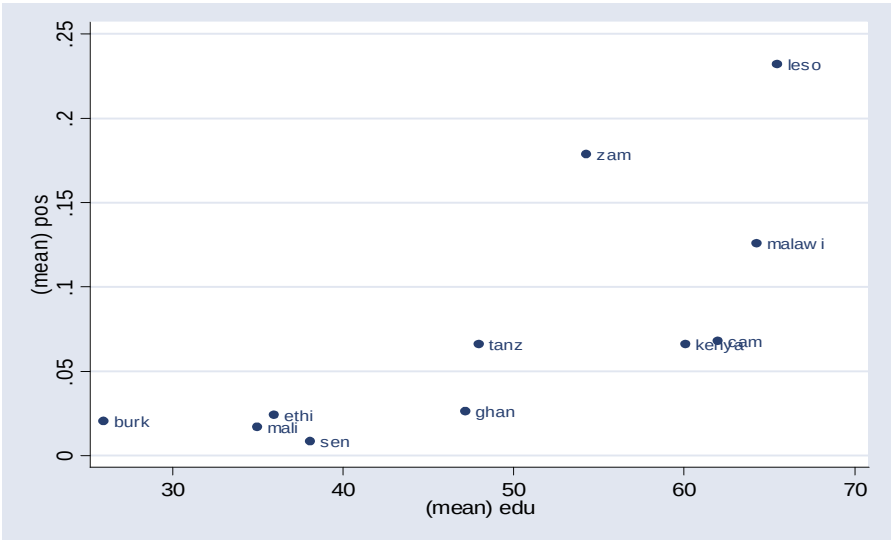


FIGURE 24

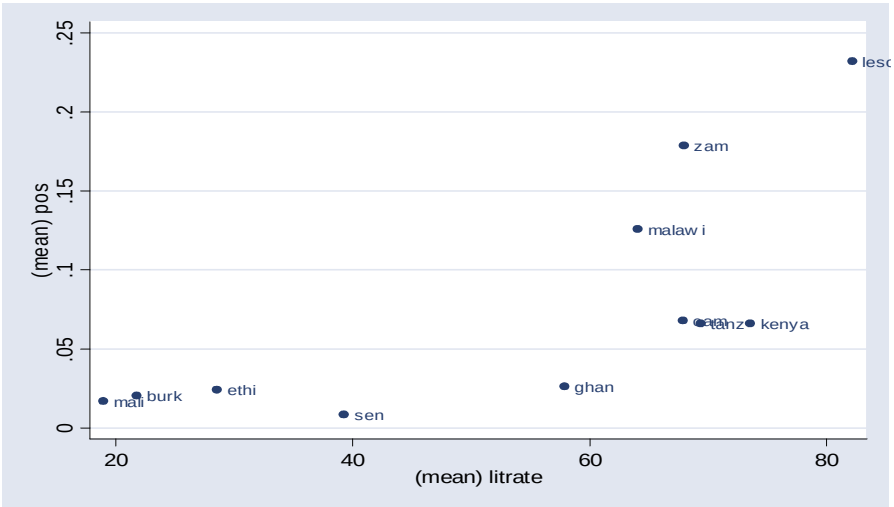


FIGURE 25

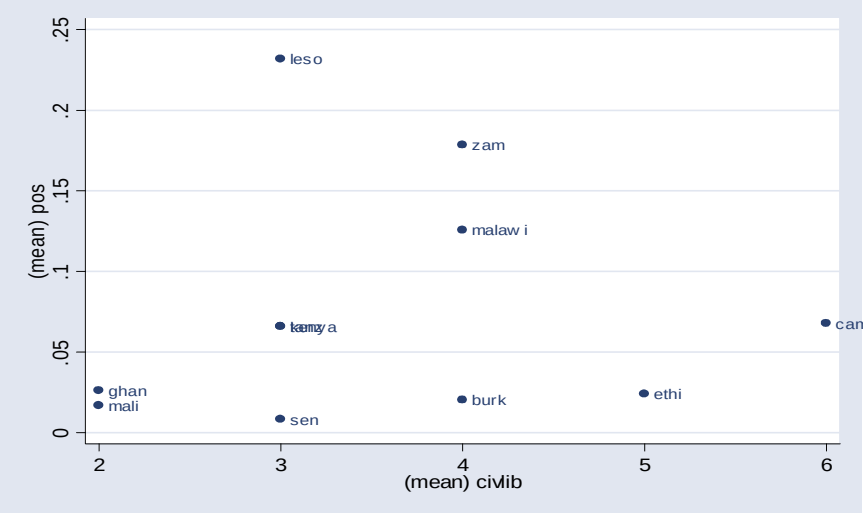


FIGURE 26

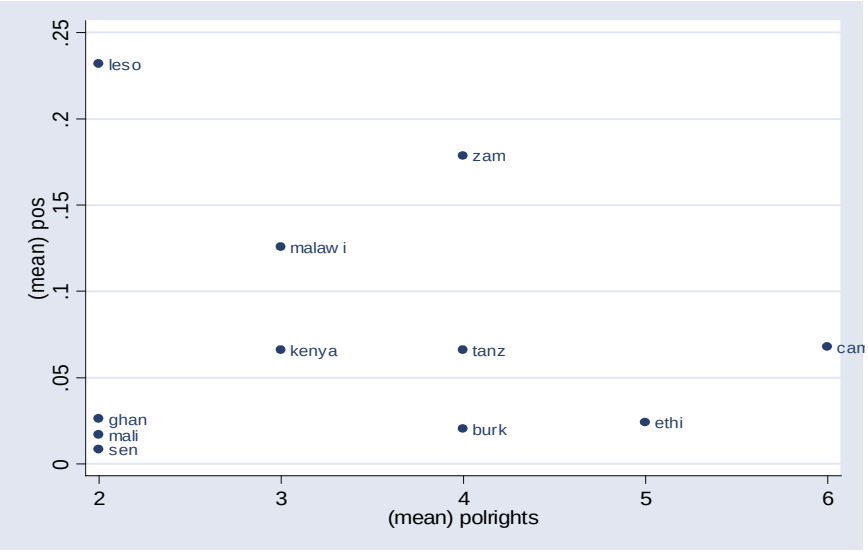


FIGURE 27

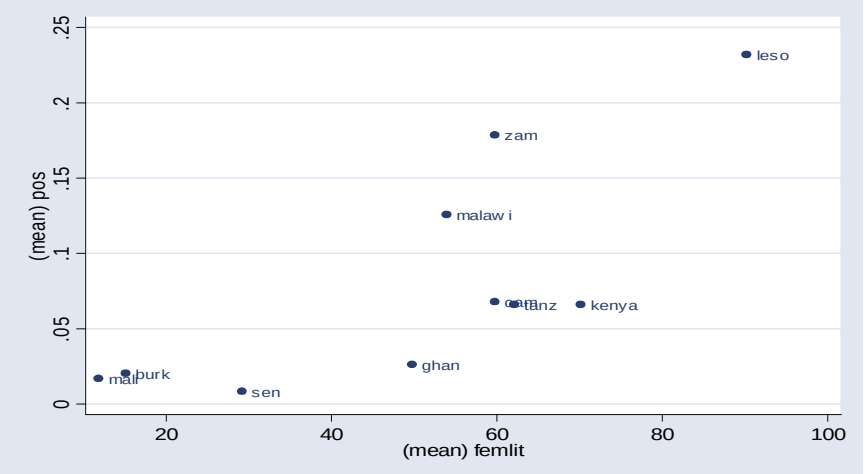


FIGURE 28

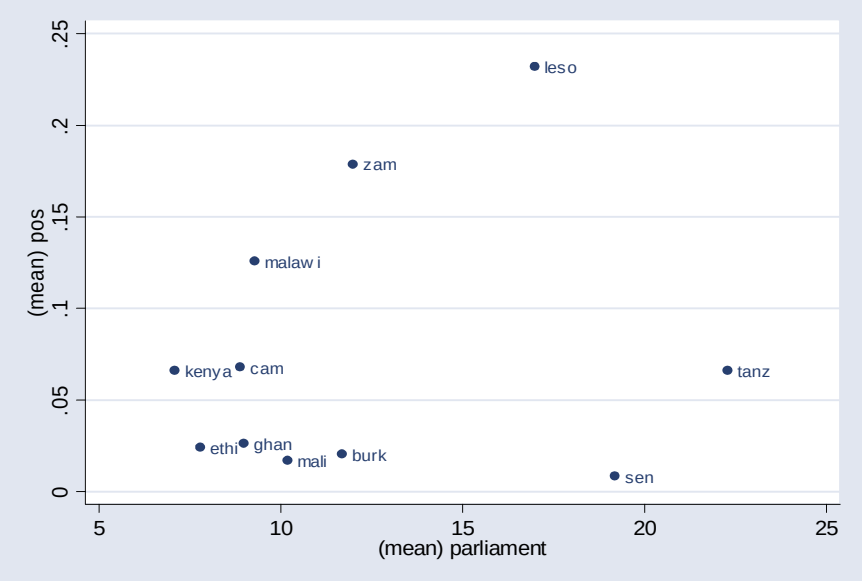


FIGURE 29

Correlation Matrix

	Civlib	Edu	Eightypov	Femlit	GDPcap	Ginicoeff	HDI	HDI80	HPI	Lifeexp	Litrate	Lowpercap	Parl	Polrights
Civlib	1													
Edu	0.202	1												
Eightypov	0.467	-0.416	1											
Femlit	0.229	**0.873**	-0.222	1										
GDPcap	-0.042	0.276	**-0.835**	0.251	1									
Ginicoeff	-0.239	0.481	-0.456	0.207	0.51	1								
HDI	-0.036	0.605	**-0.777**	0.65	**0.708**	0.162	1							
HDI80	0.311	0.732	-0.489	0.91	0.469	0.009	**0.781**	1						
HPI	-0.003	-0.611	0.435	-0.649	-0.234	0.156	**-0.826**	**-0.717**	1					
Lifeexp	-0.301	-0.591	-0.257	-0.558	0.124	-0.484	0.161	-0.308	-0.124	1				
Litrate	0.077	**0.895**	-0.34	**0.982**	0.255	0.246	0.704	**0.917**	**-0.785**	-0.481	1			
Lowpercap	0.263	0.24	-0.419	-0.42	0.046	0.18	0.148	**-0.715**	-0.296	0.15	0.025	1		
Parl	-0.29	-0.101	0.05	0.11	-0.019	-0.088	0.074	-0.19	-0.199	0.011	0.21	-0.108	1	
Polrights	**0.866**	0.083	**0.742**	0.23	0.262	-0.513	-0.103	0.354	-0.111	-0.234	0.103	0.014	-0.165	1

FIGURE 30

Regression 1a

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	-.023*** (.003)
Electricity Dummy	-.038*** (.002)
Years of Education	.007*** (.001)
Male Dummy	-.017*** (.003)
Rural Dummy	-.007*** (.003)
Age	.0002 (.0001)
Pre-Marital Sex Dummy	.016*** (.002)
Number of Observations	55,663
Log Likelihood	-12,880.198

*** Denotes Statistical Significance at the 1% level

FIGURE 31

Regression 1b

Country Fixed Effects Model of The Effect of Individual Poverty Measures on the Probability of being HIV-Positive
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	-.012*** (.003)
Electricity Dummy	.010*** (.003)
Years of Education	.0003 (.0003)
Male Dummy	-.011*** (.002)
Rural Dummy	-.003*** (.002)
Age	.0001 (.00009)
Pre-Marital Sex Dummy	.006*** (.002)
Burkina Faso Dummy	-.049*** (.001)
Cameroon Dummy	-.039*** (.002)
Ethiopia Dummy	-.052*** (.001)
Ghana Dummy	-.051*** (.001)
Kenya Dummy	-.038*** (.002)
Lesotho Dummy	.018*** (.004)
Malawi Dummy	-.056***

	(.001)
Mali Dummy	-.018*** (.002)
Senegal Dummy	-.065*** (.001)
Number of Observations	53,663
Log Likelihood	-11,538.895

*** Denotes Statistical Significance at the 1% level

FIGURE 32

Regression 1c$_1$

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive in Burkina Faso
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	.027* (.022)
Electricity Dummy	-.007 (.004)
Years of Education	-.0007 (.0007)
Male Dummy	-.011 (.008)
Rural Dummy	-.029*** (.009)
Age	.0004* (.0002)
Pre-Marital Sex Dummy	.017*** (.005)
Number of Observations	4,098
Log Likelihood	-371.761

***Denotes Statistical Significance at the 1% level
*Denotes Statistical Significance at the 10% level

FIGURE 33

Regression 1c$_2$

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive in Cameroon
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	-.010 (.011)
Electricity Dummy	.001 (.009)
Years of Education	.003** (.001)
Male Dummy	-.043*** (.009)
Rural Dummy	-.017** (-.009)
Age Dummy	.001*** (.0004)
Pre-Marital Sex Dummy	.044*** (.007)
Number of Observations	4,804
Log Likelihood	-1139.849

***Denotes Statistical Significance at the 1% level
** Denotes Statistical Significance at the 5% level

FIGURE 34

Regression 1c$_3$

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive in Ethiopia
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	.003 (.008)
Electricity Dummy	.025*** (.010)
Years of Education	-.0002 (.0004)
Male Dummy	-.013*** (.0004)
Rural Dummy	-.015** (.008)
Age	.0003* (.0001)
Pre-Marital Sex Dummy	.017*** (.004)
Number of Observations	5,806
Log Likelihood	-558.755

***Denotes Statistical Significance at the 1% level
** Denotes Statistical Significance at the 5% level
* Denotes Statistical Significance at the 10% level

FIGURE 35

Regression 1c$_4$

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive in Ghana
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	-.008 (.005)
Electricity Dummy	.002 (.005)
Years of Education	.00004 (.0005)
Male Dummy	-.018*** (.005)
Rural Dummy	-.003 (.005)
Age	.0007*** (.0002)
Pre-Marital Sex Dummy	.018*** (.004)
Number of Observations	5,196
Log Likelihood	-592.449

***Denotes Statistical Significance at the 1% level

FIGURE 36

Regression 1c$_5$

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive in Kenya
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	-.009 (.013)
Electricity Dummy	.006 (.013)
Years of Education	-.001 (.0009)
Male Dummy	-.0003 (.007)
Rural Dummy	-.0002 (.009)
Age	.0002 (.0004)
Pre-Marital Sex Dummy	-.007 (.008)
Number of Observations	5,654
Log Likelihood	-1390.226

FIGURE 37

Regression $1c_6$

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive in Lesotho
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	-.052 (.044)
Electricity Dummy	.011 (.031)
Years of Education	-.002 (.002)
Male Dummy	-.260** (.013)
Rural Dummy	.019 (.015)
Age	-.0009 (.0006)
Pre-Marital Sex Dummy	.0003 (.012)
Number of Observations	4,923
Log Likelihood	-2664.829

**Denotes Statistical Significance at the 5% level

FIGURE 38

Regression $1c_7$

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive in Malawi
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	-.068*** (.018)
Electricity Dummy	.010 (.021)
Years of Education	.0008 (.011)
Male Dummy	.008 (.011)
Rural Dummy	-.019 (.014)
Age	.0006 (.0005)
Pre-Marital Sex Dummy	-.010 (.010)
Number of Observations	5,236
Log Likelihood	-1967.055

***Denotes Statistical Significance at the 1% level

FIGURE 39

Regression 1c$_8$

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive in Mali
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	.014 (.021)
Electricity Dummy	-.013** (.004)
Years of Education	.0001 (.0009)
Male Dummy	.003 (.005)
Rural Dummy	-.013** (.007)
Age	.0001 (.0001)
Pre-Marital Sex Dummy	-.004 (.003)
Number of Observations	6,651
Log Likelihood	-555.073

**Denotes Statistical Significance at the 5% level

FIGURE 40

Regression 1c$_9$

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive in Senegal
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	-.002 (.003)
Electricity Dummy	-.001 (.003)
Years of Education	.00004 (.0003)
Male Dummy	-.0005 (.003)
Rural Dummy	-.0008 (.003)
Age	-.0002 (.0001)*
Pre-Marital Sex Dummy	.001 (.002)
Number of Observations	7,507
Log Likelihood	-351.800

*Denotes Statistical Significance at the 10% level

FIGURE 41

Regression 1c$_{10}$

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive in Zambia
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	.031 (.027)
Electricity Dummy	-.029 (.022)
Years of Education	.003 (.002)
Male Dummy	-.002 (.015)
Rural Dummy	.007 (.016)
Age	-.001 (.0007)
Pre-Marital Sex Dummy	-.0002 (.013)
Number of Observations	3,788
Log Likelihood	-1772.067

FIGURE 42

Regression 2a

The Effect of National Poverty Measures on the Probability of being HIV-Positive
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Natural Log of GDP per Capita	.158*** (.040)
Human Poverty Index	.030*** (.005)
Gini Coefficient	-.030*** (.007)
Literacy Rate	.015*** (.003)
% of Parliament Female	.011*** (.003)
Measure of Civil Liberties	-.189*** (.045)
1980 $1/day Poverty rate	.448*** (.150)
Number of Observations	43,623
Log Likelihood	-8,421.9881

*** Denotes Statistical Significance at the 1% level

FIGURE 43

Regression 2b

The Effect of National and Individual Poverty Measures on the Probability of being HIV-Positive
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Natural Log of GDP per Capita	.175*** (.040)
Human Poverty Index	.032*** (-.033)
Gini Coefficient	-.033*** (.007)
Literacy Rate	.016*** (.003)
% of Parliament Female	.013*** (.003)
Measure of Civil Liberties	-.216*** (.045)
1980 $1/day Poverty rate	.543*** (.151)
Toilet Dummy	-.010*** (.003)
Electricity Dummy	.010*** (.003)
Years of Education	.00003 (.0002)
Male Dummy	-.009*** (.002)
Rural Dummy	-.005** (.002)
Age	.000007 (.00009)
Pre-Marital Sex Dummy	.004*** (.002)
Number of Observations	43,623
Log Likelihood	-8391.809

*** Denotes Statistical Significance at the 1% level
** Denotes Statistical Significance at the 5% level

FIGURE 44

Regression 2b (re-estimated)

The Effect of National and Individual Poverty Measures on the Probability of being HIV-Positive
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Natural Log of GDP per Capita in Poorest 20% of Population	-.001 (.004)
Human Poverty Index	.018*** (.001)
Gini Coefficient	-.011*** (.001)
Literacy Rate	.007*** (.0005)
% of Parliament Female	.001*** (.0006)
Measure of Civil Liberties	-.096*** (.011)
1980 $1/day Poverty rate	Dropped due to collinearity
Toilet Dummy	-.012*** (.003)

Electricity Dummy	.014*** (.004)
Years of Education	.000007 (.0003)
Male Dummy	-.010*** (.002)
Rural Dummy	-.005* (.0026)
Age	-.00004 (.0001)
Pre-Marital Sex Dummy	.006*** (.002)
Number of Observations	36,972
Log Likelihood	-7828.2682

*** Denotes Statistical Significance at the 1% level
* Denotes Statistical Significance at the 10% level

FIGURE 45

Chi-Squared Tests for Incremental Explanatory Power of Individual Characteristics v Country of Residence

Included Variables	**Regression Model/Figure #**	**Log Likelihood**	**X^2 Test Statistic**
Individual Characteristics	Regression 1a/Figure 46	-12880.198	**2682.61**
Individual + Country Dummies	Regression 1b/Figure 33	-11,538.895	
Country Dummy Variables	Regression 1d/Figure 48	-11587.449	97.108
Country Dummies + Individual	Regression 1b/Figure 33	-11,538.895	

FIGURE 46

Regression 3

The Effect of Living in a Certain County on the Probability of being HIV-Positive (as compared to living in Zambia)
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Burkina Faso Dummy	-.051*** (.001)
Cameroon Dummy	-.037*** (.002)
Ethiopia Dummy	-.053*** (.001)
Ghana Dummy	-.051*** (.001)
Kenya Dummy	-.037*** (.002)
Lesotho Dummy	.021*** (.004)
Malawi Dummy	-.018*** (.002)
Mali Dummy	-.058*** (.001)
Senegal Dummy	-.067*** (.001)
Number of Observations	55,663
Log Likelihood	-11587.449

***Denotes Statistical Significance at the 1% level

FIGURE 47

Regression 1a (re-estimated with smaller sample)*

The Effect of Individual Poverty Measures on the Probability of being HIV-Positive
Dependent Variable: =1 if Individual is HIV-positive
=0 if Individuals is HIV-negative

Independent Variables:	
Toilet Dummy	-.018*** (.003)
Electricity Dummy	-.039*** (.002)
Years of Education	.007*** (.0002)
Male Dummy	-.016*** (.003)
Rural Dummy	-.007** (.003)
Age	.00005 (.0001)
Pre-Marital Sex Dummy	.012*** (.002)
Number of Observations	43,623
Log Likelihood	-9588.054

*** Denotes Statistical Significance at the 1% level
** Denotes Statistical Significance at the 5% level

FIGURE 48

Chi-Squared Tests for Incremental Explanatory Power of Individual v Country Characteristics

Included Variables	**Regression Model/Figure #**	**Log Likelihood**	**X^2 Test Statistic**
Individual Characteristics	Regression 1a*/Figure 4	-9588. 054	2397.488
Individual + Country Indicators	Regression 2b/Figure 45	-8391.809	
Country Indicators	Regression 2a/Figure 44	-11077.97	**5327.32**
Country Indicators+ Individual	Regression 2b/Figure 45	-8391.809	

Data Appendix

Variable Name: *age*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: Respondent's age
Variable Values and Coding: Respondent's age is recorded in years
- Mean: 28.20
- Median: 27
- Standard Deviation: 9.48
- Minimum: 15
- Maximum: 49

Source Variable: v012
Modifications to Source Variable: None

Variable Name: *agesex*
Number of Non-Missing Observations: 37, 211
Percentage of Non-Missing Observations: 57.07%
Variable Description: Age of respondent at time of first intercourse
Variable Values and Coding: Respondent's age is recorded in years
- Mean: 12.753
- Median: 15
- Standard Deviation: 7.39
- Minimum: 0
- Maximum:46

Source Variable: v525
Modifications to Source Variable:
a) "At first union" coded as "96" converted to "." because age unknown
b) "Inconsistent" coded as "97" converted to "."
c) "Don't know" coded as "98" converted to "."
d) Missing values coded as "99" converted to "."

Variable Name: *country*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: Respondent's country of residence
Variable Values and Coding:
- Burkina Faso (6.42% of non-missing values)
- Cameroon (7.90% of non-missing values)
- Ethiopia (9.09% of non-missing values)
- Ghana (8.11% of non-missing values)
- Kenya (9.08% of non-missing values)
- Lesotho (7.82% of non-missing values)
- Malawi (8.22% of non-missing values)
- Mali (10.51% of non-missing values)
- Senegal (12.00% of non-missing values)
- Tanzania (14.80% non-missing values)

Zambia (6.06% of non-missing values)
Source Variable: none
Modifications to Source Variable: none
Comments: Variable was created to distinguish observations from each of the smaller national datasets

Variable Name: c*ivlib*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: Measure of the level of civil liberties that a country affords its citizens. Civil Liberties are defined as rights that, "allow for the freedoms of expression and belief, associational and organizational rights, rule of law, and personal autonomy without interference from the state." (Freedom House)
Variable Values and Coding: Measure of civil liberties in the respondent's country of residence that can take on values from 1-7 with lower values representing "freer" societies
Mean: 3.44
Median: 3
Standard Deviation: 1.13
Minimum: 2
Maximum: 6
Source Variable: none
Modifications to Source Variable: none
Comments: Variable was added to the dataset using statistics from Freedom House.

Variable Name: e*du*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: The number of students enrolled in primary, secondary, and tertiary levels of education, regardless of age, as a percentage of the population of official school age for the three levels.
Variable Values and Coding: Represents the percentage of individuals being educated in the respondent's country of residence
Mean: 48.17
Median: 48
Standard Deviation: 12.28
Minimum: 26
Maximum: 65.6
Source Variable: none
Modifications to Source Variable: none
Comments: Variable was added to dataset using statistics from the 2006 UNDP Human Development Report

Variable Name: e*duyrs*
Number of Non-Missing Observations: 65,040
Percentage of Non-Missing Observations: 99.75%
Variable Description: Number of years of education attained by the respondent
Variable Values and Coding: Respondent's level of education recorded in years

Mean: 3.91
Median: 2
Standard Deviation: 4.41
Minimum: 0
Maximum: 21

Source Variable: v133
Modifications to Source Variable:

a) Missing values coded as "99" converted "."
b) Codebook noted maximum value for this variable to be 21 so all observations with values >21 were converted to ".", as it was assumed that these values were wrongly recorded.

Variable Name: e*ightypov*
Number of Non-Missing Observations: 54,691
Percentage of Non-Missing Observations: 83.88% (value missing for Cameroon and Malawi)
Variable Description: national $1/day poverty rate in 1980
Variable Values and Coding: The $1/day poverty rate in the respondent's country of residence in 1980

Mean: .38
Median: .338
Standard Deviation: .15
Minimum: .11
Maximum .565

Source Variable: none
Modifications to Source Variable: none
Comments: Variable added to dataset with statistics from Sala-i-Martin (2002)

Variable Name: e*lectricity*
Number of Non-Missing Observations: 53,948 (values missing for Tanzania)
Percentage of Non-Missing Observations: 82.74%
Variable Description: Whether a Respondent has electricity in his/her home
Variable Values and Coding:

0: Respondent does not have electricity in his/her home (75.67% of non-missing values)
1: Respondent had electricity in his/her home (24.33% of non-missing values)

Source Variable: v119
Modifications to Source Variable:

a) Missing values coded as "9" converted to "."
b) Not dejure residents coded as "7" converted to "."

Variable Name: f*emlit*
Number of Non-Missing Observations: 59, 274
Percentage of Non-Missing Observations: 90.91% (value missing for Ethiopia)
Variable Description: Percentage of literate females in country
Variable Values and Coding: Female literacy rate in the respondent's country of residence

Mean: 49.71

Median: 59.8
Standard Deviation: 23.04
Minimum: 11.9
Maximum: 90.3
Source Variable: none
Modifications to Source Variable: none
Comments: Variable added to the dataset with statistics from WDI online

Variable Name: *gdpcap*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: Gross domestic product (in billions of US dollars) divided by midyear population
Variable Values and Coding: GDP per capita in the respondent's country of residence
Mean: 1325.91
Median: 1140
Standard Deviation: 654.7
Minimum: 646
Maximum: 2619
Source Variable: none
Modifications to Source Variable: none
Comments: Variable added to dataset with statistics from the 2006 UNDP Human Development Report

Variable Name: g*inicoeff*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: Measure of national income inequality; coefficient that takes on a value from 0 to 100 with 0 representing prefect income equity and 100 representing perfect income inequality
Variable Values and Coding: Value of Gini Coefficient in respondent's country of residence
Mean: 42.96
Median: 41.3
Standard Deviation: 8.35
Minimum: 30
Maximum: 63.2
Source Variable: none
Modifications to Source Variable: none
Comments: Variable added to dataset with statistics from the CIA World Factbook

Variable Name: *hdi*
Number of Non-Missing Observations: 65, 202
Percentage of Non-Missing Observations: 100%
Variable Description: A composite index measuring average achievement in three basic dimensions of human development—a long and healthy life, knowledge and a decent

standard of living. Index is measured from 0 to 1 with 1 representing the greatest level of development.
Variable Values and Coding: Value of the Human Development Index (HDI) in the respondent's country of residence in 2006

Mean: .434
Median: .43
Standard Deviation: .062
Minimum: .338
Maximum: .532

Source Variable: none
Modifications to Source Variable: none
Comments: Variable added to dataset with statistics from the 2006 UNDP Human Development Report

Variable Name: *hdi80*
Number of Non-Missing Observations: 45,438
Percentage of Non-Missing Observations: 69.7% (value missing for Burkina Faso, Ethiopia, and Tanzania)
Variable Description: A composite index measuring average achievement in three basic dimensions of human development—a long and healthy life, knowledge and a decent standard of living. Index is measured from 0 to 1 with 1 representing the greatest level of development.
Variable Values and Coding: Value of the Human Development Index (HDI) in the respondent's country of residence in 1980

Mean: .412
Median: .464
Standard Deviation: .091
Minimum: .258
Maximum: .513

Source Variable: none
Modifications to Source Variable: none
Comments: Variable added to dataset with statistics from the 2006 UNDP Human Development Report

Variable Name: *hpi*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: A composite index measuring deprivations in the three basic dimensions captured in the human development index—a long and healthy life, knowledge and a decent standard of living. Measured from 0 to 100 with higher numbers representing greater levels of deprivation
Variable Values and Coding: Value of the Human Poverty Index (HPI) in the respondent's country of residence

Mean: 44.48
Median: 44
Standard Deviation: 9.16

Minimum: 33.1
Maximum: 60.2
Source Variable: none
Modifications to Source Variable: none
Comments: Variable added to dataset with statistics from the 2006 UNDP Human Development Report

Variable Name: *lifeexp*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: The number of years a newborn infant would live if prevailing patterns of age-specific mortality rates at the time of birth were to stay the same throughout the child's life.
Variable Values and Coding: Number of years of life expectancy in individual's country of residence
Mean: 46.83
Median: 47.5
Standard Deviation: 6.23
Minimum: 35.2
Maximum: 57
Source Variable: none
Modifications to Source Variable: none
Comments: Variable added to dataset with statistics from the 2006 UNDP Human Development Report

Variable Name: *litrate*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: The percentage of people ages 15 and older who can, with understanding, both read and write a short, simple statement related to their everyday life.
Variable Values and Coding: The literacy rate in the respondent's country of residence
Mean: 53.5
Median: 64.1
Standard Deviation: 21.2
Minimum: 19
Maximum: 82.2
Source Variable: none
Modifications to Source Variable: none
Comments: Variable added to dataset with statistics from the 2006 UNDP Human Development Report

Variable Name: *lowpercap*
Number of Non-Missing Observations: 58,351
Percentage of Non-Missing Observations: 89.5% (value missing for Mali)
Variable Description: GDP per capita (in billions of US dollars) for the poorest 20% of the population

Variable Values and Coding: GDP per capita for the poorest 20% of the population in the respondent's country of residence

Mean: .147
Median: .129
Standard Deviation: .070
Minimum: .0483
Maximum: .2566

Source Variable: none
Modifications to Source Variable: none
Comment: Variable added to dataset using share of income for the poorest 20% of the population as reported by WDI online. Income share was then multiplied by the country's GDP and dived by one fifth of the size of the population as reported by in the 2006 UNDP Human Development Report.

Variable Name: *male*
Number of Non-Missing Observations: 55,555
Percentage of Non-Missing Observations: 85.2%
Variable Description: Respondent's gender
Variable Values and Coding:

0: Female (23.73% of non-missing values)
1: Male (76.27% of non-missing values)

Source Variable: v151
Modifications to Source Variable:

a) Females originally coded as "2" converted to "0"

Variable Name: *nosmoke*
Number of Non-Missing Observations: 48, 658
Percentage of Non-Missing Observations: 74.63%
Variable Description: Whether respondent smokes
Variable Values and Coding:

0: Respondent smokes (3.66% of non-missing values)
1: Respondent does not smoke (96.34% of non-missing values)

Source Variable: v463z
Modifications to Source Variable:

a) Missing values coded as "9" converted to "."

Variable Name: *parliament*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: Percentage of seats in national parliament held by women
Variable Values and Coding: Percentage of women in parliament in respondent's country of residence

Mean: 13.03
Median: 10.2
Standard Deviation: 5.39
Minimum: 7.1
Maximum: 22.3

Source Variable: none
Modifications to Source Variable: none
Comments: Variable added to dataset with statistics from the 2006 UNDP Human Development Report

Variable Name: *polrights*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: Measure of a nation's political rights, which are defined as rights that, "enable people to participate freely in the political process, including the right to vote freely for distinct alternatives in legitimate elections, compete for public office, join political parties and organizations, and elect representatives who have a decisive impact on public policies and are accountable to the electorate." (Freedom House)
Variable Values and Coding: Measure of political rights in the respondent's country of residence that can take on values from 1-7 with lower values representing "freer" societies

Mean: 3.31
Median: 3
Standard Deviation: 1.28
Minimum: 2
Maximum: 6

Source Variable: none
Modifications to Source Variable: none
Comments: Variable added to dataset with statistics from Freedom House

Variable Name: *pos*
Number of Non-Missing Observations: 65,202
Percentage of Non-Missing Observations: 100%
Variable Description: Respondent's HIV-Status
Variable Values and Coding:

0: HIV-Negative (93.13% of non-missing values)
1: HIV-Positive (6.87% of non-missing values)

Source Variable: IFHIVRES, RESULT, HRESULT, HIV03, HIV_RES, HIVFINAL (different for each country)
Modifications to Source Variable:

a) IFHIVRES originally coded: 0 Negative; 1 Positive HIV-1; 2 Positive HIV-2; 3 Positive HIV-1/2; 4 Positive HIV-1 NEW. Values "2", "3", and "4" converted to "."
b) RESULT originally coded: 0 Not tested; 1 HIV positive; 2 HIV negative; 8 HIV status undetermined. "0" and "8" converted to ".". "2" converted to "0".
c) HRESULT originally coded: 0 Not tested; 1 Positive; 2 Negative; 7 Indeterminate; 9 Missing. "0", "7", and "9" converted to ".". "2" converted to "0"
d) HIV03 originally coded: 0 HIV negative; 1 HIV positive; 2 HIV2 positive; 3 HIV1 & HIV2 positive; 4 ERROR; 5 ERROR; 6 ERROR; 7 Indeterminate. "2" and "3" converted to "1". "4", "5", "6", and "7" converted to ".".
e) HIV_RES missing values coded as "9" converted to "."
f) HIVFINAL missing values coded as "9" converted to "."

g) All missing values, ".", dropped from sample.

Variable Name: *rural*
Number of Non-Missing Observations: 64,762
Percentage of Non-Missing Observations: 99.33%
Variable Description: Respondent's type of residence
Variable Values and Coding:
0: Urban Residence (39.05% non-missing values)
1: Rural Residence (60.95% non-missing values)
Source Variable: v102
Modifications to Source Variable:
a) Urban residence coded as "1" converted to "0"
b) Rural Residence coded "2" converted to "1".

Variable Name: *sexbe4mar*
Number of Non-Missing Observations: 55, 436
Percentage of Non-Missing Observations: 85.02%
Variable Description: Whether respondent ever engaged in pre-marital sex
Variable Values and Coding:
0: Respondent did not engage in pre-marital sex (48.36% of non-missing values)
1: Respondent did engage in pre-marital sex (51.64% of non-missing values)
Source Variable: v525
Modifications to source Variable:
a) "At first union" coded as "96" converted to "0"
b) Values "7" to "46" converted to "1"
c) "Inconsistent" coded as "97" converted to "."
d) "Don't know" coded as "98" converted to "."
e) Missing values coded as "99" converted to "."

Variable Name: *toilet*
Number of Non-Missing Observations: 53,892
Percentage of Non-Missing Observations: 82.65% (values missing for Tanzania)
Variable Description: Whether a respondent has a toilet with running water in home
Variable Values and Coding:
0: No toilet or pit toilet (without running water)
1: Toilet with running water
Source Variable: v116
Modifications to Source Variable:
a) Flush toilets coded "11" to "19" converted to "1".
b) Pit latrines coded "21" to "26" converted to "0".
c) No facility coded "31" and "32" converted to "0"
d) Not dejure residents coded "92" to "97" converted to "."
e) Missing values coded "99" converted to "."
f) Some observations coded with "71" to "79" values that were undefined and thus were converted to "."