Sexually Risky Behavior, its Social Determinants, and the Economic Consequence of HIV/AIDS in Zimbabwe

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Abstract:

Zimbabwe has one of the highest HIV/AIDS prevalence rates in Africa and in the world. This virus has led to a drastic decrease in life expectancy, and thus, has considerably decreased the incentive for high levels of educational attainment. The current and future levels of human capital have been lowered. Because of the high costs associated with caring for one inflicted with AIDS, domestic and national savings rates have been reduced, thereby curtailing Zimbabwe's capital accumulation and real GDP growth. Since HIV spreads mainly through heterosexual relations, it is imperative that Zimbabwean males (and females) practice safer sexual behavior. Increasing condom usage and engaging in sexual relations with only one's wife or spouse are necessary behavioral changes to combat the further spread of HIV/AIDS. A higher level of educational attainment and the increase of knowledge concerning the prevention of the spread of the virus will be important steps towards reversing the pattern of sexually risky behavior, and will hopefully decrease the HIV/AIDS prevalence rate in Zimbabwe. This, in turn, will increase capital accumulation rates, and with luck, will lead to a faster economic growth in the future.

Overview:

HIV/AIDS greatly increases adult mortality and is the fourth leading cause of death throughout the world. Only heart disease, stroke, and lower respiratory infections have caused more deaths, but whereas these three usually affect those in the older generations, AIDS generally kills off the productive working age population (Dixon, 411). Moreover, those inflicted with HIV/AIDS are far more susceptible to acquiring tuberculosis, thereby increasing mortality resulting from AIDS (UNAIDS). The HIV/AIDS epidemic is rampant in Africa, especially in the Sub-Saharan region. As illustrated in Table 1 below, the prevalence rate is estimated to be 5.1 percentage points (and hence 510 percent) higher in Sub-Saharan Africa than in the world. The Southern African region alone, moreover, accounted for roughly 32% of all new HIV infections and AIDS-related deaths globally in 2007 (UNAIDS). In fact, the disease's prevalence rate exceeds 15% in Botswana, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe, an alarming statistic unobserved anywhere else throughout the world (UNAIDS). Among these countries, Zimbabwe has seen the largest decrease in prevalence in recent years: its 2005 estimated rate was 20.1% (DHS 2005/2006) down from an estimated 24.1% in 2001 (CIA Factbook). These statistics are presented in Table 1:

Table 1

Aids Prevalence Rates in 2005	**Ages: 15-49 (%)**	**Total Cases (mm)**
World[1]	1.0	38.6
Sub-Saharan Africa[1]	6.1	24.5
Zimbabwe: Adult[2,3]	20.1	1.8
Zimbabwe: Men[2]	15.0	-
Zimbabwe: Women[2]	21.0	-

1 UNAIDS 2006
2 DHS 2005/2006
3 CIA Factbook 2008

Zimbabwe presents a good case to study given its extremely high yet decreasing rates of prevalence, for it could be useful to analyze the current policies in place that has led to this slight reduction. Nevertheless, the prevalence rate is still far too high and needs to be drastically reduced, not only to save millions of lives in the coming years, but also for there to be a marked improvement in real GDP growth and in Zimbabwe's development as a whole.

This paper first examines the macroeconomic consequences of the presence of AIDS. Section I analyzes the impact of AIDS on education and human capital, while Section II looks at an applied neo-classical growth model given the occurrence of HIV/AIDS in a dualistic economy containing both formal and informal sectors. The second half of the paper examines the micro-level behavior of Zimbabwean men. Heterosexual contact is the primary means of transmission of HIV in Zimbabwe (DHS), so understanding the sexual patterns of men is imperative. A 2005/2006 Demographic and Health Survey (DHS) given to Zimbabwean men is used to explore two sexual behaviors considered risky—not using a condom during last intercourse and engaging in sexual contact with more than one partner. Using a probit regression model, this paper seeks to answer how current marital status, educational attainment, and the spread of HIV/AIDS knowledge reduces the probability of men engaging in these sexually risky behaviors.

Section I: Rising Mortality and its Effect on Education and Human Capital

Education is largely considered a vital component of economic growth. Amar Hamoudi and Nancy Birdsall argue education is a catalyst in enhancing human development and reducing poverty: education enhances the capacity for the poor to participate in political processes and to demand governments to be more representative and accountable (Hamoudi and Birdsall 2004: i97). Furthermore, education is necessary to increase human productivity and human capital attainment (i97).

The HIV/AIDS pandemic ravaging Sub-Saharan Africa has negative effects on both the supply of and the demand for education, which will greatly diminish human capital accumulation. Because the virus is primarily transmitted through sexual contact, over 95% of those infected by HIV/AIDS are over the age of 15 (Hamoudi and Birdsall 2004: i101). Hamoudi and Birdsall find in their survey that through previous empirical studies, it has been shown that a disproportionate number of this 95% are relatively well educated, and as a result, pedagogy has been one of the hardest hit professions. Peter Glick and David Sahn argue that the nature and greater density of social networks among the better educated make it relatively easier to meet new partners, for they claim both wealth and schooling are associated with urban residence, where the supply of potential partners is greater (Glick and Sahn 2008: 400). Moreover, it can be assumed that greater educational attainment leads to greater expected wealth. Glick and Sahn assume that number of sexual partners is a normal good: as wealth increases, the expected number of partners also increases (at least for

men). Wealth and schooling also increase the status of the individual, thereby making it easier to attract potential partners (400). Taryn Dinkelman, David Lam and Murray Leibbrandt confirm Glick and Sahn's hypothesis through econometric methods: by regressing sexually risky behaviors against household income, household fixed effects, a set of individual control variables (including age, education, and race) and the presence of a negative household income shock (a dummy variable: shock equals one if there was a loss of a job or family death within the household, and zero otherwise), they find that higher levels of household income are associated with an increase in partners for males (Dinkelman, Lam and Leibbrandt 2008: s54, s57). The combination of these effects makes the original assumption reasonable: highly educated individuals have been prone to contracting HIV through their increased ability to attract partners. Thousands of teachers have already died because of AIDS (Hamoudi and Birdsall i100), and this fact presents the first negative shock to the supply of adequate teachers.

Hamoudi and Birdsall present a basic model of a population that is broken into two distinct groups: students and teachers. Students are children and are added to the school system at a constant rate (assuming fertility levels remain roughly constant), and teachers are adults added to the school system by training a proportion of previous students (Hamoudi and Birdsall 2004: i102). Because thousands of teachers have already been killed off by AIDS (and because many others leave due to retirement or death by other means), the educational system must find a way to increase the current supply of teachers. Increasing the wage level of teachers is one way to attract an additional proportion of school graduates into the pedagogy field, but this would increase governmental educational expenditures, which already presents a fiscal burden relative to other economic sectors (i105-i106). This would also draw skilled labor from these other sectors, thereby incurring additional costs on other areas of the economy. Thus, this solution is unlikely to occur. Another solution involves decreasing educational requirements for teachers, but this would result in a lower quality of teacher, and therefore, would hurt the quality of education. The stigma which HIV/AIDS carries may also affect the supply of teachers, as only 75% of men and 71% of women in Zimbabwe would want a female teacher who has AIDS to continue teaching (DHS 191). The generation of future human capital would not be maximized, but rather, decreased (i106). Rural areas, in particular, are expected to suffer as teachers migrate to urban settings due to the greater density of health facilities (i107).

HIV/AIDS also greatly diminishes the demand for education. First, AIDS has and will continue to orphan millions of children across he African continent, which will consequently rupture traditional familial structures. As parents die due to the contraction of AIDS, the opportunity costs of children's time increases, for they must incur the household responsibilities their parents once held (Hamoudi and Birdsall 2004: i101). As a result, educational demand will decrease. Secondly, life expectancy and demand for education are correlated. The HIV/AIDS epidemic has drastically reduced life expectancy in Africa. Table 2 presents statistics given by the 2008 CIA Factbook on Zimbabwe's population:

Table 2

2008 est.	
Population	11.35 mm
Life Expectancy	44.28 years
Median Age	16.4 years
Population Growth Rate	-0.787%

Not only has HIV/AIDS contributed to the presence of a negative population growth rate (many others have fled Zimbabwe because of Mugabe's reign, which has largely contributed to the negative population growth rate), but it has also shortened life expectancy to an extraordinarily low level. The life expectancy of a Zimbabwean individual has dropped from 61.0 years in 1992 (DHS 1992) to a mere 44.3 years in 2008. There is no doubt this significant drop is the result of AIDS. Hamoudi and Birdsall assert that after contracting HIV, the median time one has to live is only 6 years (i126), thereby quantitatively illustrating the primary role that AIDS has in the life expectancy drop. As life expectancy decreases, the opportunity cost of an extra year of educational investment increases as the foreshortening of time horizons reduces the expected lifetime private return to education (Hamoudi and Birdsall i101). Although not able to prove causality, Hamoudi and Birdsall theoretically posit that a decrease in life expectancy of 10 years results in a loss of approximately 0.6 years of educational attainment (i119). As the presence of HIV/AIDS has burgeoned, and the probability of contracting HIV has increased since its inception, incentives are higher to join the workforce more prematurely, and thus, reduce education (Cuddington 1993b: 176). Individuals will rationally choose to preserve expenditures and demand less education. The decrease in demand will exacerbate the decrease in human capital attainment that the decrease in educational supply already generates.

HIV/AIDS not only discourages growth of future human capital, but it severely cuts into the current stock of human capital. As aforementioned, HIV/AIDS is primarily transmitted through heterosexual contact and therefore mainly affects adults in the working age. In doing so, it effectively decreases the current labor supply, and thus, the existing stock of human capital (Cuddington 1993b: 176). The disproportionate loss in the well-educated sector of the population (at least in the "first wave" of AIDS) only magnifies the loss of existing human capital since they represent the most productive segment (Hamoudi and Birdsal 2004: i121). The huge losses incurred within the labor supply shifts the age structure of the labor force toward a more youthful cohort. Since this younger-age cohort has attained less schooling, Cuddington argues they will be less experienced and far less productive, thereby further contributing to the erosion of current human capital (177). Lastly, the productivity of those taking care of friends and family stricken with AIDS will be compromised (Cuddington 174). These combined effects (the decrease in labor supply and in its productivity) will effectively cause a decline in output and GDP growth (Cuddington 176).

The prevalence of HIV/AIDS will also cut into GDP through increased healthcare expenditures. The costs associated with treating HIV are enormous, and households need to finance the impending increased health expenditures through reductions in other areas. A typical adult can either reduce his domestic savings, his expenditures on other non-healthcare normal goods, or a combination of the two (the latter method is usually observed). In either case, AIDS represents a negative wealth effect, and the aggregate effect of many households afflicted with AIDS is a reduction in the national savings rate. Capital accumulation is therefore reduced, and GDP growth will consequently be retarded (Cuddington 1993b: 175-176). Furthermore, many households finance these increased expenditures with a reduction in education expenditures, thereby reducing human capital attainment even further (Cuddington 176).

Section II: The Presence of AIDS in a Dualistic Economy

John T. Cuddington (1993a) presents a neo-classical growth model adapted for the presence of HIV/AIDS in an economy containing formal and informal sectors. First, though, he examines the impact of HIV/AIDS on an economy with full employment. He defines labor supply as:

$$E^S = \sum_{i=15}^{64} \rho_i L_i \qquad (1)$$

where E^S is effective labor supply, L_i is the number of workers of age i, and ρ_i is the productivity coefficient for workers of age i. Productivity increases as experience increases, and since there is no direct way to measure experience, it is proxied by taking the worker's age and subtracting 15 years. Cuddington further argues that although productivity and experience are positively correlated, the relationship is nonlinear. Hence, $\rho_i = 0.8 + 0.02(i-15) - 0.0002(i-15)^2$ (He takes this equation from de Beyer, 1993). It is assumed that the labor force encompasses workers of ages 15 to 64 (Cuddington 1993a: 405).

Cuddington utilizes E^S in his aggregate production function, which takes the prevalence of AIDS into account:

$$Y = \alpha\gamma[(1-za)E]^{\beta}K^{1-\beta} \tag{2}$$

where Y is GDP, E is the labor supply as defined above, K is the capital stock, a is the proportion of the active work force afflicted with AIDS, z is the fraction of worker productivity lost because of AIDS-related illness, β is labor's share of total output and α is a constant reflecting the initial values of Y, E and K, and γ is an exogenous time trend capturing technological progress. As a and/or z increase, Y will decrease as these factors diminish the effective labor productivity (E) (405).

Labor demand is derived from profit maximizing behavior as:

$$E^D = \phi K, \text{ where } \phi = [\alpha\gamma\beta(1-za)^{\beta}/w]^{1/(1-\beta)} \tag{3}$$

Firms face a fixed real wage schedule in which relative wages correctly reflect age-specific productivity differentials. Labor demand possesses an inverse relationship with wage (w). As wages increase, labor demand decreases. The same relationship holds with labor demand and the prevalence of AIDS—as a and/or z increase, labor demand will decrease (406).

Cuddington uses these supply of and demand for labor equations as his basis for a more realistic, dualistic, African economy. He posits that such an economy will possess a sticky wage, characterized by being fixed and above the market-clearing level (408). With the sticky wage in place, there will be unemployment, defined as $U = E^S - E^D$ (408). The unemployed will work in the informal sector, which is comprised of jobs such as urban service activities and smallholder agriculture. Workers prefer formal sector employment, as wages here are significantly higher than

those in the informal sector (408). The informal sector, moreover, is highly unregulated and unrecorded and contains little or no access to organized markets or credit institutions (Mhone 1995: 4). Furthermore, it utilizes very little capital and requires only low levels of technology and skills (Mhone 4). Hence, the informal sector is more labor intensive than the formal sector ($\beta_I > \beta_F$, where I denotes the informal sector and F denotes the formal sector). Formal sector labor demand (employment) is the nearly equivalent to the labor demand function in the one-sector economy defined above:

$$E_F = \phi_F K_F, \text{ where } \phi_F = [\alpha_F \gamma_F \beta_F (1 - z_F a)^{\beta_F} / w]^{1/(1-\beta_F)} \quad (4)$$

Informal sector employment is just the difference between total labor supply and employment in the formal sector, that is, $E_I = E^S - E_F$. The income in the informal sector is assumed to be divided among all informal sector workers with appropriate weight for age-related productivity levels:

$$y_I = Y_I / E_I = \alpha_I \gamma_I (1 - z_I a)^{\beta_I} (K_I / E_I)^{1-\beta_I} \quad (5)$$

where y_I is the average revenue product. Each worker in the informal sector receives his weighted average revenue product rather than his marginal revenue product (408).

As analyzed in Section I, the incidence of AIDS negatively affects national savings rates due to increased healthcare expenditures. Cuddington (1993a) presents an application of a neo-classical growth model, which encompasses both the presence of HIV/AIDS and the dualistic nature of many African countries, thereby offering a practical model. Since the formal sector is much more capital intensive than the informal sector, and because of its easier access to capital markets, Cuddington utilizes two separate equations for national capital accumulation:

$$\Delta K_F = s_F Y_F + s^* (Y_F + Y_I) - x_F (H_F + \omega H_I) - \delta_F K_F (t-1) \quad (6) \text{ and}$$

$$\Delta K_I = s_I Y_I - x_I (1 - \omega) H_I - \delta_I K_I (t-1) \quad (7)$$

where s is the savings rate and $s^*(Y_F + Y_I)$ denotes the available foreign funds. Cuddington assumes that foreign capital inflows stay constant at their historical ratio to GDP, s^*. This will be the case whether or not AIDS inflicts the country, for these inflows have been predominately in the form of aid and loans in the recent past. H is AIDS-related healthcare costs, x is the proportion of AIDS-related medical costs that are paid for by reducing national saving rather than current non-medical consumption, δ is the depreciation rate, and ω is an explanatory parameter accounting for the fact that the formal sector, through a socialized medical system evident in many African countries, incurs costs for the informal sector's AIDS-related healthcare costs (409). Given ω,

formal sector dissavings are exacerbated, and since the formal sector is that which has wider access to capital markets, capital accumulation is hit even harder. It is therefore mathematically clear that the high presence of AIDS, through increased healthcare expenditures, drastically reduces capital accumulation, one of the most instrumental factors in economic growth. As $H_{F,I}$ increases, ΔK decreases, and Y necessarily decreases as a result. Moreover, it is imperative for an economy to develop a formal sector comprising a large proportion of the population. Otherwise, the rate of its capital accumulation will be limited by the allocative and technical inefficiency of the large informal sector (Mhone 6). This sector not only reduces the rate at which the national capital accumulation can grow due to its limited access to credit markets, but it forces the formal sector to reduce its own rate of capital accumulation through increased healthcare expenditures.

Section III: Zimbabwe's Economy

Zimbabwe is an excellent case study, for its soaring prevalence of HIV/AIDS and its presence of a large informal sector allow one to adapt Zimbabwe into Cuddington's neo-classical growth model.

Up until its independence in 1980, Zimbabwe had been defined by British colonial rule characterized by apartheid-type discrimination both politically and economically (Mhone 1995: 9). White political control of the region resulted in a system of exploitation of cheap indigenous African labor in which the British colonizers developed a formal sector dominated by primary production and mining (Mhone 8). The British were able to establish this economic system through primary and secondary discrimination of the local Africans. Primary discrimination included the concentration of indigenous Africans on communal and marginal land, an inequitable share of economic infrastructure and social services that included educational possibilities and health care (Mhone 9). Marginal land contained poor soils and unreliable rainfall, and the producers on these lands lacked control of water rights and were excluded from the bulk of the nation's natural resources (Moyo 6, 11). Secondary discrimination encompassed wage discrimination (whites were paid higher salaries for the same work as their African counterparts) and occupational barriers in which the skilled jobs were reserved for the whites (Mhone 9). Both types of discrimination, moreover, were legally reinforced through acts such as the Land Apportionment Act of 1930, the Master and Servant Act, Industrial Conciliation Act, African Juvenile Employment Act, African Labor Regulation Act, and the Foreign Migratory Act (Mhone 9). This white economic domination resulted in the overpopulation of

communal farmlands by indigenous Africans and the consequent inefficiency and lack of productivity of the land, a disproportionate number of Zimbabweans regulated to low-skilled jobs, labor mobility constraints, and limited Zimbabwean initial human capital development (due to the lack of educational opportunities) (Mhone 10).

The colonial period came to an end in 1980 as Zimbabwe gained its independence with Robert Mugabe as its newly appointed leader. The new government established a socialist type regime aimed at reversing the inequitable policies they experienced under British control (Mhone 10). These socialist policies included the protection of its import substitution industrialization strategy (developed during the 1970s during Zimbabwe's period of nationalism and isolationism), a refined web of price controls, and an expansion of educational and health services (Mhone 8, 10-11). The policies also achieved a marked increase in minimum wage for low-skilled formal sector employees, and implemented severe restrictions on employers' ability to fire workers and on workers' rights to collective labor action (Mhone 11). These policies resulted in short and medium term gains in social welfare, but in doing so, they compromised long-term economic growth and efficiency (Mhone 11). Firstly, the import substitution strategy had already exhausted its growth potential (Mhone 9). Mhone also asserts that during this period, healthcare expenditures increased by more than 300%, public assistance expenditures increased by roughly 200%, and the amount of secondary schools were 10 times greater in number at the end of the 1980s as they were in the beginning of the decade (12). These socialist policies resulted in an unsustainable government budget deficit (Mhone 12), and the economy became stagnated (16).

As it became clear that the socialist policies were not working, Zimbabwe's government implemented the economic structural adjustment programs (ESAP) at the close of the 1980s, aimed at creating a more capitalistic, neo-liberal economy. They first reduced the import substitution industrialization policy and replaced it with trade liberalization measures, including the reformation of their tariff structure to allow only modest protection (Mhone 17). They also desired to reduce inflation from its normal 15% throughout the 1980s to 10% annually, deregulate the economy by removing controls over prices, distribution, employment, and wages, reduce the budget deficit by reducing social services, and perhaps most importantly, embark on a massive land reform program (Mhone 17-18). The Land Acquisition Act of 1992 (Moyo 2000: 12) aimed to acquire and redistribute much of the Zimbabwean large-scale commercial farmland (LSCF) from the white

minority to the African smallholder farmers (Moyo 5). In particular, the government targeted 1,470 farms in 1997 (Moyo 5). 59% of these farms, representing 72% of the large-scale farm area, was owned by white companies, while another 39% of the farms representing 24% of the area was mainly owned by individual white farmers (Moyo 17-18). Moreover, 72 owners accounted for 1.2 million hectares, which represents 30% of all LSCF area (Moyo 18). These owners were not socially integrated and were isolated from mainstream party politics (Moyo 12). These ownership patterns limited effective use of the land and resulted in the failure of landowners to invest in capital and human resources on their many dispersed farms (Moyo 18). Thus, it was hoped that land redistribution would increase the efficiency of the quality land and lead to greater production output.

The ESAP failed miserably. Many of the measures in which the ESAP enacted could not be successfully implemented into the economy within a short period of time (Mhone 18). There was also high political sensitivity to price decontrols and reductions in social services (18). The ESAP was also unfortunately accompanied by the worst drought in Zimbabwe's history in 1991/1992, leading to a major drop in agricultural output (Mhone 18). This consequently increased government expenditures for food imports, and rather than reducing the government's deficit, actually worsened it (18). Between 1989 and 1992, Mhone asserts that GDP declined by 2%, prices increased by 75%, and government debt increased by roughly 100% (18-19). The land redistribution program, moreover, was characterized by failure and violence. Moyo asserts that as the land reform policy was being implemented, critics forecast that tobacco production (Zimbabwe's main export) would drop 50% as the small indigenous farmers gaining ownership of new land lacked the resources and skills required to effectively harvest tobacco (they were lacking the skills due in part to the inequitable educational opportunities during the colonial discrimination). Moreover, the critics argued the investment climate would worsen due to investors' uncertainty regarding property rights during the transitional period (Moyo 6). These critics were correct in their assessment: the land reform program was characterized by violence and chaos as Mugabe caused a "white exodus" in 2000 (CIA Factbook). The policy badly damaged the commercial farming sector, which was the provider of roughly 400,000 formal sector jobs (CIA Factbook), and no doubt encouraged the growth of the informal sector as a result.

Zimbabwe's population increased by about 2.8% annually in the 1990s, while formal sector employment only increased only 2% during this entire time (Mhone 18-19). During this time, moreover, unemployment skyrocketed and thousands of workers were retrenched. As a result, Mhone asserts the informal sector increased from comprising about 10% of the labor force in 1980 to about 25% of the population in 1995 (1). The land reform policy has only exacerbated the numbers in the informal sector. Zimbabwe's economy in the most recent decade has only further deteriorated as its participation in the war in the Democratic Republic of Congo has drained hundreds of millions of dollars from its budget (CIA Factbook). Inflation has soared from 32% in 1998 to about 26,000% in November of 2007 due to the government's routine printing of money to fund its budget deficit (CIA Factbook). There has also been a rapid depreciation in Zimbabwe's currency: the official exchange rate fell from approximately 1 Zimbabwean dollar per US dollar in 200 to 30,000 Zimbabwean dollars per US dollar in 2007 (CIA Factbook). Table 3 illustrates other key statistics of today's Zimbabwean economy:

Table 3

CIA Factbook		**Year Estimate**
GDP (mm)	$641.0	2007
GDP Real Growth Rate	-5.5%	2007
GDP/Capita	200.0	2007
Unemployment Rate	80.0%	2005

With the unemployment rate reaching roughly 80% in 2005, one can only expect the informal sector to have grown considerably (note that earlier percentages were just estimates, as it is exceedingly hard to measure the informal sector given that it is not officially regulated nor recorded). Cuddington asserts that AIDS-ridden economies can ill-afford income losses due to resource misallocation (416). Zimbabwe, through its growth in the resource inefficient informal sector and through its expenditures in the war in the Democratic Republic of Congo, has lost millions of dollars due to its misallocation. It can only expect an elongated dualistic era, and therefore, a low capital accumulation rate, especially given its HIV/AIDS prevalence rate of roughly 20.1%. As the informal sector remains a large proportion of the population, the formal sector, that which is able to access capital markets, will have to incur extra healthcare costs (to finance the informal sector's AIDS-related costs), and therefore, will not be able to accumulate the capital necessary for long-term economic growth.

Section IV: Sexually Risky Behavior

It is apparent that reducing the prevalence rates of HIV/AIDS is imperative in capital accumulation and economic growth. Therefore, one must understand the principal mode in which HIV is transmitted. In Zimbabwe, as in the rest of Africa and the world, the primary mode is through heterosexual contact, which accounts for 80-90% of all HIV infections in the country (DHS). HIV, moreover, is generally transferred through sexually risky behavior. There are three main sexual behaviors that are largely considered risky: not using a condom during last intercourse, engaging in sexual relations with more than one partner (that partner being your wife or spouse), and having one's sexual debut at an early age. This section analyzes the first two of these risky behaviors amongst men in Zimbabwe. It is important to understand the determinants of sexually risky behavior, for it is reasonable to assume that as risky behavior decreases, HIV transmission will as well. This section utilizes data from the 2005/2006 Measure DHS, a survey conducted by The Central Statistical Office as part of the Zimbabwe National Household Survey Capability Programme and the Demographic and Health Surveys program (DHS xviii). This survey interviewed 7,175 men aged 15-54 and 8,907 women aged 15-54 across Zimbabwe (DHS xix). The data used in this paper are taken from the men's recode. This section particularly examines the roles of marriage, education, and the spread of knowledge in determining sexually risky behavior using three primary probit regression models.

The first model examines the use of a condom during last intercourse within a 12 month period. The dependent variable, use of a condom, is a binary variable that equals one if the male did use a condom and zero if he did not. The binary nature of the variable allows one to use a probit model and thus observe the estimated increase or decrease in the probability of using a condom given a unit increase in one of the explanatory variables. The dependent variable "condomuse" is regressed against current marital status, a variable describing if the male is divorced, separated, or widowed, educational attainment, a knowledge index, the frequency in which the male reads a newspaper or magazine, age, region, and wealth. Current marital status is one of the most telling predictors, for it is expected that the probability of using a condom would decrease if one is married. Unless his wife is engaging in sexually risky activity outside of the marriage, or if the man suspects his wife of secretly harboring the HIV virus, there is little incentive for him to use a condom, save decreasing fertility. This variable is a dummy variable that equals one if the male is married and zero otherwise. Formerly married is also a dummy variable that equals one if the male is divorced,

separated, or widowed. Educational attainment is measured in single years of schooling and is an important predictor, for it is expected that as years of education increase, knowledge attainment about HIV prevention methods would likewise increase. Knowledge index is a summary variable which measures the male's comprehensive knowledge of HIV/AIDS. It encompasses nine individual questions:

> 1.Has the male heard of STDs? 2. Has he heard of HIV/AIDS? 3. Does he know that one can reduce the chance of acquiring HIV by abstaining from sex? 4. Does he know that one can reduce the chance of acquiring HIV by using a condom? 5. Does he know that one can reduce the chance of acquiring HIV by having sex with only 1 partner? 6. Can one acquire HIV from mosquito bites? 7. Can one acquire HIV by sharing food with someone who has AIDS? 8. Can a healthy looking person have AIDS? and 9. Can one acquire HIV by witchcraft or other natural means?

The correct answer to each question equals one, while the incorrect answer equals zero. The number of correct answers was then added together, thus creating the knowledge index. Hence, a male is considered to possess comprehensive knowledge of HIV/AIDS if his knowledge index equals nine, that is, if he answered all of the above questions correctly. Although similar in nature to educational attainment, this variable captures knowledge that educational attainment may not. Although it is probable that one would attain knowledge about HIV prevention methods throughout their scholastic career, it is not definite that education is responsible for his knowledge of the answers to the questions listed above. "Read" is a dummy variable equaling one if the male reads a newspaper or magazine at least once a week. This measure is included due to the presence of HIV/AIDS awareness advertisements presented in newspapers and magazines. Thus, it is expected that the more frequently one reads, the more he would know about HIV/AIDS. The males were broken up into eight 5-year cohorts: ages 15-19, ages 20-24, ages 25-29, and so on until ages 50-54. The first seven of these cohorts are included in the regression as dummy variables (if you are in a certain age cohort, that cohort equals 1). The eighth cohort is omitted to avoid multicolinearity problems. Since the younger cohorts are those that are actively searching for a potential spouse or wife, it is expected that these are the cohorts that would wear a condom with higher probability. Younger cohorts are also less likely to be married, and less likely to want children of their own. The variables cohort1*married, cohort2*married, cohort3*married, cohort4*married, cohort5*married, cohort6*married, and cohort7*married are included to account for interaction effects. A member in a given cohort who is married is expected to act differently than a member of the same cohort who

is not married. Without these measures, the effect of current marital status would be inflated. These are all also dummy variables: They equal one if a male is both within the given cohort and married, and zero otherwise. The region variable is a dummy variable that equals one if the male lives in a rural setting and zero if he lives in an urban area. It is expected that those living in an urban setting would have a higher probability of wearing a condom due to the density of stores that would increase their supply. The transportation cost of acquiring a condom is lower in urban areas. Finally, a wealth index is included, for as wealth increases, it becomes more affordable for one to purchase condoms. This variable ranges from 1 to 5, with 1 signifying being the "poorest" and 5 signifying being the "richest." The final two variables are used as controls:

$$\begin{aligned}\text{Probit } (condomuse) &= \alpha_0 + \beta_1(currentmaritalstatus) + \beta_2(formerlymarried) \\ &+ \beta_3(educationalattainment) + \beta_4(knowledgeindex1) + \beta_5(read) + \beta_6(cohort1) \\ &+ \beta_7(cohort2) + \beta_8(cohort3) + \beta_9(cohort4) + \beta_{10}(cohort5) + \beta_{11}(cohort6) \\ &+ \beta_{12}(cohort7) + \delta_1(cohort1 * currentmaritalstatus) + \delta_2(cohort2 * currentmaritalstatus) \\ &+ \delta_3(cohort3 * currentmaritalstatus) + \delta_4(cohort4 * currentmaritalstatus) \\ &+ \delta_5(cohort5 * currentmaritalstatus) + \delta_6(cohort6 * currentmaritalstatus) \\ &+ \delta_7(cohort7 * currentmaritalstatus) + \lambda_1(urbanorrural) + \lambda_2(wealthindex) + \varepsilon\end{aligned}$$

Table 4

Variable	Coefficient	Std Deviation	Coeff*Std.Dev.	P-Value
currentmaritalstatus	-0.641	0.497	-0.318	0.025
formerlymarried	0.287	0.216	0.062	0.006
educationalattainment	0.037	2.719	0.100	0.001
knowledgeindex1	0.084	1.358	0.114	0.000
read	0.066	0.492	0.033	0.266
cohort1	0.752	0.447	0.336	0.006
cohort2	1.068	0.400	0.427	0.000
cohort3	0.773	0.351	0.272	0.005
cohort4	0.565	0.328	0.185	0.050
cohort5	0.280	0.286	0.080	0.361
cohort6	0.071	0.243	0.017	0.828
cohort7	-0.139	0.237	-0.033	0.693
cohort1*married	-0.412	0.031	-0.013	0.527
cohort2*married	-1.117	0.193	-0.215	0.000
cohort3*married	-1.016	0.281	-0.285	0.001
cohort4*married	-0.964	0.300	-0.289	0.002
cohort5*married	-0.314	0.263	-0.082	0.342
cohort6*married	-0.213	0.223	-0.048	0.551
cohort7*married	0.033	0.220	0.007	0.931
urbanorrural	-0.044	0.475	-0.021	0.567
wealthindex	0.057	1.391	0.080	0.037
constant	-1.762	0.331	-0.584	0.000

Table 5

Number of Obs.	4616
Pseudo R^2	0.302

The results are illustrated in Tables 4 and 5 above.

Most of these variables obtain heir expected signs. As predicted, educational attainment, knowledge index, and read all carry a positive sign, signifying that an increase knowledge awareness does indeed increase the probability of a male wearing a condom during intercourse. The more years in which one schools, the higher his knowledge index score is, and the more frequently he reads the newspaper, the likelihood of that male wearing a condom increases. Moreover, both educational attainment and knowledge index are significant. Unfortunately, the read variable is not statistically significant, so no causality exists there.

The age variables and current marital status variable should be analyzed together. First, though, the current marital status carries its expected sign if taken alone and is also statistically significant. If one is married, there is less incentive to use a condom since the fear of contracting the HIV virus is greatly diminished. The impact of age, however, requires more complex analysis. Analyzing the impact of age alone on the probability of wearing a condom is inexact, for the samples within the individual cohorts differ. For example, there are many males in cohort 3 and 4 who are married, but also many who are not. Those who are married within these cohorts are less likely to use a condom than those who are still searching for a spouse. Thus, being married has different effects on different age groups. Because of this, it is necessary to analyze both the cohort and the cohort*maritalstatus variables together. If a male within any cohort is not married, the positive or negative impact of his age is simply the sign of his cohort variable. The coefficients of cohort1, cohort2, cohort3, and cohort4 are all positive, and perhaps more importantly, are statistically significant. This is extremely encouraging, for it indicates that the probability of an unmarried male using a condom increases if he is between the ages of 15-34. Although the coefficients of cohort5 and cohort6 are also positive, these variables are insignificant. Unlike those in the first few cohorts, those in cohort5 and cohort6 represent males aged 35-44, and thus present a group whose makeup probably consists of more married than unmarried individuals. Their coefficients are expected to be negative. Hence, it makes sense that they are insignificant. The coefficient of cohort7 carries a

negative sign, which makes sense since the males in this cohort are aged 45-49 and most likely married. This variable, however, is insignificant. In the case of a married male, it is necessary to analyze the additive effects of the coefficient of their age cohort variable and that of the cohort*currentmaritalstatus variable due to interaction effects. The additive effects of the coefficients of the seven cohorts are listed in Table 6 below:

Table 6

COHORT	Cohort Coefficient	Cohort*married Coefficient	Additive Coefficient
1	0.752	-0.412	0.340
2	1.068	-1.117	-0.049
3	0.773	-1.016	-0.243
4	0.565	-0.964	-0.399
5	0.280	-0.314	-0.034
6	0.071	-0.213	-0.142
7	-0.139	0.033	-0.106

The additive coefficient of cohort 1 is a bit unexpected, for the probability of a married male using a condom increases if he is between the ages of 15-19. This cohort1*currentmaritalstatus variable, however, is insignificant, probably because of the dearth of married males within cohort 1. Indeed, the mean of this variable is a mere .0009756, which proves that there are very few married males in cohort1 since this variable is a dummy variable. The additive effects of the two variables for cohorts two, three and four, however, are expected. The probability of using a condom decreases if a married male is in either of these cohorts. Furthermore, the additive coefficient is more negative for cohort3 than for cohort2, and more negative for cohort4 than for cohort3. That is, the probability of wearing a condom decreases further for a married male in cohort4 than it does for a male in cohort3. This is also expected: not only are there most likely more married males within cohort4 than in cohort3 (and more within cohort3 than in cohort2), which would increase the sample size and therefore increase the reliability of the data, but it is also assumable that those in cohort4 are more mature and less presumptuous than those in cohort3. Moreover, older males, especially if married, are likely to be at or close to their desired completed family size, and hence may be using condoms more often to prevent additional births. The variables cohort2*currentmaritalstatus, cohort3*currentmaritalstatus, and cohort4*currentmaritalstatus are all statistically significant, which is encouraging. Like the previous three cohorts, the additive coefficient of cohorts five, six, and seven are all negative, thereby implying that the probability of using a condom decreases if a married

male is 35-49 years of age, which is expected. Despite this observation, the variables cohort5*currentmaritalstatus, cohort6*currentmaritalstatus, and cohort7*currentmaritalstatus are all statistically insignificant.

The coefficient of wealthindex carries the expected sign and is significant. As wealth increases, condoms become more affordable. Lastly, as expected, living in a rural setting seems to decrease one's probability of using a condom. This variable, though, is insignificant.

It is useful to look at the "average male" within cohort2 (ages 20-24), for these are the males that are presumably most sexually active. By restricting the data to those only aged 20-24, it is observed that the average Zimbabwean male has attained 9.2 years of education, scored an 8 on the knowledge index assessment, lives in a rural setting, is not married (and clearly not formerly married), and does not frequently read the magazine or newspaper. Utilizing the probit regression, one can see numerically how a unit increase in the knowledge index increases the probability of using a condom for a male aged 20-24 (the sign of the coefficient is positive, so we know the probability will increase). The increase in the knowledge index from 8 to 9 (from average knowledge to comprehensive knowledge) increases the probability of wearing a condom during last sexual intercourse by approximately 2.85%. Putting this percentage into relative perspective, the change is very important. The standard deviation of knowledge index amongst all males is 1.358, while this value is 1.24 amongst males only in cohort2, and the "impact" of this variable's effect on condom usage probability (defined as the standard deviation multiplied by the coefficient of the variable) is .114 and .104 for the two sets, respectively. Since the highest possible score on the knowledge index is a 9, these standard deviations show that there is plenty of opportunity to raise further awareness about HIV. Indeed, DHS indicates that only 48.4% of men aged 20-24 possess comprehensive knowledge (208). Furthermore, the standard deviation of knowledge index is one of the highest amongst all variables, illustrating the importance of continuing to raise awareness to increase the probability of using a condom. The size of the percentage change is also large compared to other variables, for only becoming married and becoming older carry a higher impact.

The increase in educational attainment from 9 to 10 years (the average to one extra year) also increases the probability of wearing a condom during last sexual intercourse by approximately 1.08%. The standard deviation of education amongst all males is 2.719 years, while this value is

2.329 years amongst males in cohort2. As with knowledge index, there is plenty of room to improve educational attainment, thus making this percentage increase an important one. Also like knowledge index, the impact is high compared to other variables. It is .1 for all males and .085 for males within cohort2. Only current marital status, cohort level, and knowledge index carry a higher impact. These are very encouraging signs, and they suggest that policy makers should stress the further spread of knowledge through more education and public campaigns that urge safer sex.

It is useful to examine multiple variations of a regression to more fully understand the relations and causality between the independent variable and the explanatory variables. Like the above regression, the following regression analyzes the probability change of using a condom during last intercourse given a change in the dependent variables—the only difference is that age is measured in single years rather than by cohorts. Hence, the cohort variables were omitted and substituted by age and age squared variables. The age squared variable is included due to the quadratic nature of age and the use of condoms. As a young male first matures, say from 15 to 29, the probability of him having sex increases. Further, it is expected that condom use will also increase at this time since the majority of these males will be unmarried and actively searching for a spouse. As a male's age increases past 29, though, the probability that he becomes married increases, and thus, the probability that he uses a condom decreases. Hence, a single variable function with age as the independent variable and condom use as a dependent variable would be quadratic and concave. Thus, the alternate condom use probit model is:

$$\begin{aligned}\text{Probit}\ (condomuse) &= \alpha_0 + \beta_1(currentmaritalstatus) + \beta_2(formerlymarried) \\ &+\beta_3(educationalattainment) + \beta_4(knowledgeindex1) + \beta_5(read) + \beta_6(age) \\ &+\beta_7(age^2) + \delta_1(age * currentmaritalstatus) + \delta_2(age^2 * currentmaritalstatus) \\ &\lambda_1(urbanorrural) + \lambda_2(wealthindex) + \varepsilon\end{aligned}$$

The results are illustrated in tables 7 and 8 below:

Table 7

Variable	Coefficient	Std Deviation	Coeff*Std.Dev.	P-Value
currentmaritalstatus	-0.478	0.497	-0.238	0.485
formerlymarried	0.209	0.216	0.045	0.043
educationalattainment	0.036	2.719	0.098	0.001
knowledgeindex1	0.084	1.358	0.114	0.000
read	0.064	0.492	0.032	0.279
age	0.066	10.534	0.691	0.020
age squared	-0.002	798.976	-1.234	0.001
age*married	-0.102	18.638	-1.909	0.014
agesquared*married	0.002	798.976	1.694	0.001
urbanorrural	-0.048	0.475	-0.023	0.530
wealthindex	0.058	1.391	0.081	0.034
constant	-1.545	0.435	-0.671	0.000

Table 8

Number of Obs.	4616
Pseudo R^2	0.296

This regression illustrates many similar findings as the previous one. Formerly married, educational attainment, and knowledge index are all significant, and their coefficients all carry a positive sign indicating that a unit increase in any of these variables would increase the probability of a using a condom. Read and urban or rural carry the same sign and insignificance in this regression as in the previous one. Also like before, wealth index carries a positive sign and is significant. The coefficients of age and age squared variables obtain their expected signs, and the variables are encouragingly significant. Moreover, the coefficient of age is more positive than the coefficient of age squared is negative, which is expected. The probability of an unmarried male using a condom decreases as his age increases. The additive effect of the age and age*currentmaritalstatus coefficients is negative, implying as before that the probability of using a condom decreases if a male is married. Lastly, the sign of the coefficient of current marital status is negative as before. However, the variable is statistically insignificant in this regression, proving to be the only major distinction between the two. Because of this, the first regression probably has a better fit.

As in the case with condom use, the following models utilize a probit regression for the variable "morethan1partner." The first model is restricted to those males who are only married, while the second restricts the samples to only unmarried males. The dependent variable is binary and equals one if the male engages in sexual relations with more than one partner and zero if he does not. The name of the variable, "more than 1 partner," is a bit misleading—this name only applies to the male if he is married. The true meaning of the variable is: "is the male engaging in sexual contact with any partner other than a wife or spouse," for this is the definition DHS supplies of engaging in "sexually risky behavior." This variable, moreover, takes polygyny into account. If a male has 3 wives, suppose, then it is not considered risky to engage in sexual activity with all three wives. He would be considered engaging in sexual activity with more than one partner if he had sex with 4 partners: his 3 wives and a fourth casual partner. This variable was regressed against most of the same explanatory and control variables as the dependent variable "condomuse:"

$$\text{Probit}\ (morethan1partner) = \alpha_0 + \beta_1(educationalattainment) + \beta_2(knowledgeindex1) + \beta_3(read) + \beta_4(cohort2) + \beta_5(cohort3) + \beta_6(cohort4) + \beta_7(cohort5) + \beta_8(cohort6) + \beta_9(cohort7) + \lambda_1(urbanorrural) + \lambda_2(wealthindex) + \varepsilon$$

The results are illustrated in Tables 9 and 10 below:

Table 9

Variable	Coefficient	Std Deviation	Coeff*Std.Dev.	P-Value
educationalattainment	-0.030	3.090	-0.092	0.034
knowledgeindex1	0.003	1.191	0.003	0.000
read	0.072	0.488	0.035	0.225
cohort2	1.111	0.282	0.313	0.012
cohort3	0.964	0.396	0.382	0.871
cohort4	0.718	0.418	0.300	0.075
cohort5	0.668	0.374	0.250	0.991
cohort6	0.353	0.323	0.114	0.334
cohort7	0.445	0.319	0.142	0.403
urbanorrural	-0.234	0.475	-0.111	0.494
wealthindex	-0.016	1.425	-0.023	0.051
constant	-1.644	0.300	-0.493	0.000

Table 10

Number of Obs.	3168
Pseudo R^2	0.0413

This regression presents rather intriguing results, some of which are counter-intuitive. Firstly, the variables current marital status and formerly married were omitted. By definition, a married male is currently married, and thus, not formerly married. The variable cohort1 was also omitted since there were only 7 married males within the cohort. A unit increase in educational attainment (corresponding to an extra year of schooling) decreases the probability of engaging in sexual relations with more than one partner and is statistically significant. This is expected and encouraging, for it appears that extra educational attainment raises awareness about HIV prevention methods. However, the signs of the coefficients of knowledge index and read are positive, suggesting that as one increases his score on the knowledge index test or as one reads the newspaper more frequently (both assessments of awareness of HIV prevention methods) the probability of engaging in sexual affairs with more than one partner actually increases. This finding is odd on a few levels. Unlike the previous regression where it was expected to see the probability of using a condom decrease amongst married males, it is never expected to see the probability of engaging in sexual relations increase amongst this group. It is also odd to see how an increase in knowledge awareness actually causes an increase in probability of engaging in sexual relations with more than one partner. Although read is insignificant, thereby implying that no causality can be inferred, knowledge index is significant. The opposite of this observed effect was expected, but the data do not show this. It is possible, however, that there is an endogeneity issue within the regression. Those who engage in a high level of sexual risky behavior may decide to learn more about HIV prevention. Thus, their behavior could actually help determine their knowledge of the virus.

The size of the coefficients and the impact of the cohort variables decrease as the cohort level increases, which is expected. Although this regression was restricted to married individuals, younger males are still more opportunistic than older ones. Hence, it appears as if the probability for a higher frequency of sexual relations decreases as age increases. Despite this finding, only cohort2 is significant at the $\alpha = .05$ level, and only cohort4 is significant at the $\alpha = .10$ level. The probability of engaging in sexual relations with more than one partner decreases if the male lives in a rural setting. This potentially reflects the fact that there is a greater density of people in urban areas, and hence, a greater supply of potential partners. This variable, however, is insignificant. Another counter-intuitive result seen in this regression is that the coefficient of wealth index is negative, implying as wealth increases, the probability of engaging in sexual relations with more than one partner decreases. As mentioned in Section I, wealth is associated with more education since

education is a normal good, and wealth may also increase the "status" of the males, thereby increasing the capability to attract more partners. Therefore, it would be expected that wealth would increase the probability of engaging in sexual activity with more than one partner. However, it is possible that the tragic nature of Zimbabwe has transformed the nature of this perceived normal good. As a male's wealth increases, his social class will also increase, and as a result, he will encounter different sets of people than he did in the past. Specifically, he may encounter women with more educational attainment (since education is a normal good, it is expected that these women will have attained more schooling because of their higher degree of wealth) who have a high awareness of HIV prevention methods. Therefore, they may be less willing to engage in a high frequency of sexual relations, thus decreasing the male's probability of engaging in sexual relations with more than one partner. This variable, moreover, is significant.

The equivalent probit regression for unmarried males gives very similar results to the above regression:

$$\begin{aligned}\text{Probit}\ (morethan1partner) &= \alpha_0 + \beta_1(formerlymarried) + \beta_2(educationalattainment) \\ &+ \beta_3(knowledgeindex1) + \beta_5(read) + \beta_6(cohort1) + \beta_7(cohort2) + \beta_8(cohort3) \\ &+ \beta_9(cohort4) + \beta_{10}(cohort5) + \beta_{11}(cohort6) + \beta_{12}(cohort7) \\ &+ \lambda_1(urbanorrural) + \lambda_2(wealthindex) + \varepsilon\end{aligned}$$

The results are illustrated in Tables 11 and 12 below:

Table 11

Variable	Coefficient	Std Deviation	Coeff*Std.Dev.	P-Value
formerlymarried	0.725	0.284	0.206	0.000
educationalattainment	0.001	2.382	0.003	0.916
knowledgeindex1	0.030	1.478	0.044	0.071
read	0.174	0.495	0.086	0.001
cohort1	0.298	0.500	0.149	0.202
cohort2	1.135	0.454	0.515	0.000
cohort3	1.141	0.306	0.349	0.000
cohort4	1.011	0.197	0.199	0.000
cohort5	0.527	0.164	0.086	0.040
cohort6	0.240	0.136	0.033	0.379
cohort7	0.131	0.123	0.016	0.645
urbanorrural	-0.067	0.475	-0.032	0.343
wealthindex	-0.066	1.363	-0.090	0.009
constant	-1.293	0.282	-0.365	0.000

Table 12

Number of Obs.	3993
Pseudo R^2	0.105

This regression is perhaps even more important than the previous one, for it is predicted that unmarried males engage in a higher frequency of sexual partners than do married males. The coefficient of formerly married is positive and statistically significant. This makes sense. DHS indicates that the mean number of partners that a formerly married man has had in his lifetime is 9.4, the highest mean of any sub-group. The regressions confirm this observation. If one is formerly married, the probability of him engaging in sexual activity with more than one partner increases significantly, given that the value of its impact is .206. This variable carries the third highest impact amongst the predictors in this regression—only cohorts two and three have a higher impact on the probability of engaging in sexual relations with more than one partner. Like the previous regression, the impact of cohort groups decreases as the cohort age increases. It appears is if older males are less opportunistic amongst unmarried males as well. This statement is untrue of cohort1, though. The value of this variable's coefficient is only .298, and its impact is only .149, considerably less than those of cohort2. This observation is predicted, though, for those in cohort1 are still relatively young (15-19), so the frequency of engaging in sexual relations increases as they age into cohort2 (20-24). Although this variable is statistically insignificant, cohrot2, cohort3, cohort4, and cohort5 are all significant. As in the previous regression, the coefficient of urban or rural is negative and the variable insignificant. The coefficient of wealth index also carries a positive sign, and this variable is also significant, as in the previous regression.

The variables educational attainment, knowledge index, and read present superficially counter-intuitive results, but unlike the previous regression, there is a potential explanation for these observations. The coefficients of all three variables carry positive signs, implying that the probability of engaging in sexual relations with more than one partner increases as knowledge about the HIV virus increases. The coefficient of educational attainment, though, is only .001, which is extremely small. Its impact is also fairly negligible. This variable, moreover, is statistically insignificant. However, knowledge index is significant at the $\alpha = .10$ level, and read is significant at the $\alpha = .05$ level. The coefficients' positive signs do have an explanation. Glick and Sahn use the term "risk compensation" to describe this seemingly counter-intuitive result (423). As seen in the first

regression, an increase in spread of knowledge increases the probability of using a condom amongst unmarried males, as does the increase in educational attainment. Men, however, view this as practicing safe sex and therefore rationalize that if they use a condom, they can engage in sexual activity with more partners. They believe using a condom ensures sexual safety, so they compensate this form of protective behavior with another form of sexually risky behavior (423). This confirms Hamoudi and Birdsall's findings that the well educated are indeed very susceptible to contracting HIV. His "risk compensation" may also explain why the variable "educationalattainment" is insignificant in the second regression. As one attains more schooling, he becomes more aware of and knowledgeable about HIV, but he also may practice "risk compensation" and substitute one risky behavior (condom use) for another (more than 1 partner). It is also possible that the same endogeneity problem that exists in the previous regression exists within this one as well. Thus, the effect of education is unclear on overall reduction of sexually risky behavior. The effect of spread of knowledge (proxied by knowledgeindex1) is also unclear on the overall effect of reducing sexual behavior due to "risk compensation."

In its final report, DHS presents telling statistics. They are reproduced below as Tables 13 and 14:

Table 13

Past 12 Months	**Sex with 2+ Partners(%)[1]**	**More than 1 Partner (%)[2]**	**Used a Condom (%)[3]**	**Mean Partners**
Age				
15-19	15.2	96.5	54.4	2.9
20-24	21.7	69.9	75.6	4.3
25-29	15.9	34.4	77.9	5.8
30-39	10.6	16.4	79.9	5.7
40-49	9.8	10.4	55.9	8.0
Marital Status				
Never Married	19.7	98.9	69.7	4.2
Married	11.7	10.8	75.3	5.8
Divorced/widowed	20.2	83.0	71.9	9.4

1 Implying engaging in sexual relations with 2 or more women, regardless of their status as a spouse/wife

2 Implying engaging in sexual relations with anyone who is not a spouse/wife.

3 Exluding sex with wife or spouse

Table 14

TEACHING AGES 12-14 ABOUT CONDOMS		
	Women (%)	**Men (%)**
Age		
18-24	41.6	51.4
25-29	41.2	48.9
30-39	41.2	45.0
40-49	41.3	43.8

Table 13 represents only those males who were sexually active in the preceding 12 months before the survey was taken. This table illustrates that the Zimbabwean youth are still engaging in very sexually risky behaviors. A staggering 96.5% of those aged 15-19 who are having sex are doing so with a woman who is not their wife or spouse. This number significantly drops in the 20-24 aged cohort, and drops even further in the 25-29 aged cohort, which is expected since more males get married within these age groups. Nevertheless, 69.9% of those aged 20-24 and 34.4% of those aged 25-29 are engaging in sexual activity with someone else besides their wife or spouse, which is far too high a percentage given the extreme prevalence of HIV/AIDS in Zimbabwe. The percentages are more encouraging in the second column of Table 13. 54.4% of those aged 15-19 are using condoms, whereas 75.6% of those aged 20-24 are using condoms during last intercourse. Although these are better figures than the percentages of those not engaging in sex with more than 1 partner, they still need improvement. Almost 50% of those aged 15-19 does not use condoms. Based on this rate, it is not surprising that HIV/AIDS prevalence rates are still above 20%. Through examining Table 14, it appears that less than 50% of the sample feel that children aged 12-14 should be taught about condoms in school. These figures are baffling given the high level of HIV/AIDS in the country. The younger generations are clearly engaging in sexually risky activity, so it is apparent that they should be informed about condom use. It appears that children aged 12-14 are only 1-3 years away from engaging in sexual activity, and almost half of these youths will probably not wear a condom. Maybe it is a lack of sexual education at a young age that is explaining the low use of condoms. Nevertheless, the regressions and these tables illustrate the importance of the spread of knowledge about HIV/AIDS in reducing sexually risky behavior (through increased condom use at least), and thus, reducing the transmission rate of HIV.

It is also interesting to note that those who were formerly married have the highest mean number of lifetime partners. This is not surprising, for the DHS final report asserts that the divorced and widowed have the highest HIV/AIDS prevalence rates of any subgroup (225).

Section V: Limitations

There are several limitations present in this model. The third widely used measure to evaluate sexually risky behavior is sexual debut. Given that this paper only uses one DHS survey (the 2005/2006 Measure DHS Survey), the conclusions one can draw are limited. Assume that a male debuts when he is 15. After his debut, he may go on to gain further educational attainment and learn more about HIV/AIDS. Thus, when he did debut, he may not have known as much as he currently does. Hence, his current levels of educational attainment and his knowledge index score could potentially be very misleading and biased. Not only this, but as one gets older, the social norms may change. For example, it may be more socially acceptable now to stall one's debut than it was 15 years ago. Thus, as social norms change, individuals may lie about their debut and succumb to "social desirability bias" (Glick and Sahn 408). Moreover, variables such as marital status and formerly married would not represent causality at all, as they would widely be irrelevant. All these factors illustrate that it is much more useful and accurate to observe how sexual debut changes over time across different subsets of people—that is, to see how the mean age of sexual debut changes over time by utilizing multiple DHS surveys. Sexual debut is also a more useful behavior to study amongst women, who may leave school early at a young age to marry an older man. This practice is very common in polygamous cultures.

Another limitation occurs due to biased responses. In answering survey questions, many men may have felt societal pressures and have altered the true responses. For example, a man may feel uncomfortable in telling a DHS employee if he has had sex with anyone besides his wife.

Section VI: Conclusion

The prevalence of HIV/AIDS in Zimbabwe is still above 20%, representing one of the highest prevalence rates in the world. It is imperative to curb this rate in order to facilitate economic growth through various means. The only way to curb HIV incidence, moreover, is to limit sexually

risky behavior amongst all males in Zimbabwe, but especially amongst the youth who represent (or who soon will represent) the primary working human capital in the economy. This extraordinary prevalence has greatly reduced the average life expectancy in Zimbabwe. Because of this, the opportunity cost of an additional year of education has increased, thereby decreasing the educational attainment that an average Zimbabwean male is expected to possess. Moreover, because HIV/AIDS inflicts the sexually active, a large proportion of the current human capital has been or soon will be killed off. These cumulative effects lead to a younger generation of workers who have less educational attainment and experience—something that will impede GDP growth. Decreasing the incidence of HIV will go a long way towards reversing this pattern. Using a condom during intercourse and limiting sexual relations to only one's spouse or wife will curb the HIV/AIDS prevalence rate in Zimbabwe. As seen in the regressions, increasing educational attainment and furthering awareness of HIV/AIDS will greatly contribute towards limiting sexually risky behavior (even if risk compensation is observed, a higher educational attainment will increase the probability of wearing a condom amongst married and unmarried males, which alone will help decrease the spread of the virus). If the HIV/AIDS prevalence rate decreases, it is probable that rational households will choose to keep their children in school for longer periods of time due to the decreasing opportunity cost of an additional year of education. This will therefore result in a more educated workforce and will contribute to a positive real GDP growth.

The high rate of HIV/AIDS does not only decrease educational attainment, but it also lowers national savings rates due to the increased healthcare expenditures that the nation incurs, which will undoubtedly help cause Zimbabwe's real GDP to grow at slower rates. As explained in Section II, John Cuddington presents a model of capital accumulation for an economy characterized by possessing both formal and informal sectors:

$$\Delta K_F = s_F Y_F + s^*(Y_F + Y_I) - x_F(H_F + \omega H_I) - \delta_F K_F(t-1)$$

$$\Delta K_I = s_I Y_I - x_I(1-\omega)H_I - \delta_I K_I(t-1)$$

Zimbabwe fits well into the above model as a case study, for its informal sector has continued to grow due to Zimbabwe's poor economic policies. The implementation of ESAP, which resulted in the reallocation of the Zimbabwean large-scale commercial farmland from the white minority to the indigenous majority, and Mugabe's insistence on participating in the war in the Democratic Republic of Congo has not only led to a worsening governmental budget deficit, but has been the main contributor to the collapse of the formal sector and hence a decline in the part of the economy

responsible for savings. The model predicts that the rate of capital accumulation will be deterred by the high prevalence of HIV/AIDS. The formal sector, and hence, the government, will have to cut its national savings to finance two new immediate expenditures: the first represents the AIDS related healthcare costs of those in the formal sector, and the second represents a portion of the AIDS related healthcare costs of those in the informal sector who are unable to finance their own expenses. Because of Mugabe's aggressively poor economic policies, national savings already have been drastically reduced. The high prevalence of HIV/AIDS will only exacerbate this problem, thereby impeding capital accumulation even further. Moreover, individual households will have to both cut into its own future savings and decrease other normal goods expenditures in order to finance their familial members' AIDS related healthcare costs. One of these normal goods will probably be education—many households will have to substitute educational expenditures for drastically rising healthcare costs. This effect will only decrease human capital even further. Thus, reducing the rate of HIV/AIDS will decrease the necessary expenditures on AIDS related healthcare and consequently help enable Zimbabwe to accumulate capital at faster rates. This increased rate of capital accumulation, in turn, will contribute to faster real GDP growth. Once again, since HIV is contracted mainly through heterosexual relations, it is imperative to increase knowledge awareness concerning the epidemic so that young males throughout Zimbabwe practice safer sexual behaviors. Even when this happens, though, there will still be a transition period in which capital accumulation remains stagnant, for there is a lag between the point in which HIV develops into AIDS. Even when sufficient knowledge of preventing HIV contraction is possessed by the nation, there will still be a proportion of the young population that has HIV and that awaits this virus to transform into AIDS, whence they will incur the aforementioned healthcare costs. Hence, even if we assume that Zimbabwe possess the knowledge awareness needed to rid a majority of the nation from HIV/AIDS today (which is not the case anyway), its economy would not be able to grow and develop for at least a few more years due to substantial healthcare expenditures.

Only through decreases in sexually risky behaviors will the spread of HIV through sexual activity be reduced. It is shown through probit regressions that the increase in the spread of knowledge and educational attainment increases the probability of using a condom, although this effect is partially offset due to "risk compensation," in which men will engage in sexual activity with more partners because of the use of a condom. Nevertheless, policies should favor increased public advertisement campaigns preaching safe sex. Only through these micro behaviors will the

transmission of HIV be reduced. The reduction of HIV/AIDS prevalence rates will increase national savings and present a catalyst in capital accumulation, as governments can spend more on other economic sectors (not healthcare) and even in the educational sector. With luck, GDP will then increase. Of course, there are many other concerns which will impede economic growth if not dealt with, but the presence of AIDS must be one of the first problems to be improved upon. Thus, it is imperative that the Zimbabwean government use a portion of its budget to relay the message of safe sexual behavior. Unfortunately, the Mugabe regime has misallocated a large portion of the government's capital to the war in the Democratic Republic of Congo, so the size of the effort to relay this message will not be optimal. This will only slow the rate at which the prevalence rate of HIV/AIDS in Zimbabwe is curbed.

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