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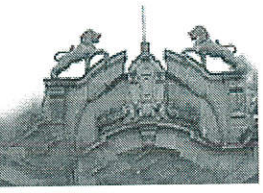

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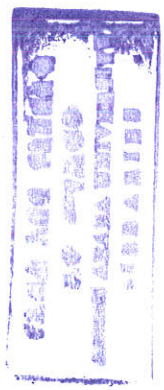
SOCIOECONOMIC FACTORS BEHIND HIV PREVALENCE AND RISKY SEXUAL BEHAVIORS IN ETHIOPIA



BY MELAKU TEKLEA

A thesis submitted to the School of Graduate Studies Addis Ababa University in partial fulfillment of the requirements for the Degree of Master of Science in Economics (Economic Policy Analysis)

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ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

"Socio Economic Factors behind HIV Prevalence and Risky Sexual Behaviors in Ethiopia."

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Abbreviations

AFI – Age at First Intercourse

AIDS – Acquired Immunodeficiency Syndrome

ANC – Antenatal Clinics

CSA – Central Statistical Authority

DHS – Demographic and Health Survey

EDHS – Ethiopian Demographic and Health Survey

HIV – Human Immunodeficiency Virus

HAPCO – HIV/AIDS Prevention and Control Office

ILO – International Labor Organization

MOH – Ministry of Health

MTCT – Mother to Child Transmission

PLWHA – People Living With HIV/AIDS

SES – Socioeconomic Status

SNNPR – Southern Nations, Nationalities and People's Regional state

STI – Sexually Transmitted Infections

VCT – Voluntary Counseling and Testing

WFP – World Food Program

Abstract

This study analyzes the socioeconomic factors behind HIV prevalence and risky sexual behaviors using the 2000 and 2005 Ethiopian Demographic and Health Surveys. The study also examines changes in risky sexual behaviors occurred between the two surveys. Econometric models used in the study include Heckman Probit model for HIV prevalence, Proportional Hazard model for age at first intercourse, and Probit model for condom use and number of sexual partners. According to the results of Heckman Probit model, Women who attend higher education are at lower risk of HIV infection, whereas those who attend primary education are at higher risk. However, education appears to have insignificant effect for men's HIV infection. On the other hand, wealth has a protective effect against HIV for men, whereas women of highest wealth quintile are at higher risk of HIV infection. Marriage for women and urban residence for both sexes consistently predicts higher HIV prevalence.

With regard to the effect of education and wealth on risky sexual behaviors, both factors are associated with lower risky behaviors and the protective effects of these factors are more apparent in 2005 data. The exception to this fact is that education increases hazard rate of early sexual initiation for males in both survey data. Marriage and urban residence significantly increase risky behaviors, with exceptions that marriage reduces multiple partnerships and urban residence increases the probability of condom use. Changes in sexual behaviors are more pronounced among men than women. Compared to the earlier survey (2000), men have experienced later age at first sex, lower probability of multiple partners and higher probability of condom use in the later survey (2005). With exception of lower probability of multiple partners, women, however, exhibited earlier sexual initiation in 2005 than in 2000. Hence, the study assures that there are still opportunities to reduce HIV prevalence by devising policies which promote behavioral changes among women and the poor and illiterate society.

Chapter One: Introduction

1.1 Background

Human Immunodeficiency Virus (HIV), the agent that causes Acquired Immunodeficiency Syndrome (AIDS), is currently widely spread all over the world. It goes back to 1980 that scientific evidence on the existence of HIV were discovered. With its devastating social, economic and demographic consequences, the virus continues to claim life's of significant number of population in the world. UNAIDS 2007 report indicate that 33.2 million people in the world are living with the virus, of which around 67 percent exists in Sub-Saharan Africa countries. According to this report, the prevalence rate to Sub-Saharan Africa region is much higher than that of the world's prevalence rate which is 5.0 percent and 0.8 percent respectively. Similarly, the report asserts that observed new infection of HIV in the world is 2.5 million of which 1.7 million pertains to Sub-Saharan Africa region. This statistical report suggests that Sub-Saharan Africa is the region where the largest burden of the epidemic prevails on.

Ethiopia is one of the highly affected Sub-Saharan Africa countries. Since the reporting of Ethiopia's first HIV (1984) and two AIDS cases (1986), its HIV epidemic has evolved into a generalized epidemic, and AIDS is now the leading cause of morbidity and mortality among adults (Hladik et al. 2006). According to ministry of health (MOH) 2006 report in 2005 estimated number of people living with HIV/AIDS (PLWHA) was around 1.3 million while the modeled and adjusted national HIV prevalence, using data from Antenatal Clinic (ANC) clients, was 3.5 percent; 3 percent among males and 4 percent

among females. The report indicated that the prevalence is highly concentrated in urban areas with 10.5 percent while it is 1.9 percent in rural areas.

The social and economic effects of the virus are striking. The virus is currently attacking the labor force of the country. Around half (48 percent) of the 1.3 million people living with HIV are under age 20-34 (MOH, 2006). It was estimated that 35 percent of adult death in 2005 was due to HIV/AIDS and life expectance is expected to reduce by 5 year due to the virus (ibid). The virus is also expected to reduce the population size by 1.3 million. One of the many social and economic impacts of the virus is its effect on the dependency ratio of the country. According to the MOH 2006 report, in 2005 it was estimated that there were a total of around 4.5 million orphans, of which 15 percent were orphans due to AIDS. Generally, the epidemic is not only a health problem, but it encompasses all areas including social, economic, and political aspects of the country.

Estimates from the 2005 Ethiopian Demographic and Health Survey (EDHS), however, exhibits lower prevalence rate of 1.4 percent, with prevalence rate of 5.5 percent in urban and 0.7 percent in rural areas. Before the DHS, Ethiopia as most of Sub-Saharan Africa countries national HIV prevalence estimates has been derived primarily from sentinel surveillance regarding pregnant women attending antenatal care facilities (CSA, ORC Macro 2006). Compared to the DHS, Antenatal Clinic (ANC) surveillance based estimate is suspected to be upwardly biased. Firstly, it doesn't incorporate other population segments other than pregnant women. Secondly, geographic and service coverage of the antenatal care is limited. While it is more biased towards urban areas, the numbers of pregnant women who get the service are also limited. Consequently estimates from the

2005 EDHS are more appropriate and representative of the Ethiopian population. Although the prevalence rate as shown from the EDHS declines to 1.4 percent, it is still above the worlds average prevalence rate.

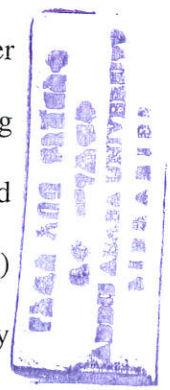
Economic, social and demographic consequences of HIV/AIDS are devastating. Especially for countries with high HIV prevalence rate, the impact of HIV becomes strong and mysterious. Many researches have been undertaken to understand the impact of the epidemic across different regions of the world. Despite some macroeconomic controversies, majority of the research findings exhibit negative impact of HIV/AIDS on socioeconomic affairs. Though many literatures exist on the macro and micro economic impacts of HIV, little has been known on the socioeconomic covariates associated with prevalence of the epidemic and its behavioral factors. Especially in Ethiopia, the observed tradition is on estimating prevalence of the virus based on ANC surveillance data with less attention given on socioeconomic and demographic covariates of the prevalence and behavioral factors which are causes for the viral infection.

1.2 Statement of the problem

Other than the basic behavioral risk factors, there are socioeconomic and demographic factors which affect prevalence of HIV; sex, age, education, wealth, and type of residence being some of them. Some of these covariates affect HIV status of individuals through their effect on knowledge of HIV/AIDS and risky sexual behaviors. Knowing the effect of such socioeconomic and demographic factors on risky sexual behaviors, HIV/AIDS knowledge and HIV status are very important to devise an appropriate and targeted

policies to improve HIV/AIDS knowledge, reduce risky sexual behaviors thereby reduce prevalence of the epidemic.

Education, one of the socioeconomic factors, has been cited by several well-credible sources including the World Bank as one of the most important factors in helping to prevent the group of "window of hope" (age 5-14) from contracting HIV and AIDS (WFP, 2006). However, empirical studies provide contradicting evidence. Even though some researchers found a positive correlation between HIV prevalence and education, some others reveal a negative correlation. Especially researches undertaken in 1990's are most likely to observe positive correlation, it is in recent time that negative correlation started to be observed from empirical evidences. Hargreaves and Glynn (2002), after reviewing twenty seven articles undertaken in developing countries, found an increasing risk of HIV infection among more educated ones, with one exception that found reduced risk of HIV infection among educated cohorts. Recent research by De Walque (2006) using data from five Africa countries, however, found that education is not positively associated with HIV status.



Similar to education, the effect of poverty (wealth) on HIV prevalence and sexual risk behaviors doesn't acquire a consensus. Though there is positive association at global level, evidence from African countries reveals the opposite. Logical and theoretical assessments by Hughes (2007), Fenton (2004), and Butler (2000), noticed poverty as a cause for risky sexual behaviors and subsequent HIV infection. However, empirical evidences have come out with mixed results. Some found poverty as a risk factor for HIV infection while others not. Of the mixed results, Wojcicki (2005) observed that out of 36

studies that met the inclusion criteria in his critical review fifteen found no association between socioeconomic status (SES) and HIV infection, twelve found an association between high SES and HIV infection, and eight found an association between low SES and HIV infection and one was mixed.

The contradicting effect of education and wealth on HIV prevalence and risky sexual behaviors needs further analysis to get statistically appropriate correlation. According to De Walque (2006) only few studies undertaken to understand the socioeconomic profile of HIV/AIDS epidemic had used nationally representative sample including Clark and Vactatachellum (2003), and Fylkesnes et al. (2001). And recently Lachaud (2007), Glick and Sahn (2008), and De Walque (2006) have used nationally representative samples. Most other studies, however, use data set either from cohort studies limited to specific areas or from surveillance data taken from pregnant women attending antenatal care clinics. Or else they use data set of years back to the early stage of the epidemic like those literatures reviewed by Hargreaves and Glynn (2002). Among studies undertaken in Ethiopia, Fontanet et al. (2000), Abebe et al. (2003) and Bradley et al. (2007), no one had used a nationally representative sample. In Ethiopia, studies that assess how individuals with different socioeconomic status respond to the epidemic with respect to changing risky sexual behaviors are also limited. Based on this ground, using the Ethiopian Demographic and Health Surveys of 2000 and 2005, this study tries to give answer for the following basic questions:

- Is there any significant association between HIV prevalence and socioeconomic status measured by education and wealth?

- Does socioeconomic status (as measured by education, wealth and other indicators) reduce sexual risk behaviors?
- Is there evidence of change in sexual risk behaviors in response to higher prevalence of the epidemic?

1.3 Objectives

The general objective of the paper is to identify the socioeconomic and demographic factors which affect the odds of HIV prevalence and risky sexual behaviors. Accordingly, after controlling for other socioeconomic and demographic confounding factors, the study aims to identify the effect of education and wealth/poverty on HIV prevalence and sexual risk behaviors. Following the general objective, specific objectives of the study includes:

- ❖ Statistically test the effect of education and poverty (wealth) on HIV prevalence, thereby know who is most vulnerable to the epidemic, either the educated and wealthier ones or the illiterate and poor ones
- ❖ While controlling for confounding factors, provide insight into the effect of education and wealth on risky sexual behaviors
- ❖ Ascertain if there is significant change in risky sexual behaviors between the two survey years

1.4 Significances

The socioeconomic and demographic correlates of HIV prevalence are vast and need special treatment to devise targeted policies for the vulnerable groups. Thus, this study

aims to identify vulnerable groups from the population. Subsequently, it helps to devise appropriate and targeted policies to get rid of the vulnerable groups from the epidemic. In addition, assessing changes in sexual risk behaviors helps to evaluate success of existing prevention programs and devise policies that reduce the sexual risk behaviors and reverse trends of the epidemic. Moreover, this study is the one of the few studies which uses the two round Ethiopian demographic and health surveys in order to assess changes in sexual risk behaviors and factors of HIV prevalence using appropriate econometric models. Hence it will become a reference for farther studies in the field.

1.5 Scope and Limitation

This study has three main limitations:

- Unlike the 2005 EDHS, the 2000 EDHS don't have HIV blood test for sub-sample of the observations. Consequently, the study is limited to assess the socioeconomic correlates of onetime HIV prevalence, making it impossible to assess associated factors of changes in HIV prevalence (makes it difficult to assess the effect of education and wealth across different period of time)
- Cross sectional nature of the DHS data creates endogeneity which is impossible to account for. Results of the regression analysis has thus to be interpreted as associations rather than causal relations.
- The scope of this study is also limited to analyze the correlates of HIV prevalence and sexual risk behaviors. Though issues regarding HIV knowledge and attitude are very important, this study doesn't cover these issues.

1.6 Organization of the paper

The paper is organized in to five chapters. The first chapter has discussed the introduction part including statement of the problem and the objectives. The second chapter reviews literatures including overview of the world and Ethiopian HIV epidemic, impact of HIV/AIDS, socioeconomic factors of HIV infection and risky behaviors, and changes in sexual behaviors. Data and methodology used in the study are discussed in chapter three. Following the methodology and data discussed in chapter three, estimation results and their interpretations and discussions are presented in chapter four. Finally, chapter five concludes the paper and summarizes the recommendations.

Chapter Two: Literature Review

2.1 Overview of HIV/AIDS Epidemic

2.1.1. Overview of the World HIV/AIDS Epidemic

Since its existence AIDS becomes the most devastating disease which affects all communities of the world. It is one of about 30 infectious diseases that have emerged as a result of profound worldwide changes in human ecology (Weiss and McMichael, 2004 cited in Kloos et al. 2007). Accelerated rural to urban migration, social disruption due to war and conflict, changes in personal behavior, human induced environmental changes, and weak or delayed government response to disease outbreak are some of the underlying factors in creation of conditions conducive to transmission and spread of infectious diseases (Kloos et al. 2007). Majority of these factors are largely concentrated in developing countries with low level of income, education and underdeveloped infrastructures. Thus, the disproportionate effect of the epidemic is incurred largely by low income countries, affecting their developmental efforts.

An estimated 33.2 million (30.6 million – 36.1 million) people worldwide are living with HIV in 2007; an estimated 2.5 million (1.8 million – 4.1 million) become newly infected with HIV and an estimated 2.1 million (1.9 million – 2.4 million) lost their lives due to AIDS (UNAIDS, 2007).

HIV/AIDS is highly concentrated in Sub-Saharan Africa region which is the most impoverished region of the world. Though the region accounts for about one tenth of the

world population, it is home for almost 68 percent of all people living with HIV/AIDS (UNAIDS, 2007). The region also accounts for almost 76 percent of 2.1 million adult and child deaths due to AIDS and for 68 percent of 2.5 million adult and child newly infected with the virus (ibid). The region's adult HIV prevalence rate was also estimated to be 5.0 percent in 2007, while the world's aggregate prevalence was estimated to be 0.8 percent (ibid). Thus, mortality, morbidity and medical expenses associated with the epidemic are largely affecting development efforts of the region.

Although the global HIV incidence rate is believed to have peaked in late 1990s, many countries in Africa keep on experiencing significant increase in the incidence and prevalence rates. Even with in Sub Saharan Africa, eastern and western Africa countries are experiencing declining in their prevalence rates. However, Southern Africa remains at high prevalence rate and becomes the epicenter of the epidemic. The prevalence is still at its steep in South Africa, Mozambique, Botswana and Swaziland. Almost one in three people infected with HIV globally and about 43 percent of all children living with HIV are dwelling in Southern Africa (UNAIDS, 2006). Only South Africa accounts for 14 percent of 38.6 million adults and child living with HIV in 2005. However countries like Kenya, Ethiopia, Tanzania, Ghana and other eastern and western Africa countries are now experiencing decline in HIV prevalence (UNAIDS, 2006).

2.1.2. Overview of the Ethiopian HIV/AIDS Epidemic

In Ethiopia the first evidence of HIV was observed in 1984, and the first two AIDS cases were reported to MOH in 1986. Following the surveillance activities began in 1989, Ethiopia's HIV/AIDS estimates were mainly based on data from ANC. In 2005 ANC

based HIV surveillance data included 44 rural and 38 urban sites. The estimated HIV prevalence indicates some encouraging signs in that the epidemic is stabilizing. As of MOH (2006), urban prevalence appears to have stabilized in 1996 to 2000 and is slowly and gradually declining since 2001; similarly in rural areas, where majority of the population resides, the epidemic has remained relatively stable since prevalence peaked in 1999-2001. Even though it is relatively stabilized, the current prevalence rate is still high and is plenty enough to have much devastating effects on the economy and social affairs of the country.

In 2005 the fitted national prevalence was 3.5 percent (10.5 percent in urban and 1.9 percent in rural) (MOH,2006). Estimated people living with HIV/AIDS were 1.32 million, where 0.63 million live in urban areas and 0.68 million people live in rural areas (ibid). Though the 3.5 percent national prevalence rate is lower than those of most eastern Africa and all southern Africa countries, the large size of Ethiopian population ranks the country among the most afflicted countries in terms of total number of cases (UNAIDS, 2006). The prevalence was at its steep during 1990-1997 but since 1998 it has started to stabilize. The current prevalence is slightly lower than the previous year's prevalence rate.

Using the ANC data in 2005 HIV incidence was estimated to be 0.26 percent (0.99 percent in urban and 0.12 in rural), which is a total of 128,922 new HIV infection including 30,338 HIV positive births (mother to child infection) (MOH, 2006). The national incidence rate increased until 1992, then stabilized between 1992 and 1995, and started declining beginning 1997 to 2001. The number of new infection had been greater

in urban areas until 1994; beginning 1995, the number in rural areas had surpassed that of urban areas until 2001. However, the trend is expected to reverse, that the number began to exceed in urban areas than that of rural areas beginning in 2003 (ibid).

The regional HIV prevalence estimates in 2005 ranges from 1.2 percent in Somali to 11.7 percent in Addis Ababa (MOH, 2006). Due to the combined effect of both relatively high HIV prevalence and large population size, Amhara, Addis Ababa, Oromia and SNNPR accounted for 86.6 percent of all PLWHA in 2005 (ibid). Following the significant rate of infection, the epidemic has become one of the most killing diseases of the country. Cumulative number of AIDS deaths was above 1.2 million by 2005 and projected to reach 1.9 million by 2010 if present trend continuous (ibid). AIDS adult death also accounts for 35 percent of young adult death in 2005.

The only alternative data from population based survey is the 2005 Ethiopian DHS, which included a total of 11,050 adults (83 percent of the eligible women and 76 percent of eligible men) tested for HIV. The estimated HIV prevalence from this population based survey is 1.4 percent (1.9 for women and 0.9 for men; 7.7 in urban and 0.6 in rural) (CSA & ORC Macro, 2006). The peak HIV prevalence age among women is 35-39 years with 4.4 prevalence rate, while for men is 40-44 years with 2.8 prevalence rate. The regional prevalence indicates that Addis Ababa (with 4.7) and Gambela (with 6.0) have the highest prevalence, whereas SNNPR is the region with the lowest prevalence rate (0.2 percent) (ibid). Socioeconomic composition of the epidemic indicated that the epidemic is disproportionately affecting those with high socio-economic status. As education and wealth are basic indicators of socioeconomic status, 5.5 percent and 6.1 percent

prevalence rate was observed for highest and secondary educational attainment, and highest wealth quintile respectively.

In addition to the basic transmission of HIV through heterosexual practice and contaminated blood transfusion, there are social, economic, cultural and political factors that create conducive environment for exacerbation of the virus. In Ethiopia, estimation indicates 87 percent of HIV transmission is through heterosexual contract, 10 percent by mother to child transmission (MTCT) and a smaller proportion thought to be due to traditional harmful practices (HAPCO, 2004 cited in Kloos et al. 2007). The basic behavioral factor responsible for majority of new infections is sex without condom. Other direct determinant of HIV in Ethiopia includes receiving a blood transfusion contaminated with HIV, receiving an injection or piercing from a needle contaminated with HIV, and having multiple sexual partners. The indirect determinants of HIV include poverty, ignorance, gender inequality, socio cultural barriers and social disruption (war, famine, migration etc.).

2.2 Economic Impact of HIV/AIDS

HIV/AIDS affects economic growth and social development through its effect on labor supply and other related costs. It is mainly affecting the labor force (working age population). The ILO estimates that at least 26 million people infected with HIV worldwide are workers aged 15-49 years, in the prime of their working age and this is about three quarter of all adults living with HIV/AIDS (Lisk, 2002). Costs related to the epidemic immediately affect individuals and households. The macro level impact of the epidemic manifests as the number of individuals illness and death accumulates over time.

The epidemic mainly has two major economic effects: reduction in labor supply and increased costs/expenditures. Mortality and morbidity associated with the epidemic leads to reduction in labor force as well as change in the demographic composition of the population. The costs associated with illness and death affect savings and investment of individuals, households, firms and governments which in turn affect economic growth of highly infected countries.

2.2.1 Microeconomic Impact

As noted above, the micro and macro economic impact of the virus mainly depends on declined labor supply, reduced income and increased costs/expenditures associated with the virus. The microeconomic impacts are those which immediately affect individuals, households, enterprises and different sectors of the economy.

A. Impact at Individual Level

The individual level impact includes reduction in income and productivity, increased medical cost, and discrimination and exclusion from economic activities. Shisana and Letiape (2004) discussed that banks and insurance companies may decline the loan or insurance or may charge higher premiums if the person apply for is HIV positive. Associated with other social discriminations people living with HIV/AIDS (PLWHA) may decrease their socioeconomic activities which in turn reduce their income and productivity. Overtime, these individuals will become inefficient to generate enough revenue to cover their medical expenses and to sustain their life, and subsequently become dependent on their families and the society until their death.

B. Impact at Household Level

Impacts to household, as of UNAIDS (2006), ranges from increased medical costs and expenditures on funerals to withdrawal of family members from work or school to look after those who are ill. Illness of household member means loss of the contribution to work and income of the person affected, increased medical expenses, and diversion of other family members from work and school attendance to caring for the patient (Lisk, 2002). As infected family member becomes dependent on his/her family, other family members will start to care for him/her by reducing their working time resulting in reduction of their income, if not permanent loss. Study by Rabalino et al. (2002), observed that in Kenya the rural household could see their income fall by 50 percent as a result of AIDS (cited in Shisana and Letiape 2004).

After long period of sickness and high medical expenses, final destiny of infected individuals is death. Death subsequently results in permanent loss of income, funeral expenses, removal of children from school to save money and increase family labor. Death of parents and care givers also increases the likelihood of children being orphaned. In Sub-Saharan Africa, approximately 9 percent of children under age 15 have lost at least one parent due to AIDS, and one in six households with children is caring for at least one orphan (UNAIDS, 2006). Estimates by UNICEF (2006) indicated that in Sub-Saharan Africa the total number of AIDS orphans is expected to rise to 15.7 million in 2010, which is 30 percent of the total estimated 53.5 million orphans.

The burden of orphan care is then the subsequent burden of households and family members. As noted in UNICEF (2004), the burden of orphan care is already shifting in

countries with highest HIV prevalence to female headed and grand parent households. With limited resources and capacity to make enough funds to sustain their families, such households face higher burden of orphan care.

C. Impact at Enterprise Level

Illness and deaths of employees and their families could significantly affect productivity and revenue of enterprises. Enterprises in all sectors in the most seriously affected countries have reported increases in absenteeism (due to illness and bereavements), in labor turnover (due to illness and death), and in costs of recruitment, training and staff welfare including health care and funeral costs (Lisk, 2002). Absenteeism, labor turnover and subsequent recruitment of new employees reduce labor productivity and increases costs associated with training and recruitment of employees. Productivity will be largely hampered by absenteeism, loss of skilled workers, recruitments of new inexperienced employees and high work load of healthy uninfected workers. UNAIDS (2000) identified two areas where impact of HIV/AIDS felt on individual business operations: productivity and increased costs.

According to the UNAIDS (2000), the principal areas in which HIV/AIDS affects productivity are through increased absenteeism and organizational disruption. The observed increase in absenteeism is a result of employee's illness due to HIV and its associated opportunistic infections, the demand of caring for family members who are ill, and the need to attend funerals. The high rate of morbidity and mortality from HIV/AIDS generate increasing disorganization within the work force as a result of rising staff turnover, loss of skills, loss of tacit knowledge (gained from experience of both the work

and company experience) and declining morale. These all factors highly influence productivity of enterprises. In the same way, factors that result in increased costs include recruitment and training, insurance cover and pension, health care management and funeral costs.

2.2.2 Macroeconomic Impact

A. Impact on Population and Labor force

AIDS related mortality significantly affects the growth of population in the hardest hit countries. Projection by UNAIDS (2000), in the 60 countries most affected by AIDS, suggested that the total population will be 115 million less than it would be in the absence of AIDS. Since the seropositivity is mainly concentrated in the working population, the virus mainly reduces the labor supply. Deaths related to HIV/AIDS are highly concentrated in the working age population (age 15-49), reducing the growth and number of the labor force.

The epidemic is also affecting the demographic composition of the population. It significantly distorts the age-sex structure of the entire population. Mortality and morbidity of experienced and skilled workers leads to a significant loss in human capital across the worst affected countries. Children who lost the head of their family or care giver become orphan, left with less opportunity and finance to attend school. Orphaned children then compelled to work and participate in the labor market (as unskilled laborer) to lead their life. Loss of skilled and experienced workers associated with unskilled and

inexperienced orphaned children being in the labor market, distorts the age and skill composition of the labor market.

B. Government Revenue and Pattern of Expenditure

A reduction in the rate of growth of labor force combined with falling productivity means less government revenue from individuals and enterprises (Lisk, 2002). At the same time the costs of dealing with the epidemic requires larger proportion of government budget. Given decreased revenue from taxes of individuals and companies, the state is also expected to fail to meet its mandate to deliver critical service such as health, education and welfare; the quality and quantity of health and education services are also likely to decline as budgets are being overstretched or cut and limited funds are being divert to treat those living with HIV/AIDS, especially if the international community does not contribute funds to help affected countries (Shisana and Letiape, 2004). Estimates by UNAIDS and the IMF for HIV and AIDS related services in some of the affected countries in southern Africa are substantial, accounting for 20 and 90 percent of health budget (Lisk, 2002).

C. Savings, Investment and International Competitiveness

Countries experiencing higher HIV prevalence will see their savings highly impaired as result of increased medical expenses and reduced income and productivity. Households, enterprises and governments will divert proportion of their income from savings to daily consumption and health care expenses, and reduced income and productivity associated with the epidemic will lower their absolute income living less room to have higher

savings. Since domestic and foreign savings are the source of investment on physical and human capital, reduction of savings will hamper domestic investment. On the other hand, higher domestic labor cost (resulting from subsequent labor recruitment and training), falls in profitability and increased health care expenses lead to curtail foreign direct investment.

As unit labor cost rises, comparative advantage of economies with high prevalence rate will be increasingly based on their natural resource rather than human resource (Lisk, 2002). Since the pandemic is affecting the skilled and professional managerial workers and is associated with higher labor cost, countries comparative advantages in terms of human power will diminish. The reduction in productivity and comparative advantage reduces competitiveness of highly affected countries in international market. Lower domestic productivity associated with loss of comparative and competitive advantage reduces export while import of expensive health care goods has increased. This will also in turn affect savings and investment.

D. GDP Growth, Poverty and Inequality

The implication of HIV/AIDS for GDP growth will clearly be significant both through the direct impact on labor supply, human capital and savings, as well as through a decline in total factor productivity (Lisk, 2002). One of the things that distinguish the HIV/AIDS pandemic from other global diseases is that it predominantly affects young adults, stripping families, communities and nations of those who are also the main contributors to income-generating activities (Barnett and Whiteside, 2002 cited in Shisana and Letiape, 2004). Impact of the disease on savings, investment, labor supply and human

capital adversely affects productivity and growth. Aggregated reduction in productivity of individuals, households, firms and government leads to decline in GPD. Most importantly the impact on savings and investment associated with other factors affects economic growth measured by growth of GDP and of GDP per capita. Most studies on the impact of HIV/AIDS have found a negative impact on growth of GDP and/or growth of GDP per capita. A summary of main international studies on the growth impact of HIV/AIDS are listed in *Table 2.1* below:

Table 2.1: Studies on macroeconomic impact of HIV/AIDS

Study	Countries and period covered	Period of HIV/AIDS data	Growth of GDP	Growth of GDP per capita
Over (1992)	30 African countries (1990-2025)	Early 1990s		Reduced by 0.15% (0.6% in the 10 most affected countries)
Bloom and Mahal (1995)	51 countries (1980-1992)	Early 1990s	Insignificant effect	
Bonnel (2000)	50 countries (1990-1997)	Mid 1990s		Reduced by 0.7% a year
Dixon et al. (2001)	41 countries (1960-1998)	Late 1990s	Reduced by 2-4% in relation to prevalence of HIV	
Coulibaly (2004)	41 countries (1992-2002)	Early 2000s	Reduced annually by 0.9% on average	Reduced annually by 0.6% on average
	33 African countries (1992-2002)		Reduced annually by 1.1% on average	Reduced annually by 0.7% on average

Source: ILO, 2004 adopted from UN, 2003

The reviewed studies found that HIV/AIDS reduces the average annual growth rate of GDP and GDP per capita. According to ILO the above studies, however, have a strong shortcoming that they do not include the broad range of effects on labor force and employment. Including the broad range impacts ILO study confirm that between 1992 and 2002 HIV/AIDS reduced the rate of GDP growth by 0.9 percent a year in 41

countries where the economic impact of HIV/AIDS was measurable. Other study by Arndt (2003) found that Mozambican economy will be 14 to 20 percent smaller in 2010 on account of AIDS; per capita GDP growth will be between 0.3 and 1.0 percent lower per annum.

As result of the reduced productivity and GDP growth economies of highly infected countries will began to experience poverty and inequality crises. Poverty which is the result of low level of productivity, income and economic growth is thus more likely to prevail as result of the epidemic. According to Lisk (2002), the epidemic creates vicious cycle by reducing economic growth which leads to increased absolute poverty which in turn facilitates the rapid spread of AIDS as household expenditure on health and nutrition declines thereby reducing resistance to opportunistic infections. The epidemic also increases income inequality by reducing income and increasing medical expenditures of the poor infected individuals and increasing the price of skilled labor leads to higher wage of skilled workers compared to the unskilled ones.

2.3 Determinants of HIV prevalence and Sexual Behaviors: Poverty/Wealth and Education

A. Poverty/Wealth

Poverty is cited as a risk factor for HIV infection in many literatures and HIV is frequently described as an epidemic of poverty and underdevelopment. At global level the association between poverty and HIV/AIDS is positive. Cross country evidence indicates a strong statistically significant relationship between HIV prevalence and poor

socio-economic performance whether measured by per capita income, income inequality, absolute poverty, or the UNDPs human poverty index (Bloom et al. 2002). Thus, poverty is often perceived as a factor that increases vulnerability of individuals and society to the epidemic. Evidencing this hypothesis, Lachaud (2007) stated that 95 percent of the world population affected by HIV is localized in transitional or developing countries, while the later includes 85 percent of the inhabitants of the world. Moreover, although the microeconomic evidence is less clear, several studies, in particularly in Asia, tend to show that the poorest and the least educated individuals have a greater susceptibility to HIV infection (Bloom and Goodwin, 1997 cited in Lachaud, 2007).

Having described poverty as a risk factor for HIV infection, it requires an answer that how poverty becomes a cause for HIV infection or how it contributes to the progression of the epidemic? There are several theoretical propositions which tried to answer this question. Stillwaggon (2002) argued that poverty increases biological susceptibility to HIV/AIDS in the same way it does to many other infectious diseases. According to Stillwaggon, poverty leads to malnutrition, parasitosis and lack of access to health care among the poor, suggesting that these factors undermine epithelial integrity and immunity and increases the likelihood of having other untreated sexually transmitted infections which contribute to prevalence of the epidemic.

According to Collins and Rau (2000) survival of the poorest household generates high-risk behaviors which bolster the propensity to the diffusion of HIV in particular labor migration and prostitution. The poor are less able to protect themselves, have less access to information about health risks and even when information on HIV does get through to

poor communities, they may still fail to take preventive measures, if they do not understand the message or if they do not perceive the risk to be significant than the other problems they face on day-to-day basis (Bloom et al. 2002). Since poverty is associated with lack of education and illiteracy, messages regarding risk and prevention becomes inaccessible or being wrongly interpreted. The poor are also more likely to be forced by marginalization into making sub-optimal choices, like prostitution and women's early sexual initiation which increases the chance of HIV infection (Bloom et al. 2002).

Among empirical evidences, there are some studies which approve the proposition that poverty exacerbates propagation of HIV infection. Amongst, Glick et al. (2004) using data from Madagascar observed that less educated and poor women are more likely to have misconception about transmission of the virus and less likely to use condom, indicators which increase chance of HIV infection among the poor individuals and households. Other studies by Glick and Sahn (2007) using DHS of nine African countries found that the effect of household wealth on both preventive knowledge and testing estimated from probit model tend to be positive, if not always statistically significant; which indicate the poor to be less knowledgeable and possibly less likely to undertake HIV blood test, subsequently increases the likelihood of HIV infection among the poor society. Booysen and Summerton (2002) also empirically tested that more affluent households have more knowledge on HIV/AIDS to protect themselves against the virus, while found poorer women are more likely to engage in risky sexual behaviors compared to women in more affluent households.

Contradicting to the idea that poverty exacerbates HIV infection, some empirical findings, however, exhibited a negative association between poverty and HIV infection; that is the poor are less likely to be infected than their counterparts. While taking a cross country regression among Sub-Saharan Africa countries, O'Farrell (2001) found a weak positive correlation between HIV prevalence and GNP where this correlation disappears while the analysis is restricted to countries with GNPs lower than $1000. Similarly, using household survey data from Burkina Faso, Lachaud (2007) observed a negative association between poverty and HIV prevalence at micro (household) level and macro (regional) level. Other study by De Walque (2006) using five DHSs (Burkina Faso, Cameroon, Ghana, Kenya and Tanzania) found a non-monotonic positive relationship between household wealth index and HIV prevalence. Regarding the sexual risk behaviors Isiugo-Abenihe and Oyedrin (2003) using data from Nigerian female youth confirmed that those who have access to the media and those of high socioeconomic status are more sexually exposed than their counterparts who do not have access to media or have less household facilities.

According to Bloom et al. (2002) and Fenton (2004), in its early stage the epidemic affects the wealthy, educated and more mobile ones, but after it matures HIV/AIDS is becoming increasingly concentrated in the poor population. However, even recent studies undertaken to understand the association observe a positive association between wealth and HIV prevalence. Glick (2007) provided a reason for such observation that the better off individuals tend to have more concurrent sexual partners which increase the chance of HIV infection for the wealthy individuals. Better off individuals have the financial willingness and ability to cover the financial costs of accompanying more than one

concurrent partners. In favor of this statement, Shelton et al. (2005) argued that wealth is the key for such networks because wealth is associated with the mobility, time and resource to maintain concurrent partnerships. Consequently, the correlation between poverty/wealth, and HIV prevalence and risky sexual behavior is yet inconclusive. The theory of positive association between poverty and HIV infection states that poverty increases risky behaviors (like prostitution and early sexual debut), reduce accessibility of information and also increases malnutrition and untreated STIs, whereas the theory that questioned the positive association argue that it is rather high wealth which creates high risky sexual behaviors which increases the prevalence of HIV/AIDS. Depending on which effect, effect of poverty or wealth, outweighs will determine either poverty or wealth being a risk factor.

B. Education

Education is thought to have a protective effect against HIV infection. Educated societies and individuals have better access to HIV related information and will process the information appropriately to protect themselves from the infection. Lakhanpal and Ram (2008) argued that increased education is likely to enable individuals and households to (a) acquire and use more information about the nature of the disease and its transmission, (b) adopt efficient ways to avoid receiving or transmitting the virus, and (c) undertake optimal treatment if they have got infected. Individuals who get sufficient instruction are thus better placed to avoid HIV infection. Qualitative research conducted to date points to the benefits of education on individuals: increased ability to understand HIV preventive information, better access to health services, reduced social and economic vulnerability

that exposes women to risky activities and higher likelihood of participation in community groups that foster protection against HIV/AIDS (WFP, 2006).

According to Kelly (2000), education has a critical role to play in mitigating the effect of HIV/AIDS by providing "knowledge that will inform self protection; fostering the development of personally held, constructive value system; inculcating skills that will lower infection risks, and enhancing capacity to help others to protect themselves" (cited in WFP, 2006). De Walque (2007) has summarized the correlation between education and health outcomes. Accordingly the effect of education on health outcome is channeled in three different ways: (a) education as an investment drives high income and raises the value of staying alive, (b) education improves the access to health related information and processing of that information to make health related decisions, and (c) the association is mainly due to unobservable factors like the discount factor or the ability that causes the same individuals both to study longer and to take greater case of their health.

The World Bank (2002) stated that education protects against HIV infection through information and knowledge that may affect long-term behavioral change, particularly for women by reducing social and economic vulnerability that exposes them to a higher risk of HIV/AIDS than men, including prostitution and other form of economic dependence. Women who acquire better instruction are probably better placed to get safe job with better income than their less educated peers, will then avoid risky income generating activities like prostitution.

However, against the logical propositions and qualitative researches there are a number of quantitative researches that observe a positive association between education and HIV

infection. An extensive review of literature by Hargreaves and Glynn (2002), established that most of the studies undertaken in Africa and other developing countries have reported increased risk of HIV infection among the more educated ones.

Glynn et al. (2004) put the contradicting views as: "behavior and ability to change behavior are likely to be linked to education level; it is hoped that better educated individuals will be more likely to access relevant information on HIV prevention and more able to act on it to change behavior; however, the socioeconomic position, opportunity to travel, delayed first marriage and other factors that accompany education may increase behaviors leading to higher risk of HIV infection. Conversely, low education and poverty in women may increase the exchange of sex for money, and pregnancy is an important cause of school drop-out." Depending on the weights of the effect, education therefore could increase or decrease the risk of HIV infection. However, there is no study which assesses the effect of education on changing behavior after controlling for other factors using a panel or longitudinal data.

Blanc (2000) stated that in the absence of HIV epidemic more educated people generally have higher rates of sexual partner change primarily because they have greater personal autonomy and special mobility (cited in Gregson, 2001). More educated women start to have sex later but typically experience longer periods between starting sex and getting married and are liable to accumulate larger number of partners during this period than their less educated peers (Blanc and Way, 1998 cited in Gregson, 2001). Affecting mobility and income of individuals thereby opportunity to have a number of non-marital sexual partners, education increases the risk of HIV infection. De Walqe (2007) described

sexual adventure within economics framework, calling it "a normal good", a good that is in greater demand due to growing income. Thus education is identified as a factor that increases the demand for sexual adventure which is a risk factor for HIV infection by increasing individual's income. Education is, however, expected to increase condom use during extramarital sexual intercourses, a factor which decreases odds of HIV infection despite having more sexual partners.

The association is still not clear. But some researchers observed that the positive association between the two variables is changed through time. The evidences from early 1990s suggested that higher levels of education were correlated with higher HIV prevalence. The extensive review of literature by Hargreaves and Glynn (2002) could be an assertion for this statement. Since then, however, the evidence begins to show better educated population are reacting more strong than less educated population in their response towards protection through changes in risky sexual behaviors (De Walqe, 2007). But recent evidences are still providing mixed conclusions. However, it is safe to say that in countries like Uganda and Zambia, where the correlation was once positive, the correlation is now shifting to a negative one. Up-to-date researches undertaken to understand the association are summarized as follows:

- De Walque et al. (2005) assessed changing association between schooling level and HIV-1 infection over 11 years in a rural population cohort in Uganda, and found a positive correlation in 1989-1990. However, in 1999-2000 for females aged 18-29 years, they found a significant relation between higher educational attainment and lower HIV prevalence. Concluding that though more educated

individuals were more vulnerable at early stage of the epidemic, as the epidemic matures the prevalence becomes concentrated in uneducated cohorts.

- Fylkesnes et al. (2001) using data of surveillance and population based survey of Zambia found that a prominent decline in prevalence was associated with higher education, and stable or rising prevalence was observed with low educational attainment. Concluding that education is successively becoming to be a factor that protects individuals from HIV infection.
- Lakhanpal and Ram (2008) using a cross country regression observed a significant negative effect of educational attainment on HIV prevalence indicating that countries with low level of educational attainment are at risk of higher HIV prevalence than countries with more educational attainment
- Glynn et al. (2004) using data from four African cities concluded no evidence of an increased risk of HIV infection associated with education as seen in earlier studies. In each city, there was some evidence of lower rate of HIV infection and less risky sexual behavior associated with increased education levels
- Bradley et al. (2007) using data from Ethiopia Voluntary Counseling and Testing (VCT) clients found a significant negative association between education and HIV which asserts that HIV is significantly concentrated among less educated individuals
- Hargreaves and Glynn (2002) after reviewing 27 appropriately analyzed studies observed that all except one of the studies found a positive association between education and HIV prevalence.

- Abebe et al. (2003) using data of 72,000 urban and rural male army recruits of Ethiopia found a positive association between education and HIV, leaving educated individuals with higher HIV infection than uneducated ones
- Glick and Sahn (2008) found a contradicting effect of education and wealth on sexual risk behaviors; they both tend to increase the likelihood of using condoms while (for men) also increases the demand for additional sexual partners.

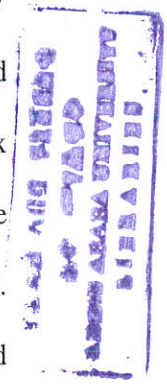
From the above summary, the effect of education on sexual behaviors and HIV infection is observed to be mixed. The effect differs from country to country and from time to time. Developmental factors like urbanization and internal migration are among the factors that contribute to the positive effect of education on HIV infection and sexual risk behaviors. These developmental factors are highly influenced by education, and educated individuals are mobile and have better living standards than their uneducated peers. Thus, though the qualitative and some quantitative observations indicate negative effect of education on HIV infection and sexual risk behaviors, positive association could also arise as result of developmental factors like migration and urbanization.

2.4 Changes in Risky Sexual Behaviors

Risky sexual behavior refers to any sexual activity that increases the likelihood of infecting by HIV and other sexually transmitted infections (STI). The main transmission ways of HIV infection are sexually risky behaviors including extra marital sex, sex without condom (unprotected sex), early sexual debut (age at first sex), having two or more sexual partners and intergenerational sexual contracts (having sex with older or younger than 10 years old). Amongst early age at first sex, unprotected sexual intercourse

(intercourse without condom) and multiple sexual partners are extensively used as basic sexual risk behaviors which increase the odds of HIV infection. As a result, HIV/AIDS prevention programs aim to persuade adolescents to delay their first sexual contract, encourage condom use when having sex with non-marital partner, and persuade to have only one sexual partner.

Changes in sexual behaviors have been advocated to reduce the spread of HIV in developing countries where heterosexual contract is the most common mode of HIV transmission. Stoneburner and Low-Beer (2004) argued that because most cases of HIV occur through consensual intercourse, it is avoidable if populations are warned and mobilized to change risk taking behaviors. In Uganda, a rapid increase in age at first sex in urban areas between 1989 and 1995 was considered as major contributing factor to the observed decline of HIV prevalence in young pregnant women (Asiimwe-Okiror et al. 1997). Similarly, as Zambia is experiencing decline in HIV prevalence, Slaymaker and Buckner (2004) found increased reported men's age at first sex, decline in multiple partnership, and increased condom use during last sexual intercourse.



Asiimwe-Okiror et al. (1997) stated that there are a number of behavioral and biological factors contribute to the decrease in HIV seroprevalence such as HIV related death or other causes of deaths; out migration of HIV infected persons to rural areas where sentinel surveillance is performed less and/or immigration of HIV negative persons; aging; saturation of susceptible population. However, Asiimwe-Okiror et al. (1997) argued that the sharp decline in HIV prevalence observed among the young age group is likely to be due to a true decline in HIV incidence resulting from behavioral change of

antenatal clients. Using a simple chi-squared test for linear trend in the two year data of urban Uganda, the study founds the following statistically significant results:

- Proportion of sexually active respondents who reported having ever used condoms increased for male from 18.4 percent in 1989 to 55.2 percent in 1995 and from 5.8 percent to 38.7 percent for females
- Proportion of male and female youths aged 15-19 years reporting that they have never had sex increased from 31 percent and 26 percent in 1989, to 56 percent and 46 percent in 1995, respectively, suggesting significant increase in age at first intercourse

Accordingly, Asiimwe-Okiror et al. (1997) concluded that behavioral changes are the basic contributing factors for the declined HIV prevalence among Ugandan pregnant women. As indicated, three behaviors; age at first sex, condom use, and number of sexual partners are the basic indicators of sexual behaviors, and are the focus of this study.

A. Age at First Sex

Early age at first sex is a risk factor for school dropout, pregnancy and contracting sexually transmitted diseases including HIV. Hallett et al. (2007) indicated the reasons that early onset of sexual activity being a risk factor for acquiring sexually transmitted diseases: (a) period of potential exposure to infections being longer, (b) for young women physiological and immunological immaturity of female genital tract increases susceptibility to HIV infection and (c) young girls who have sex with older men are unlikely to be able to insist on the use of condom. Delaying the onset of sexual

intercourse, however, contribute to more stable and monogamous partnership and higher levels of effective condom use (Singh et al. 2004). To overcome the consequences of early age at first sex and achieve substantial reduction in HIV prevalence, encouraging youths to delay the onset of sexual activity becomes objective of many prevention programs.

Countries that experience increasing trend of later age at first sex have achieved reduction in HIV prevalence. Study by Zaba et al. (2002) while examining whether Uganda's (the only country in Sub-Saharan Africa with significant decline in HIV prevalence during nineties) trend in adolescent sexual activity was different from those of other countries, found that Ugandan males and females have experienced large statistically significant increase in age at first sex. Using similar methodology, recent study by Glick and Sahn (2008) confirmed that among eight African countries Uganda and Zambia which experience decline in HIV prevalence have achieved significant reduction in early sexual activity.

B. Number of sexual partners

Having greater than one sexual partner is a risk factor for HIV infection. HIV/AIDS prevention programs mainly promote strategy called ABC (Abstinence, Being faithful and Condom use). Having one sexual partner (being faithful to only one partner) is advocated as the next best option to avoid HIV infection next to abstinence.

The Uganda's successful reduction of HIV-prevalence was mainly advocated resulting from behavioral change. According to Green et al. (2006) there are two schools of

thought debating on declining Uganda's HIV prevalence. While the one states decline in casual/multiple partnership, the other describe condom use or increase in mortality as primarily cause for Uganda's success. Modeling by Stoneburner and Low-Beer (2004) indicated that behavior change particularly partner reduction since late 1980s in Uganda appears to have had a similar impact as a potential medical vaccine of 80 percent efficacy. Many other researchers have explored reduction in number of sexual partner (increasing faithfulness) as basic indicator of Uganda's success.

A summary of evidences from Uganda reported by Green et al. (2006) indicates that dramatic fall in the proportion of males and females reporting three or more non-regular partners were observed between 1989 and 1995. Similarly, though the trend towards fewer non-regular partnership in 1995 was not statistically significant for young men aged 15-24 years, Asiimwe-Okiror et al. (1997) found a statistically significant reduction in number of non-regular partners between 1989 and 1995 for Ugandan adult men (aged 18-49). Study by Glick and Sahn (2008) also founds statistically significant reduction in the probability of multiple partnerships in general sample in countries Benin, Kenya and Zambia. Similar to these countries, there is also some evidence of change in number of sexual partners in Ethiopia. Suzuki et al. (2007) using a simple t-test for proportions in the 2000 and 2005 Ethiopian DHS founds that the proportion of respondents who reported having two or more sexual partners decreased from 1.6 percent to 0.2 percent among women and from 11 percent to 4 percent among men between 2000 and 2005.

C. Condom use

The third strategy to avoid HIV infection following abstinence and monogamy is condom use. Adults who are not married and married but having non-marital sex are advised to use condom to protect themselves from contracting HIV/AIDS. Correct and consistent use of condom can prevent susceptible individuals from acquiring HIV infection. However, in many countries repeated cross sectional studies reveal a trend of increasing prevalence of HIV infection alongside an increasing trend in reported condom use (Slaymaker and Zaba, 2003). It is in Uganda and Thailand that increasing condom use is observed with declining HIV prevalence (ibid). Though other factors such as long duration of infected individuals and unbalance between new infection and death of infected individuals contribute to stable or increasing HIV prevalence, condom use, if inconsistent, does not protect HIV infection and hence increasing condom use may not result in reduction of HIV prevalence.

In Uganda, however, increasing in condom use alongside with decline in HIV prevalence is observed. One study in Rakai district (Uganda) focusing on HIV surveillance and behavioral trends after 1994 (Wawer et al. 2005) concluded that mortality and condom use were mainly responsible for reduced HIV prevalence in the district between 1994 and 2003. The authors of Rakai study report that because after 1994 there were higher levels of condom use and lower levels of monogamy and abstinence, therefore condom use and mortality rates ought to account for the continuing HIV prevalence decline. Behavioral change in condom use, however, is cited as one factor contributing for the declining HIV prevalence in Uganda, not the only predictor but all the three strategies (ABC).

Chapter three: Data and Methodology

3.1 Data Description and Sources of Biases

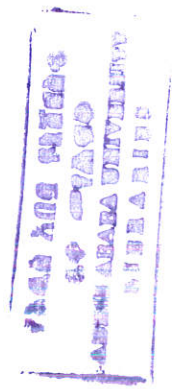
In this study, data of the two round Ethiopian Demographic and Health Survey (EDHS) which are part of the worldwide Demographic and Health Survey (DHS) project are used. These independent cross sectional surveys are nationally representative surveys of 15,367 women age 15-49 and 2,607 men age 15-59 in 2000, and 14,070 women age 15-49 and 6,031 men age 15-59 in 2005 (CSA and ORC Macro, 2001 and 2006). Both surveys have collected detailed information on fertility, family planning, infant and child mortality, maternal and child health, nutrition, and knowledge of and behaviors towards HIV/AIDS and other sexually transmitted infections. The 2005 EDHS is the first survey in Ethiopia to provide population based prevalence estimates for anemia and HIV (CSA and ORC Macro, 2005). Since the questionnaire of DHS are standardize throughout the DHS project, data quality is considered to be high though inconsistencies regarding reported sexual behaviors were observed in Gersovitz (2005) and non-response for HIV test are observed in many of the DHS surveys.

The EDHS sample for both surveys is stratified, clustered and selected in two stages. From nine regions and two city administrations, 539 and 540 enumeration areas – 138 and 145 in urban areas, and 401 and 395 in rural areas – were selected in 2000 and 2005 survey respectively (CSA and ORC Macro, 2001 and 2006). After selecting the enumeration areas, 14,642 households in 2000 and 14,500 households in 2005 were selected using the 1994 household and population survey data. Both surveys included

three of the seven zones in Somali region, and the 2005 survey included a list of villages in Afar region which are not previously included in the 2000 survey. Though some biases are suspected for Somali and Afar regions because of nomadic nature of the population, the DHSs are nationwide representatives of the whole population.

Even though DHS data are rich to analyze HIV prevalence and sexual behaviors, sexual behaviors reported in DHS data have suffered from inconsistencies and biases. The biases and inconsistencies mainly affect analysis and interpretation of sexual behaviors. Sexual behaviors are self reported and inconsistencies in reporting of the behaviors arise overtime and between groups like age groups, gender and marital groups. Among the reported discrepancies, reported condom use and number of sexual partners are significantly different between women and men. Gersovitz (2005) has discussed the issue of self reporting sexual behaviors in DHS of many countries and found several inconsistencies. However, the problem of self reporting of sexual behavior is obvious and is an inescapable problem. Where inconsistencies in reported behaviors among groups are observed, it is difficult to establish the form of measurement error.

Glick and Sahn (2008) discussed three potential problems when using repeated cross section survey rounds to measure changes in behavior: (1) changes in sample, (2) changes in the question posed, and (3) change in how people respond to these questions or changes in reporting errors. Any of these problems can lead to misleading inferences about changes in sexual behaviors overtime. The second problem is actually not a potential threat in the DHSs, because the questionnaires of different DHSs are similar overtime.



The problem of change in sample occurs when the sample drawn in two surveys differs in ways that are related to behaviors: for example, levels of education and wealth may differ beyond what would be due to simple sampling errors or the evolution of these characteristics over a short period (Glick and Sahn, 2008). Changes in sample composition could affect analysis of sexual behaviors if the changes are related with behaviors. For example, if the proportion of illiterate sample is much lower in the second round compared to the first one and illiteracy is a significant indicator of sexual risk behaviors, changes in sexual behavior occurred between the surveys could merely be due to change in sample composition (i.e. change might occur merely because observations of the second round are biased towards less risky individuals). See section 3.2.2.2. for testing and correction methods for this problem.

The third problem, change in reporting error (within cohort inconsistence), occurs when respondents of the same birth cohort respond to one standard question differently in different survey round i.e. interviewees of second round survey respond to sensitive questions of sexual behaviors differently than respondents of the first round survey. The common way to test this problem is to examine response to one standard question about HIV risk related behavior that should always be the same in expectation across surveys for people in a given birth cohort; the age at which they first had sex, or alternatively, if they had sex before marriage (Zaba et al., 2002; Gersovitz, 2005; Glick and Sahn, 2008). Observations of the same birth cohort sampled in different survey rounds are supposed to report the same age at first intercourse across the survey rounds. Reported later age at first sex of the same birth cohort in later surveys is however observed in many DHSs which asserts prevalence of this problem in many of the DHSs. This problem creates

suspicion whether changes in reported sexual behaviors, especially age at first sex, are a true change or simply reflects changes in the way peoples respond to the sensitive sexual behaviors. Correction for this problem is, however, unavailable and analyses of changes in sexual behaviors do not adjust for biases resulting from this problem.

3.2 Empirical Approach

3.2.1 Modeling Factors of HIV Prevalence

Few studies have been focused on the socioeconomic factors of HIV prevalence. Analysis method of many of these studies is mainly univariate or bivariate analysis using a descriptive statistics. However, descriptive statistics of univariate and bivariate analysis hides many important implications than it reveals. Among the studies, epidemiological studies are the most common ones which often use bivariate and multivariate logistic estimation techniques. Though the multivariate logistic estimation is important to control many confounding factors, almost all studies using this technique fail to account for sample selection bias.

In many of the DHSs, blood test for HIV is not fully observed for all respondents; many respondents who were asked to give blood for HIV test reject to accept the request. Non-response (refusal to give blood for HIV test) is also expected to prevail in many other cohort or district based surveys. In such situations, it is important to take account of the possible selection bias which could result from non-response for the seroprevalence test. This is because the non-observable characteristics of individuals which increase the propensity not to accept the request for HIV test may also be associated with increasing

probability of HIV prevalence. One study which is however from the economics literature, Lachaud (2007), had used an estimation technique which accounts for selection bias.

Estimations of probabilities of HIV prevalence adjusted for sexual risk behaviors are inappropriate. This problem is observed in many literatures which assess the factors of HIV prevalence including Lachaud (2007). Inclusion of risk behaviors as covariates while estimating socioeconomic factors of HIV prevalence leads to over-adjusted analysis where the parameters of socioeconomic factors like education and wealth are being underestimated (Hargreaves and Glynn, 2002; Victora et al., 1997). Victora et al. (1997) argued that statistical analysis should take account of the hierarchical nature of the association between health outcomes and distal factors (factors which affect health outcomes through intermediate variables or risk behaviors like education and income). Since theoretically low educational attainment and low living standards are associated with high risk sexual behaviors, inclusion of risky sexual behaviors will create endogeneity and will underestimate the true effects of education and wealth on the health outcomes. Similarly, De Walque (2006) argued that though it is regularly done in epidemiological literatures, inclusion of sexual behaviors as control for HIV infection regression leads to reverse causality and endogeneity.

To determine the factors of HIV prevalence, I used the EDHS of 2005 for which HIV test for sub-sample of the population was undertaken. The response rate for HIV test was 80 percent (76 percent in urban and 85 percent in rural; 76 percent for males and 83 percent for female). The non response which is mainly the result of refusal for HIV testing is

suspected to create selection bias that may affect the outcome of interest. To account for this non response, the Heckman two step estimation technique is commonly used in many studies. In this study, the Heckman two-step estimation for a binary dependent variable will take two probit estimations. The first probit model which is the selection equation estimates the probability of non-response conditional on given covariates. Including the adverse mills ratio calculated from the first step, the second probit model estimates the probability of HIV prevalence for sub sample of the respondents whose result of HIV test is observed.

Results of HIV test are observed only if respondents have undertaken the test i.e. for those who accept the consent statement of the HIV blood test. If we let y_{1i} is a binary indicator of the HIV test result (HIV prevalence) and y_{2i} is a binary indicator of non response for HIV test (a value of zero if individual refuses to give blood test and a value of one if individual agrees to give blood for HIV test), the model becomes:

$$y^*_{1i} = x'_{1i}\beta_1 + \varepsilon_{1i} \quad \text{.....(1)}$$
$$y^*_{2i} = x'_{2i}\beta_2 + \varepsilon_{2i} \quad \text{.....(2)}$$
$$y_{1i} = y^*_{1i} \quad \text{if } y^*_{2i} > 0 \quad \text{.....(3)}$$
$$y_{1i} \text{ is unobserved if } y^*_{2i} \leq 0 \quad \text{.....(4)}$$

The Heckman conditional expectation for sub sample of the observations (i.e., for those who undertake the HIV test) conditional on having agreed to give blood test and other covariates is:

$$E[y^*_{1i} \mid x_{1i}, y^*_{2i} > 0] = x'_{1i}\beta_1 + E[\varepsilon_{1i} \mid \varepsilon_{2i} + x'_{2i}\beta_2 > 0] \quad \text{.....(5)}$$
$$E[y^*_{1i} \mid x_{1i}, y^*_{2i} > 0] = x'_{1i}\beta_1 + E[\varepsilon_{1i} \mid \varepsilon_{2i} > -x'_{2i}\beta_2] \quad \text{.....(6)}$$

The final model of Heckman two step estimation as observed in Puhani (2000) becomes:

$$E[y^*_{1i} \mid x_{1i}, y^*_{2i} > 0] = x'_{1i}\beta_1 + \frac{\sigma_{12}}{\sigma_2}\lambda(x'_{2i}\beta_2 / \sigma_2) \quad \text{.....(7)}$$

Where $\lambda(x'_{2i}\beta_2 / \sigma_2) = \frac{\phi(x'_{2i}\beta_2 / \sigma_2)}{\Phi(x'_{2i}\beta_2 / \sigma_2)}$; which is the adverse mills ratio calculated from the first probit model of the selection equation (equ. 2).

The regression equation corrected for selectivity bias (which is the Heckman probit model) will then become:

$$y^*_{1i} = x'_{1i}\beta_1 + \alpha\lambda(x'_{2i}\beta_2 / \sigma_2) + \mu_i \quad \text{.....(8)}$$

The estimation procedure is to first estimate the selection equation (equation 2) using a probit model and calculate the adverse mills ratio to be included in the second equation which is the structural equation. The structural equation adjusted for selection bias (equation 8) will then be estimated using another probit model.

Correction for selectivity bias using the Heckman two-step estimation requires identification. Identification needs at least one variable included in the selection equation but not included in the structural equation. Lachaud (2007) used variables labor market status and urban residence to identify the model. However, Lachaud (2007) has included sexual behaviors as covariates in the structural equation. Since inclusion of sexual behaviors in the structural equation is suspected to hide the true effect of socio-economic indicators, I used sexual behavior (dummy indicator for having two or more sexual partners) and labor market status to identify the model. Inclusion of sexual behavior in

the selection equation can create endogeneity, yet the best solution to identify the model is to include at least one indicator of sexual behavior in the selection equation. Sexual risk behaviors are more likely to determine response for HIV blood test.

The independent variables of the model are education, wealth, marital status, age, age squared, religion, exposure to mass media, type of residence, sexual behavior and labor market status (employment status). Sexual behavior, having greater than one sexual partner during last 12 months, and labor market status are included only in the selection equation, not in the structural equation.

3.2.2 Modeling Sexual Behaviors

3.2.2.1 Determinants of Sexual Behaviors

This study focuses on three behaviors: age at first intercourse, number of sexual partners and condom use. Only few literatures have analyzed the determinants of these behaviors. Even these literatures have used descriptive analysis of how education, wealth and other factors are related with risk behaviors using percentages, proportions and means. Multivariate analyses of some sexual behaviors are studied by Glick and Sahn (2008), De Walque (2006), and Glick et al. (2004). Study by Glick and Sahn (2008) was only limited to use wealth and education as socioeconomic determinants of sexual risk behaviors. De Walque (2006), on the other hand, do not account for censoring problem while estimating age at first intercourse; and the age group analyzed includes all cohorts whereas the appropriate age group was those cohorts which could be highly influenced by recent information campaigns and social trends.

A. Age at First Intercourse

The appropriate method to identify the determinants of age at first intercourse is mainly using survival analysis. Virginity survival analysis helps to determine the probability of failure or sexual debut conditional on being virgin until some time and other covariates. Since age group 15-19 and 20-24 are cohorts that their initiation into sexual activity would be most likely to have influenced by recent policy or social trends, the study focuses on these cohorts. On the other hand, since first intercourse occurred before age 14 is not often done intentionally and could be by force, the analysis is restricted to intercourses occurred after age 14.

Undertaking survival analysis will help control the obvious censoring problem, because many in this age group (age 15-24) have not yet becoming sexually active. Being virgin until the age at which the survey has conducted creates right censoring. For those who are still virgin on the survey year we only know their current age, and when undertaking survival analysis their failure time (time at which they leave the virginity state) is censored to be their current age. Since the data is right censored and the interest is to estimate the probability of leaving the initial state (virginity) conditional on some covariates, the standard approach is to use hazard model of duration to first sexual intercourse.

Hazard is the chance that an individual has experienced first sex at age t given that he/she had not had sex before his/her t^{th} birthday. Survival time indicates the time that individuals stay virgin. Individuals who are still virgin until their current age (age at interview) are said to be censored.

The equation of the standard proportional hazard model as presented in Cameron and Trivedi (2005) is:

$$\lambda(t \mid x) = \lambda_0(t, \alpha)\phi(x, \beta) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where $\lambda_0(t, \alpha)$, the baseline hazard, is a function of t alone, $\phi(x, \beta)$, the scaling factor, is a function of x (explanatory variables) alone. Usually $\phi(x, \beta)$ is defined as $\phi(x, \beta) = \exp(x'\beta)$.

Consequently, the proportional hazard model of age at first sex becomes:

$$\lambda(t) = \lambda_o(t).e^{\beta x} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Where the hazard function, $\lambda(t)$, indicates the probability of sexual debut at time (age) t conditional on remaining virgin until t and a vector of explanatory variables, x. The baseline hazard rate, $\lambda_o(t)$, is considered to be parametric, taking a Weibull distributional form. Weibull distribution is simple to handle for duration dependence and is appropriate for hazards (exit from the initial state) occurred in later ages. Since age at first sex is commonly concentrated to be on later ages, Weibull distribution is actually supposed to fit the hazard distribution than other distributions.

The vector of explanatory variables includes age, educational attainment, type of residence (rural or urban), religion, household wealth index (wealth quintiles), marital status, exposure to mass media and labor market status (employment status). Since regressions are supposed to run independently for male and female, inclusion of gender

as regressor is unnecessary. Education and wealth index are to be included in different dummy indicators (see section 3.3). Describing education and wealth through dummy indicators can help to identify nonlinear relations between the independent variables, education and wealth, and the dependent variable, sexual behavior. Exposure to information campaign is also supposed to affect adolescences risk behavior. Inclusion of variables which indicate exposure to mass media can help to assess how people are responding to information campaigns being transmitted through mass media.

B. Number of Sexual Partners

Respondents of the DHS were asked about the number of sexual partners they had sex within last 12 months (including spouse). Individuals who have had two or more partners are more vulnerable to HIV infection than those abstained (having no partner) and in monogamous relations (having only one partner). Determinants of number of sexual partners are less studied though changes in number of sexual partners overtime have attracted many researchers in Uganda. The two socio-economic variables (education and wealth) are supposed to have positive effect on number of sexual partners. Theoretically, wealthier and educated individuals are expected to have more sexual partners because of their mobility and income affordability. At the same time they experience large number of concurrent partner change since the gap between their age of sexual debut and age at marriage is longer.

To examine determinants of number of sexual partners in last 12 months (including spouse), I used a probit model with binary dependent variable. The binary dependent variable takes a value of one if the individual has two or more partners and a value of

zero if the respondent has one partner or is abstained. The explanatory variables include educational attainment (EDU_{ki}), household wealth index (WEA_{li}), religion ($RELG_{ni}$), marital status ($MSTA_{mi}$), age (AGE_i), type of residence ($URBAN_i$), exposure to mass media (RAD_i and TV_i) and employment status (LM_i). Accordingly the equation to be estimated using the probit model is:

$$y_i = \beta_0 + \beta_1 AGE_i + \sum_k \beta_{2k} EDU_{ki} + \sum_i \beta_{3l} WEA_{li} + \beta_4 RAD_i + \beta_5 TV_i + \sum_m \beta_{6m} MSTA_{mi} + \sum_n \beta_{7n} RELG_{ni} + \beta_8 LM_i + \beta_{10} URBAN_i \quad \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

The dependent variable y_i is a dummy variable indicating whether the respondent had two or more partners in last 12 months. Except age all of the independent variables are a series of dummy variables.

C. Condom Use

In the DHS sexually active respondents have asked if they used condom last time they had sexual intercourse. It also includes the nature of the relationship with the individual with whom they had sex. The relationship includes spouse/cohabiting partner, boyfriend/girlfriend, casual acquaintance, commercial sex worker, and others. However, Glick and Sahn (2008) argued prevention campaigns stress the need for people to use condoms with casual or non-steady partners; among those in stable and monogamous partnership, condoms are generally not deemed necessary unless one party is HIV positive. The analysis for condom use during last sexual intercourse will then exclude sexual intercourses which were with spouse/cohabiting partner.

Since the dependent variable, condom use, is a binary variable, I used a binary probit model to estimate the determinants of condom use during last intercourse. The dependent variable is a binary dummy variable which takes value one if condom is used during last intercourse, and zero otherwise. The model and the covariates are those observed in equation (11).

3.2.2.2 Changes in Sexual Behaviors

To examine if changes in sexual behaviors are apparent between the two surveys, test for sample composition error and reporting bias (social desirability bias) is important. As discussed in section (3.1), sample composition bias refers to changes in composition of different sample characteristics between the two surveys. Reporting bias (social desirability bias), on the other hand, occurs when respondents of the same birth cohort in different surveys respond to one standard question differently. Presence of these two biases affects interpretation of changes in sexual behaviors that occur between the surveys. The first bias, change in sample composition, can simply be tested by comparing means, percentages and proportions of fixed sample characteristics. In this study Z-test for equality of proportions of fixed sample characteristics between the two surveys is undertaken to determine existence of sample composition bias. The fixed sample characteristics included in the test are education, wealth, religion, marital status, urban residence and employment status.

The other problem, reporting bias/within cohort inconsistence, is more problematic than sample composition bias. Even though it is possible to test existence of the problem, it is difficult to avoid measurement errors occurred due to the problem. To test this problem

commonly used variable is age at first intercourse. In reality, age at first intercourse is the same for observations of the same birth cohort in different surveys, despite later age at first sex is observed in later surveys if reporting bias is apparent. Previous studies mainly compare mean age at first sex and/or the percentage of individuals who were sexually active at their 18^{th}. However to control for possible sample composition error, I used a multivariate survival analysis of age at first intercourse. The data used to test the problem is generated by pooling respondents of the same birth cohort in the two surveys. The generated data has three birth cohorts; age 20-24 in the first survey (25-29 in the second survey), age 25-29 in first survey (30-34 in second survey), and age 30-34 in first survey (age 35-39 in second survey). The equation used to test existence of the problem using the multivariate survival analysis is:

$$AFI_i = \alpha_1 survey_i + \alpha_2 X_i + e_i \quad \text{.....(12)}$$

Where AFI_i is reported age at first intercourse of respondents in each birth cohort, X_i's are fixed covariates which are found to have statistically different proportions between the two surveys (variables that indicate sample composition bias). The coefficient α_1, measures the change in reporting error that occur between the two surveys. In the absence of reporting bias, respondents of the same birth cohort are supposed to report similar age at first intercourse and hence the coefficient α_1 becomes insignificant (statistically equal to zero). Regressions are undertaken independently for each birth cohort.

Following testing the potential sources of biases, the next step is to examine change in sexual behaviors between the two surveys by accounting for sample composition error, if exists. There are two ways to take account of sample composition error while analyzing changes in sexual behaviors. One is controlling the problem by stratifying the data on key characteristics such as education and location, and examining changes in behavior within these strata (Zaba et al. 2004). The other method which is used in this study and proposed by Glick and Sahn (2008) is to estimate a regression (probit or hazard model as appropriate) for the behavior including as regressors indicators for survey rounds and control for a broader change of characteristics, i.e.

$$y_i = \alpha_1 survey_i + \alpha_2 X_i + e_i \quad \text{.....(13)}$$

Where y_i`is the behavior reported by individual i, $survey_i$ indicates survey round and X_i is a vector of individual, household and other controls. Provided that this is the only data problem and that the included covariates are adequate to account for the relevant differences in the samples, the coefficient on survey year captures the change in behavior between surveys controlling for between sample differences in other factors that affect the behavior (Glick and Sahn, 2008)). For simple comparison and interpretation I used $survey_i$ to be a dummy variable which takes the values:

$survey_i = 1$, for survey round two

$survey_i = 0$, for survey round one

Thus the parameter α_1 indicates the change in behavior between the two surveys controlling for sample composition bias, and can be interpreted as change in behavior resulting from later survey compared to the previous (round one) survey. If, however, sample composition error is not apparent, the estimation technique that examines changes in sexual behavior will become a bivariate analysis without fixed characteristics. To examine changes in sexual behaviors using the above regression equation, data of the two surveys are pooled. Change in age at first intercourse is analyzed using a pooled data of respondents aged 15-24 in both surveys.

3.3. Definition of Variables

- HIV test consent statement (dependent var. of equ. 2): dummy variable indicating whether the respondent agrees to give HIV blood test or not.
- HIV test result (dependent var. of equ. 8): dummy variable indicating HIV prevalence of respondents
- Age at first sex: indicates the respondents' age of sexual debut.
- Number of sexual partners: dummy variable which takes a value of one if respondent has two or more sexual partners during last 12 months.
- Condom use: dummy variable indicating whether condom is used during last intercourse.
- Education dummies (like in equ. 10): no education (reference group), primary education, secondary education, and post secondary education (higher education).
- Wealth dummies: poorest (reference group), poorer, middle, richer, and richest

- Marital status dummies: never married (reference group), currently married, and formerly married.
- Religion dummies: Orthodox (reference group), protestant, Muslim, and others (includes catholic, traditional and other religion)
- Type of residence: dummy variable indicating urban residence (takes a value of one if respondents live in urban area, and zero if lives in rural area)
- Frequency of listening radio: dummy variable indicating whether respondents listen to radio at least once a week or not.
- Frequency of watching TV: dummy variable indicating whether respondents watch TV at least once a week or not.
- Labor market status: dummy variable indicating whether the respondent is currently employed or not

Chapter Four: Results and Discussion

4.1 Socioeconomic Factors of HIV prevalence

There are many socio-economic and demographic factors associated with the prevalence of HIV infection among individuals, households and societies. Socioeconomic and demographic factors do not directly affect HIV status, but indirectly affect as the infection rate is different for different socioeconomic and demographic indicators like age, education, wealth, place of residence and others. There are two competing theories describing the correlation between HIV infection and socioeconomic status (measured by education and wealth), as discussed in the previous chapters. Education and wealth are thus expected to have either positive or negative correlation with HIV infection. Majority of earlier studies found a positive association between HIV infection and socioeconomic status. However, findings of recent study are more or less mixed.

Using the 2005 Ethiopian DHS, this study has analyzed the correlates of HIV infection. The descriptive statistics summarized in *Table 4.1* indicates a positive association between socioeconomic status (measured by education and wealth) and HIV prevalence for both sexes. However, the association is not a one way linear relationship. Education, one of the socioeconomic factors, is observed to have a positive impact on HIV prevalence. The prevalence among individuals who attend higher education is 1.93 and 1.09 for men and women respectively, whereas it is 0.7 and 1.20 among uneducated men and women respectively. Respondents with secondary educational attainment have the highest prevalence rate for both sexes. However, among women in all educational level,

those who have attained higher education are less affected by HIV implying that higher education has a protective effect against women's HIV infection than no education even though the prevalence is higher among respondents with primary and secondary education.

Table 4.1: Percentage of HIV positive respondents categorized by wealth and education for each gender category

Men				Women			
Variable	% of HIV+	Variable	% of HIV+	Variable	% of HIV+	Variable	% of HIV+
Age Group		Wealth		Age Group		Wealth	
15-19	0.08	Poorest	0.83	15-19	0.87	Poorest	0.58
20-24	0.77	Poorer	0.43	20-24	2.07	Poorer	0.68
25-29	1.69	Middle	1.03	25-29	3.04	Middle	0.91
30-34	2.52	Richer	0.88	30-34	2.06	Richer	0.86
35-39	1.85	Richest	1.87	35-39	3.44	Richest	4.48
40-44	2.24	Religion		40-44	2.24	Religion	
45-49	0.24	Orthodox	1.72	45-49	1.41	Orthodox	3.35
50-54	1.05	Muslim	0.35			Muslim	0.76
55-59	0.53	Protestant	1.49			Protestant	1.53
Education		Other	0.00	Education		Other	0.00
No education	0.70	Marital status		No education	1.20	Marital status	
Primary	0.88	Never Married	0.57	Primary	2.69	Never Married	1.26
Secondary	2.23	Currently Married	1.42	Secondary	4.80	Currently Married	1.70
Higher	1.93	Formerly Married	3.75	Higher	1.09	Formerly Married	6.09
Labor Market		Residence		Labor Market		Residence	
Employed	1.34	Urban	2.21	Employed	2.68	Urban	4.91
Unemployed	0.30	Rural	0.78	Unemployed	1.84	Rural	0.85

Source: Compiled from 2005 EDHS raw data of HIV prevalence

Like education, wealth is positively related with HIV infection for women with 0.58 prevalence in the poorest quintile and 4.48 in the highest wealth quintile. Even though the richest wealth quintile has largest prevalence of 1.87, men's HIV prevalence indicates non linear association between wealth and HIV infection. But the descriptive statistics generally indicate that both wealth and education are positively associated with HIV

infection for both sexes with the exception of lower prevalence rate among highly educated women. Prevalence of HIV is increasing with age and after some positive trends it declines in the upper age groups, indicating a non-linear relationship between the two factors. Likewise, the descriptive statistics shows that urban residents have higher HIV prevalence than the rural dwellers with the higher prevalence being among women (4.9 percent) as compared to men (2.2 percent). Other demographic factor observed to have positive effect is marriage. Formerly married (widowed, divorced and separated) individuals have higher prevalence which is 6.1 percent for women and 3.7 percent for men. Among never married, the prevalence is 1.3 for women and 0.6 for men while it is 1.7 and 1.4 among currently married women and men respectively. For both sexes, the prevalence is higher among Orthodox Christians followed by Protestants and Muslims.

The multivariate model used to determine the correlates of HIV infection is the Heckman two step model which corrects for selection bias that arise from non response for HIV blood test. Since the dependent variable is a binary outcome, the Heckman selection model undertakes two probit estimations, one for selection (observability of HIV blood test) and the other for prevalence of HIV. The independent variables are those indicated in *Table 4.1*.

Estimation results of the Heckman Probit model (*Table 4.2*) indicate that HIV prevalence increases with age, and the relation is observed to be non-linear which increases at a decreasing rate, reaches a maximum at some point and starts to decline. The coefficient of age is significant positive while the coefficient of age squared is significant negative. The correction term for selection bias is significant for men signify that the non-

observable characteristics that increase the probability of non acceptance for HIV blood test are correlated with HIV infection. Men's negative coefficient of the selection term is to mean that the unobserved characteristics that increase the chance of not accepting HIV blood test are negatively correlated with HIV infection. Similarly, correction term for women's estimation of HIV prevalence is significant positive, contrary to the result of men, indicating the unobserved characteristics that increase women's non-acceptance for the HIV blood test are positively related with the infection. In both cases, significance of the selection term approves that Heckman-Probit model which accounts for selectivity bias is appropriate than models which do not account for selectivity bias.

Effect of education on the prevalence of HIV among women is mixed. While primary education and secondary education have positive effect, higher education has negative effect. The positive coefficient of primary education and negative coefficient of higher education are significant. Thus, Women's education has a non linear effect. Compared to the uneducated individuals women who attend primary and secondary education have higher probability of HIV infection, whereas women who attend higher education (college or university) have lower probability. Accordingly, it is only higher education that has a protective effect against HIV. Illiterate women are more vulnerable to HIV infection than highly educated women leaving illiteracy as significant indicator of HIV infection. But it is also true that women who attend primary and secondary education are more vulnerable than the illiterate ones. Even though it is arguable that higher education has a protective effect, it is impossible to generalize and draw education as a tool to combat HIV. Consequently, encouraging higher education and implementing school

based HIV/AIDS prevention campaigns could possibly strengthened the protective effect of higher education and reduces the prevalence among women.

Education is also found to have a non-linear effect for men's HIV infection. Primary and secondary education have negative coefficients and higher education has positive coefficient, but none of them are significant. The positive coefficient of higher education could possibly be the result of years back positive association between education and HIV infection. Even though men's higher education is positively associated with HIV infection, uneducated individuals are observed to have greater probability of HIV infection than individuals with primary and secondary education. Hence, it is ambiguous to conclude that education has a protective effect, even though men who attend primary and secondary education have insignificant lower probability than the illiterate ones.

The effect of education among both sexes has some encouraging indicators. Higher education among women, and primary and secondary education among men are negatively associated with HIV. Among men, it is only higher education which is found to have insignificant positive association. For women, both primary and secondary education have positive coefficients, however, the positive effect of secondary education is lower and is insignificant compared to that of primary education. To summarize, education has some protective effect among both sexes but significant only among highly educated women. Thus, promoting education as one part of HIV prevention program and designing school based programs could help to reduce incidence of the epidemic.

Table 4.2. Regression coefficients of Heckman probit estimation of HIV prevalence[a]

Variables	Men		Women	
	B	se [b]	β	se [b]
Age	0.063	0.020***	0.128	0.035***
Age squared	-0.086	0.027***	-0.002	0.001***
Education [c]				
Primary	-0.079	0.063	0.182	0.108*
Secondary	-0.035	0.089	0.139	0.129
Higher	0.149	0.117	-0.575	0.296*
Wealth [d]				
Poorer	-0.309	0.090***	-0.062	0.202
Middle	-0.296	0.084***	0.058	0.187
Richer	-0.16	0.085*	-0.008	0.194
Richest	-0.077	0.096	0.358	0.183*
Urban residence [e]	0.686	0.084***	0.372	0.144***
Religion [f]				
Protestant	-0.137	0.073*	-0.071	0.116
Muslim	0.207	0.087***	-0.404	0.110***
Other	-3.04	0.105***	-5.497	0.278***
Marital status [g]				
Currently married	-0.073	0.081	0.337	0.131***
Formerly married	0.126	0.130	0.792	0.138***
Frequency of listening to radio [h]	0.056	0.053	0.169	0.094*
Frequency of watching TV [h]	0.011	0.074	-0.013	0.108
Athrho	-3.107	0.748***	1.288	0.440***
Rho	-0.996	0.006	0.859	0.116
Wald test for independency (rho=0)[i]	chi2(1)=17.26 prob > chi2(1) = 0.000		chi2(1)=2.96 prob > chi2(1) = 0.0855	
Number of observation	5986		6781	
Log likelihood	-2621.171		-2980.883	
Wald chi2(17)	3632.43		789.19	

[a] The regression results are produced using a command heckprob in STATA and the results for the selection equation are reproduced in appendix1

[b] se refers to robust standard errors (with * significant at 10%; ** significant at 5%; *** significant at 1%)

[c] No education is the base category

[d] The poorest wealth quintile is the base category

[e] Dummy for urban residence (value of zero takes for rural residence)

[f] Orthodox religion is the base category

[g] Never married is the base category

[h] Takes a value of 1 for frequency of once a week or all day of the week

[i] Test for independency of the two equations (structural and selection equations)

Poverty, one of the basic socioeconomic factors, is observed to be a risk factor for men's HIV infection. Results of the Heckman Probit estimation for men confirm a statistically significant negative association between wealth and HIV infection. However, the negative association becomes weaker up in the wealth quintile. In contrast to this, the regression result for women is inconclusive; the poorer (2^{nd} wealth quintile) and the richer (4^{th} wealth quintile) have negative coefficient (indicating lower chance of HIV infection than the poorest quintile), the middle (3^{rd} wealth quintile) and richest (5^{th} quintile) have positive coefficients. With exception of the richest quintile being significant, all the other wealth coefficients are insignificant.

The negative association of wealth and men's HIV infection is likely to be in favor of the statement that HIV infection is more concentrated among the poorest and marginalized societies. The significant positive coefficient of the richest wealth quintile for women, however, is a challenge to this statement. The indicated positive association could be because women of highest wealth quintile may have more mobility and freedom to have more concurrent sexual partners than the poorest ones. For men, however, such opportunities could be similar for all wealth quintiles because the poorest have access to commercial sex workers while the richest have opportunity for more sexual partners other than commercial sex workers. Thus, men's poverty exacerbates the propagation of HIV infection. However, HIV prevalence is not associated with wealth for women, with exception of the richest quintile in which they are more vulnerable than the poorest wealth quintile.

With regard to religion, Muslim men have statistically significant higher probability of HIV infection than Orthodox Christians, while Muslim women have lower probability. Like other risk factors, marriage is found to be a significant indicator of HIV infection for women. The coefficient of currently married and formerly married reveals significant positive values. This could be due to the fact that girls are more likely to be married with older men of good socioeconomic status, such that marriage with older or younger than 10 years is a risk factor for HIV infection. On the other hand, formerly married (divorced, widowed or separated) women and those with low income are more likely to engage in exchange of sex for money, and more likely to be married with older men. Such issues are more concentrated in low income households. The results for men, however, exhibit negative effect of current marriage and positive effect of former marriage to HIV infection, but none of them are significant.

The results generally indicate that while education has insignificant protective effect among men (primary and secondary education have insignificant negative coefficients), it reduces probability of HIV infection significantly for women (the coefficient of higher education is significant negative). But results of the model also confirm that women with primary and secondary education are more vulnerable than those with no education. On the other hand, poverty (being in lowest wealth quintile) is significant indicator of HIV infection for men. However, among women it is only the richest wealth quintile that has a statistically significant greater chance of HIV infection than women of the poorest quintile. As can be seen in the next section, the multivariate analyses of women's sexual behaviors found that wealth is positively associated with risky sexual behaviors in 2000 data. Wealthier women are specially found to have earlier sexual debut and higher

probability of accompanying more than one sexual partner. In 2005 data, however, the multivariate analyses found that women of richest quintile are less likely to have risky sexual behaviors. Thus, the observed positive association between the richest wealth quintile and women's HIV prevalence could possibly be the result of years back risky behaviors observed like that of risky behaviors observed in 2000 data.

Similar to the descriptive data (*Table 4.1*), urban residence is found to be associated with higher HIV prevalence for both men and women. This could be because urban areas are highly populated and experience higher internal and external migrations. Risk behaviors and practices like commercial sex, injections and sexual abuses are also concentrated more in urban areas than in rural areas. Unexpected results that come out of the regression are those related to frequencies of exposure to mass media. The effect of frequency of watching TV and listening to radio are insignificant positive with the exception of insignificant negative effect of watching TV among women. Thus, it could be inferred that prevention campaigns using community and peer group discussions and religious teachings could be other alternatives as the effect of mass media campaigns are poor.

Results of the model indicate that policies and programs designed to prevent HIV infection should target the poor and uneducated society. In addition, programs particularly targeting girls who are primary and secondary school students are very important. Creating income generating activities, encouraging education (higher education for women), implementing school based HIV information campaign, launching information campaigns using community services (community and peer group

discussion), encouraging women to have marriage with their age mates (small age gap between marriage partners), and empowering divorced and widowed women could have a great role to reduce HIV infection in the poor and uneducated society. Thus, defining HIV infection to be a disease of poverty and underdevelopment, despite wrong from medical point of view, is not unjustifiable.

In many cases results of the multivariate and descriptive analysis may provide contradicting results. However, it is common to find contradicting results between the two analyses. Since multivariate analysis includes many variables, interaction of the variables may results to contradicting results compared to the descriptive statistics. In addition, the multivariate analysis is adjusted for sample composition bias which is impossible to see its effect in the descriptive analysis.

4.2 Socioeconomic Factors of Sexual Risk Behaviors

Analyzing correlates of sexual behaviors helps prevention programs to promote reduction in risky behaviors among high risk groups. This study has analyzed three sexual behaviors; age at first sex, condom use and number of sexual partners. Descriptive statistics of the three sexual behaviors is summarized in *Table-4.3* below.

A. Age at first sex

Age of sexual initiation is thought as risk factor for sexually transmitted infections including HIV by increasing years of potential exposure to infections. Early sexual initiation increases the probability of infecting by STIs including HIV while later age of sexual initiation reduces probability of exposing to STIs. Age of sexual initiation could

be influenced by socioeconomic and demographic factors. Although there is no theory which clearly specify factors contributing to early sexual debut, uneducated and poor women are supposed to have early sexual debut. In order to get money, the poor and uneducated women will either marry or have sex at their early age with older men who could financially support them. Such behaviors are highly exposed to HIV infection.

Table 4.3. Descriptive Statistics of sexual behaviors categorized by wealth and education for each gender category

Gender	socioeconomic indicators	2000			2005		
		% of respondents who have sex at 18th or before	% of respondents having >1 sexual partner	% of respondents used condom	% of respondents who have sex at 18th or before	% of respondents having >1 sexual partner	% of respondents used condom
Women	Education						
	No education	84.40	1.37	11.06	81.26	0.37	13.64
	Primary	86.87	2.20	30.63	89.69	0.35	33.33
	Secondary	78.60	1.54	35.45	79.56	0.72	38.24
	Higher	47.10	0.00	52.38	63.95	0.00	0.00
	Wealth						
	Poorest	85.84	0.82	0.00	80.49	0.30	7.14
	Poorer	83.49	0.75	0.00	82.74	0.28	0.00
	Middle	84.45	1.09	3.57	84.02	0.14	0.00
	Richer	84.97	1.44	2.08	86.27	0.32	0.00
	Richest	81.43	2.61	34.30	81.31	0.80	39.82
Men	Education						
	No education	51.43	8.27	5.00	45.63	5.25	11.11
	Primary	70.36	7.66	29.73	62.76	5.50	46.15
	Secondary	73.84	14.37	60.81	70.37	6.01	64.26
	Higher	48.81	7.50	60.61	55.29	6.63	83.02
	Wealth						
	Poorest	58.85	9.29	8.00	54.35	6.74	17.31
	Poorer	55.53	7.88	6.45	52.13	4.33	24.00
	Middle	57.45	8.99	7.02	50.35	4.44	41.94
	Richer	59.59	8.17	22.95	58.23	7.49	32.14
	Richest	67.87	10.41	57.80	63.90	4.86	71.18

Source: Compiled from the raw data of 2000 and 2005 EDHS

The descriptive statistics (summarized in *Table 4.3*) indicate the percentage of respondents who have had sex at their 18th or before for the two basic socioeconomic indicators, wealth and education. The percentage of women whose first sex was at age of 18 or before is larger among respondents with primary education compared to that of no education, whereas it is lower for secondary and higher educational attainments in both 2000 and 2005 surveys. Education is, however, observed to increase the percentage of men respondents whose first sex was at age of 18 or before as compared to respondents of no education in both surveys. The only exception is among men with higher education in which the percentage is lower in case of 2000 survey.

Percentage of respondents who had sex at their 18th or before does not significantly vary between the different wealth quintiles. In 2000 data, the percentage of women who had sex at their 18th or before is reduced by small fraction while going up to higher wealth quintile. In contrast, the percentage increases by small fractions in 2005 data with exception of lower percentage among respondents of richest wealth quintile. On the other hand, in 2000 data, the percentage of men who had sex before or at age of 18 increases up in the wealth quintiles. But in 2005 data, the effect of wealth becomes non linear indicating that 2nd and 3rd wealth quintiles have small percentage while the 4th and 5th quintiles have larger percentages compared to the first quintile. Using the descriptive statistics, it is thus difficult to generate a one way relationship between percentages of respondents who had sex at their 18th or before and socioeconomic status measured by wealth and education. But the percentage is decreasing with education for women in both surveys and increasing for men in 2005 indicating that education could have different impact on age of sexual initiation among boys and girls.

Table 4.4: Regression coefficients of Proportional Hazard estimation of Age at First Intercourse (standard errors in parenthesis)

	Men		Women	
Variables	2000	2005	2000	2005
	-0.0714	-0.159	-0.230	-0.207
Age	(0.031)**	(0.024)***	(0.010)***	(0.016)***
Education				
	0.146	0.178	-0.014	-0.098
Primary	(0.156)	(0.114)	(0.057)	(0.079)
	0.173	0.595	0.005	-0.215
Secondary	(0.212)	(0.139)***	(0.080)	(0.121)*
	0.751	0.546	0.207	-1.204
Higher	(0.410)*	(0.248)**	(0.291)	(0.247)**
Wealth				
	0.188	-0.350	0.042	-0.117
Poorer	(0.260)	(0.160)**	(0.085)	(0.101)
	0.229	-0.214	0.216	-0.150
Middle	(0.237)	(0.147)	(0.080)*	(0.101)
	0.241	-0.228	0.191	-0.198
Richer	(0.232)	(0.160)	(0.082)**	(0.111)*
	0.183	-0.161	0.128	-0.263
Richest	(0.298)	(0.171)	(0.097)	(0.125)**
	0.502	0.515	0.125	0.20
Urban residence	(0.249)**	(0.154)**	(0.079)*	(0.120)*
Religion				
	-0.223	0.10	-0.393	-0.162
Protestant	(0.205)	(0.122)	(0.0629)***	(0.095)*
	0.126	-0.086	-0.306	-0.088
Muslim	(0.133)	(0.098)	(0.047)***	(0.073)
	0.332	0.626	-0.151	0.020
Others	(0.295)	(0.203)**	(0.110)	(0.192)*
Marital status				
	1.577	2.337	3.679	3.748
Currently married	(0.150)***	(0.102)***	(0.074)***	(0.112)***
	1.897	1.931	3.791	3.735
Formerly married	(0.263)***	(0.243)***	(0.089)***	(0.141)***
	0.012	0.088	-0.081	0.016
Frequency of listening to radio	(0.142)	(0.095)	(0.064)	(0.092)
	0.273	0.315	0.154	0.061
Frequency of watching TV	(0.179)	(0.115)*	(0.082)*	(0.121)
	0.111	0.397	0.081	0.116
Labor market status	(0.162)	(0.117)**	(0.041)**	(0.073)*
α (Test for duration	7.621	8.528	9.047	9.693
dependency)	(0.374)***	(0.301)***	(0.136)***	(0.225)***
Number of observation	964	2260	5836	2600
Log Likelihood	-156.81	-260.83	1035.01	497.05
LR chi(17)	161	592.16	5129.02	2396.87

N.B. * significant at 10%; ** significant at 5%; *** significant at 1%

[a] Base categories are those indicated in the notes of Table 4.2

Results of the multivariate proportional Hazard model of age at first sex are reported in *Table-4.4.* The result indicates that age reduces the hazard of leaving the initial state (virginity) conditional on being virgin until some specified period of time. Education among men has a positive effect on the probability of being sexually active at early age in both surveys that is results of the proportional hazard estimation indicate that individuals with primary, secondary and higher education have greater hazard of leaving the virginity state than those of individuals with no education. Men's coefficient of higher education in 2000 data, and secondary and higher education in 2005 data are significant positive indicating that education accelerates the hazard of leaving virginity state. On the other hand, it is only in 2000 survey that women's education insignificantly increased the hazard rate of leaving the initial state. But women's educational attainment is observed to reduce the hazard rate in 2005 data with significant negative coefficients of secondary and higher education. Thus, results of the proportional hazard model indicate that education increases the hazard of leaving the virginity state for men, while it decreases the hazard rate for women.

Wealth has no significant effect on the probability of loosing virginity among men. In 2000 data, the effect of wealth on male's hazard of leaving virginity state is positive, while it is negative in 2005 data, but none of the wealth coefficients are significant. Using the 2000 data, results of the proportional hazard model indicate that wealth increases the hazard of leaving virginity state among females, with significant positive coefficients of the middle and the richer wealth quintiles. The wealth effect on females' hazard rate, however, is changed in 2005. In 2005 data, compared to the first (poorest) wealth quintile all the four wealth quintiles have lower hazard rate, with significant negative coefficients

of the richer and richest wealth quintiles. Thus, it indicates that though wealth increases women's hazard of virginity loss in 2000 data, five years later it is observed to reduce the hazard of virginity loss. For both men and women, the result assures that previously wealthier individuals were observed to have earlier sexual debut. But in recent years, the result is changed and wealthier individuals are observed to have later sexual debut than the poorest ones.

Being urban dweller, employed and currently or formerly married are observed to have higher hazard rates. The three characteristics, urban residence, marital status and employment increase the hazard of leaving the virginity state. Marriage is especially found to have a large significant positive effect on the hazard rate, and it increases the probability of being sexually active earlier than never married respondents. This indicates that marriage increases early age of sexual initiation. But this has to be interpreted carefully so that marriage could not be actual risk factor for HIV infection but early age at marriage and marriage with incomparable age or with older partner are risk factors.

Generally, results of the proportional hazard model indicate that education has increased the hazard rate for men in both surveys. Though education increases the probability of earlier sexual debut for women in 2000 data, the positive coefficient has changed in 2005 where greater educational attainment is observed to encourage delayed first sexual debut. However, change in the effect of education is not observed among men, instead the positive coefficients of secondary and higher education become more significant in 2005 than in 2000 data. As a result, education promotes earlier sexual debut for men while it recently promotes later sexual debut among women. Availability of commercial sex

workers, freedom and mobility of young males could have increased the probability of earlier sexual debut for males with primary, secondary and higher educational levels while such opportunities might be narrow among girls of the same educational attainment.

Effect of wealth on early sexual debut is also changing. Similar to education, wealth is positively correlated with earlier sexual debut in 2000 data for both sexes (with insignificant positive coefficients of wealth quintiles for men and significant positive coefficients of middle and richer quintile for women). In 2005 data, however, the coefficients become negative for both sexes with coefficients of poorer quintile being significant for men and coefficient of richer and richest quintiles being significant for women.

B. Number of sexual partners

Having greater than one sexual partner is a risk factor for HIV infection. As a result, HIV/AIDS prevention programs promote one-to-one sexual partnership. There are socioeconomic and demographic factors which affect the number of sexual partners an individual needs to have. Regarding the effect of socioeconomic status (measured by education and wealth) on number of sexual partners, there are two competing ideologies. The first ideology argues that education and wealth increase the number of sexual partners that an individual has by increasing mobility and creating better environment to afford having more sexual partners. The other theory argues that education and wealth reduce probability of having more sexual partners because educated and wealthier people value their life/health more and have better information about health risk factors than the

illiterate and poor people. To assess the effect of education, wealth and other social and demographic factors on having more than one sexual partner (during last 12 months) and to test the computing theories, this section analyzes correlates of number of sexual partners using the descriptive data and multivariate probit model.

The descriptive statistics of *Table 4.3* indicates that education and wealth have a non-linear relation with having greater than one sexual partner for both men and women. In both 2000 and 2005 data, the percentage of women who have greater than one sexual partner is higher among individuals with primary and secondary education, whereas it is lower among individuals with higher educational attainments. Besides, in 2000 data, the percentage of respondents who have greater than one partner is higher among women of better wealth quintiles, but in 2005 data the percentage is lower among women of better wealth quintiles. Likewise, in 2000 data, the percentage of men respondents who have greater than one sexual partner is higher among respondents with secondary education, while the percentage is lower among respondents with primary and higher education relative to respondents with no education. In 2005 data, however, the percentage is higher among men respondents of better educational status. With exception of the richest and richer quintiles in 2000 data and 2005 data respectively, other wealth quintiles have small percentage of men respondents who have greater than one sexual partner than the poorest quintile. Thus, using the descriptive data it is not easy to identify one clear relationship and both factors are observed to have non-linear effects.

Table 4.5: Marginal effects of Probit estimation of number of sexual partners (standard errors in parenthesis)[a]

	Men		Women	
Variables[b]	2000	2005	2000	2005
	-0.0001	0.001	-0.0003	-0.0001
Age	(0.0001)	(0.000)*	(0.000)***	(0.000)*
Education				
	-.020	-0.003	-0.002	-0.001
Primary	(0.016)	(0.009)	(0.002)	(0.000)*
	0.025	-0.003	-0.007	-0.001
Secondary	(0.027)	(0.012)	(0.001)***	(0.000)*
	-0.025	0.013	-0.009	-0.001
Higher	(0.030)	(0.024)	(0.001)***	(0.001)*
Wealth				
	-0.017	-0.012	-0.001	-0.0001
Poorer	(0.021)	(0.009)	(0.003)	(0.0006)
	-0.011	-0.009	0.002	-0.0006
Middle	(0.021)	(0.01)	(0.003)	(0.0005)
	-0.016	0.012	0.004	-0.0002
Richer	(0.020)	(0.012)	(0.004)	(0.0006)
	-0.018	-0.019	0.015	-0.001
Richest	(0.028)	(0.013)	(0.006)**	(0.001)
	-0.002	-0.006	-0.004	0.0014
Urban residence	(0.028)	(0.014)	(0.002)*	(0.0024)
Religion				
	0.014	0.066	-0.003	0.0019
Protestant	(0.023)	(0.018)***	(0.002)*	(0.002)
	-0.015	0.056	-0.003	0.0005
Muslim	(0.014)	(0.011)***	(0.002)*	(0.0008)
	0.033	0.107	0.012	0.0032
Others	(0.036)	(0.038)***	(0.007)*	(0.005)
Marital status				
	-0.136	-0.147	-0.063	-0.011
Currently married	(0.030)***	(0.029)***	(0.019)***	(0.0109)*
	-0.060	-0.030	-0.002	-0.0001
Formerly married	(0.014)**	(0.009)**	(0.003)	(0.0008)
	-0.015	0.019	0.001	0.004
Frequency of listening to radio	(0.016)	(0.008)**	(0.003)	(0.003)**
	-0.015	-0.001	-0.004	0.001
Frequency of watching TV	(0.020)	(0.012)	(0.002)	(0.002)
	-0.015	0.012	0.003	0.003
Labor market status	(0.022)	(0.011)	(0.002)**	(0.0014)**
Number of observation	1888	3654	9512	4183
Log Likelihood	-545.01	-722.74	-625.54	-81.44
LR chi(17)	66.54	116.86	216.47	58.24
Pseudo R^2	0.06	0.08	0.15	0.26

N.B. * significant at 10%; ** significant at 5%; *** significant at 1%

[a] The dependent variable a dummy for having two or more sexual partners

[b] Base categories are those indicated in the notes of Table 4.2

Results of the multivariate Probit model (*Table 4.5*) indicate that for men, education and wealth have some insignificant negative effect on the probability of having greater than one sexual partner in both surveys. Similarly, for women education has significantly reduced the probability of having more than one partner in both survey years. Wealth for women, however, has insignificant negative effect in 2005 data, whereas it has positive effect with significant coefficient of the richest quintile in 2000 data.

The probability of having greater than one partner is decreasing with age, leaving young men and women to have more partners than their elders. Urban residence is insignificant for both sexes, whereas employment increases significantly the probability of having more than one partner for women. Being currently married or formerly married among men and currently married among women are found to have significant lower probability of having greater than one sexual partner relative to never married individuals. Compared to the base category (Orthodox religion), being Muslim, Protestant or follower of other religion has significant higher probability of having greater than one sexual partner among men in 2005 data. With regard to mass media, though exposure to TV and radio has some insignificant negative coefficients, frequency of listening to radio has significant positive coefficient in 2005 data among both sexes. Thus, mass media information campaigns are less effective in reducing risky sexual behavior of having greater than one sexual partner.

To generalize, wealth which is assumed to increase number of sexual partners in the theoretical literature is found to be insignificant but has reduced the number of sexual partners for both sexes, especially. Education, on the other hand, is found to reduce the

probability of having more than one sexual partner and is significant among women. Marriage is also observed to reduce the probability and is significant for both men and women. Thus, policies designed to reduce risky behavior of having more than one sexual partner among the poor and uneducated society could have greater importance to reduce the progression of HIV infection. Prevention programs designed to promote abstinence and faithfulness should then target the illiterate and poor society and encourage latter age at marriage. In addition, designing information campaign other than media information campaign could bring better result in changing risky behaviors and persuading individuals to have single sexual partner.

C. Condom use

Condom use is the third option to prevent HIV infection and sexually transmitted diseases. Individuals who have extramarital sex and have greater than one sexual partner are advised to use condom consistently. It is supposed that different socioeconomic and demographic factors affect condom use in non-spousal and non-cohabiting sexual intercourses. This section analyzes correlates of condom use during the last non-spousal and non-cohabiting sexual intercourse.

As indicated in *Table 4.3*, percentage of respondents who have used condom during their last non-spousal/non-cohabiting sexual intercourse is observed to increase with higher educational attainment and wealth among men in both surveys. But the poorer and the middle wealth quintiles have lower percentage of men respondents who have used condom during their last sexual intercourse in 2000 data. For women, the percentage of respondents who have used condom is consistently increasing with education and wealth

only in 2000 data. Even though percentage of women who have used condom the last time they had sexual intercourse has increased by education in 2005 data, the percentage of respondents with higher educational attainment who have used condom last time they had intercourse is lower (0 percent) compared to other educational levels. On the other hand, in 2005 data the percentage of respondents who have used condom is higher among women of richest quintile than the poorest quintile, while the percentage is lower among other quintiles. From the descriptive statistics, education and wealth are thus observed to have a positive effect on condom use among men in both surveys, whereas they have no any significant effect for women in 2005 data in spite of having positive effect in 2000 data.

Marginal effects of the Probit model (*Table 4.6*) show that education in both survey years has significantly increased the probability of condom use among men. On the other hand, the results indicate that wealth does not significantly determine condom use in the earlier survey while it increases the probability of condom use with significant positive marginal effect of the middle and richest wealth quintiles in the later (2005) survey.

Education and wealth, however, have a mixed result on the probability of condom use among women. In 2000 data, both factors have significantly increased the probability of condom use. But in 2005 data, education has mixed results; while primary and secondary education have insignificant positive effects on the probability of condom use, higher education is found to have a significant negative effect. Numbers of individuals with higher educational attainment who have sex with non-spousal/ non-cohabiting partner were actually very small among women's of higher education, and this could be the

Table 4.6: Marginal effects of Probit estimation of Condom use[a] [standard errors in parenthesis)[a]

Variables [b]	Men		Women	
	2000	2005	2000	2005
Age	-0.006 (0.005)	-0.005 (0.005)	-0.009 (0.003)***	-0.001 (0.001)
Education				
Primary	0.406 (0.099)***	0.282 (0.1056)**	0.066 (0.051)	0.014 (0.022)
Secondary	0.544 (0.096)***	0.368 (0.1167)***	0.058 (0.045)	0.011 (0.017)
Higher	0.518 (0.113)***	0.430 (0.072)***	0.307 (0.128)**	-0.030 (0.014)**
Wealth				
Poorer	-0.106 (0.158)	0.0521 (0.145)	-0.051 (0.005)***	-0.051 (0.021)**
Middle	-0.164 (0.131)	0.26 (0.10)**	0.943 (0.009)***	-0.033 (0.015)**
Richer	0.134 (0.166)	0.086 (0.137)	0.93 (0.015)***	-0.028 (0.013)**
Richest	0.150 (0.165)	0.364 (0.125)***	0.597 (0.041)**	0.031 (0.019)**
Urban residence	0.086 (0.104)	0.188 (0.097)**	0.053 (0.046)	0.002 (0.023)
Religion				
Protestant	-0.041 (0.085)	0.077 (0.088)	-0.026 (0.057)	-0.014 (0.01)
Muslim	0.057 (0.067)	0.094 (0.0725)	-0.058 (0.034)*	0.039 (0.044)
Others	0.037 (0.186)	0.196 (0.121)*	-0.086 (0.066)	-0.022 (0.01)**
Marital status				
Currently married	0.193 (0.171)	-0.232 (0.144)*	-0.0237 (0.053)	-0.006 (0.014)
Formerly married	0.142 (0.116)	0.038 (0.101)	0.063 (0.039)*	0.041 (0.033)
Frequency of listening to radio	0.120 (0.061)	0.040 (0.057)	0.015 (0.030)	0.008 (0.012)
Frequency of watching TV	0.068 (0.066)	-0.002 (0.061)	0.015 (0.033)	0.009 (0.015)
Labor market status	0.205 (0.053)***	0.060 (0.064)	-0.022 (0.03)	-0.012 (0.011)
Number of observation	392	424	548	162
Log Likelihood	-186.64	-231.65	-264.79	-67.53
LR chi(17)	146.38	115.97	103.70	58.25
Pseudo R^2	0.28	0.20	0.16	0.30

N.B. * significant at 10%; ** significant at 5%; *** significant at 1%

[a] The dependent variable is dummy indicate whether condom is used during last sex with non-spousal/non-cohabiting partner

[b] Base categories are those indicated in the notes of Table 4.2

reason for which we find significant negative coefficient of higher education. In 2005 survey, wealth is also found to have mixed effects. Being in the richest wealth quintile significantly increases the probability of condom use, while other wealth quintiles (poorer, middle and richer) are less likely to use condom compared to the poorest quintile. Many studies have indicated that women's data on sexual behavior are significantly different from that of men's. Women are more likely to underreport non-spousal/non-cohabiting sexual intercourses. Such observations could have a substantial effect on the analysis of condom use, and the observed discrepancies on the effect of education and wealth between men and women could be the result of such data problems.

Urban residence is indicated to have a positive effect on the probability of condom use for both men and women, and the positive coefficient is only significant among men in 2005 data. Marriage on the other hand has insignificant negative effect on the probability of condom use, with exception of significant negative coefficient of currently married men in 2005 survey data.

To sum up, education and wealth significantly increase condom use among men, leaving the illiterate and poorest men at high risk of unprotected non-marital sexual intercourses. Recent observation of the 2005 data for women, however, indicates that higher education significantly reduces the probability of condom use, while primary and secondary education insignificantly increases the probability of condom use. Similarly, the richest wealth quintile is observed to have higher probability of condom use than the poorest quintile, whereas the poorer, the middle and the richer quintile have statistically significant lower probability than the poorest quintile. Thus, though women of lower

wealth quintiles are observed to have lower probability of condom and are at higher risk of being infected by HIV, higher education has lower probability of condom use leaving education to have no effect on the probability of condom use among women.

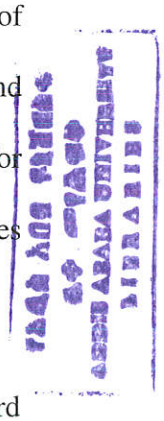
4.3 Change in sexual behaviors

HIV/AIDS, a disease of no vaccine and cure, is mainly transmitted through unprotected recurrent non-marital sexual intercourses. As a result, HIV/AIDS prevention programs mainly promote changes in sexual behaviors to curb the epidemic by reducing its ways of transmission. Thus, success of prevention programs is evaluated by the change in sexual risk behaviors and the subsequent reduction in the incidence rate of new infections.

Assessing change in sexual behaviors across different survey years needs to take care of sample composition bias and reporting error. Before trying to determine whether any change in sexual behavior is apparent or not, it is thus important to test for sample composition error and reporting error/within cohort inconsistence. Z-test for equality of proportions of fixed sample characteristics between the two surveys is undertaken to test for the existence of sample composition bias. Test for reporting error/within cohort inconsistence is done by undertaking a proportional hazard model of age at first sex. Dummy indicator for second round survey and fixed sample characteristics observed to be significant indicator of sample composition error are included in the hazard model (see equation 12).

The Z-test used to test for equality of proportions of fixed sample characteristics exhibits sample composition error between the two surveys. Results of the Z-test are reported in

appendix2. According to the test, proportion of respondents with no education and primary education among men, and proportions with no education, primary, secondary and higher education among women are significantly different between the two surveys. Besides, proportions of different wealth quintiles also exhibited statistically significant difference between the two surveys for both men and women. Similarly, while proportions of the different religions are different for both sexes, proportions of labor market status and marital status are found to be statistically different for women. In conclusion, while proportions of education, wealth, and religion are different between the two surveys for both sexes, proportions of employed respondents and indicators of marital status are also different for women. Thus, inclusion of education, wealth and religion for men, with additional indicators of labor market status and marital status for women are appropriate to account for sample composition error while examining changes in sexual behaviors between the surveys.



Test for reporting error/within cohort inconsistence is done using a proportional hazard estimation of equation(12) with dummies of education, wealth and religion being included for both sexes, while employment status and marital status are additionally included for women as fixed sample characteristics that are used to control for sample composition error. Coefficient of sample survey ($survey_i$) of the proportional hazard estimation of equation (12) for the different birth cohorts is reported in *Table 4.7*.

As can be seen in *Table 4.7*, men's coefficient for survey indicator is significant and positive for all birth cohorts. It signifies that men of the same birth cohort report age at first sex differently in different survey years, whereas it is supposed to be the same in the

absence of reporting bias. The sign is actually unexpected under normal circumstances. If within cohort inconsistence is apparent, individuals of the same birth cohort are supposed to report later age at first sex in later surveys. But the result found here is the reverse. The positive coefficients of survey round indicate that men of the same birth cohort are reporting earlier age at first sex in later survey than in the earlier survey. Even though the bias is reporting earlier age of sexual initiation in later survey, the estimation results approve that there is within cohort inconsistence in reporting age at first sex among men.

Table 4.7: Test for reporting Bias (within cohort inconsistence): coefficient and standard errors of variable survey$_i$ of equation(12)[a]

Sex	Cohort [b]	coefficient	standard error [c]
	1	0.554	0.083***
	2	0.734	0.079***
Men	3	0.424	0.084***
	1	-0.4	0.05***
	2	-0.072	0.05
Women	3	-0.172	0.05**

[a] The fixed covariates (X_i) of equation (12) includes education, wealth and religion for men and also includes marital status and labor market status for women

[b] cohort (1) refers to cohort of age 20-24 in the first survey and age 25-29 in second survey, cohort (2) refers to cohorts of age 25-29 in first survey and age 30-34 in second survey, and cohort (3) refers to cohort of age 30-34 in first survey and age 35-39 in second survey

[c] significant at 10%; ** significant at 5%; *** significant at 1%

Reporting error/within cohort inconsistence is found also among women, but women's reporting error is not in the same direction with that of men's reporting error. The coefficient of survey indicator is significant negative for two cohorts and insignificant negative for one cohort. As in other studies (Zaba et al., 2002; Gersovitz, 2005; Glick and Sahn, 2008), the negative coefficient of dummy indicator for survey round reveal that women respondents of the same birth cohort report later age at first sex in later survey than respondents of earlier survey. Thus, reporting error is apparent for both sexes but is in different direction. Hence, the results indicate that changes in sexual behaviors

between the two surveys could partially arise from reporting error and it is difficult to differentiate which part of the change is mere result of reporting bias. Here, although the results indicate inconsistence in reported age at first sex, changes occurred in other behaviors could not actually be the result of reporting error; they could, however, be upwardly biased as result of reporting errors.

Following tests for existence of the biases, what comes next is to assess changes in sexual behaviors occurred in recent years. While examining changes in sexual behaviors, correction for possible sample composition bias has been taken into consideration; this is done by including fixed sample characteristics observed to have statistically different proportions between the two surveys. Using equation (13), models used to determine changes in sexual behaviors are hazard model for change in age at first sex and Probit model for change in condom use and number of sexual partners. Coefficient of $survey_i$ of equation(13) is reported in *Table 4.8* below indicating the effect of survey round on sexual behaviors, which measures change in sexual behavior occurred between the two surveys. The coefficients for survey round reported in *Table 4.8* indicate significant changes in age at first sex, condom use and number of sexual partners among men. The coefficient of dummy indicator for second round survey is significant negative in the hazard model of age at first sex for men indicating hazard of earlier sexual initiation is becoming lower in recent years. Similarly, the coefficient for condom use is significant positive indicating the probability of condom use among men is significantly higher in recent years. Besides, the coefficient of survey year indicator is significant negative for number of sexual partners among men confirming that men's probability of having

greater than one sexual partner is lower in 2005 data than in 2000 data.

Table 4.8: Estimation results of changes in sexual behaviors occurred between the two surveys adjusted for sample composition error (equation 13) [a]

Variables	age at first sex [b]		condom use [c]		number of sexual partners [d]	
	Men	Women	men	women	men	women
$survey_i$ [e]	-0.282 [0.071]***	0.102 [0.038]***	0.139 [0.039]***	0.024 [0.032]	-0.037 [0.008]***	-0.005 [0.001]***
Number of observation	3229	8449	816	710	5548	13714
Log Likelihood	-775.02	1146.96	-437.90	-351.70	-1339.06	-727.15
LR chi(df), where df=11 for men, and df=14 for women	56.08	6758.89	253.81	123.47	66.64	270.36
Pseudo R^2			0.25	0.15	0.24	0.2

[a] full results of the model including the other covariates are reported in appendix3
[b] using hazard model for age at first sex (pooled data of age15-24 in both surveys)
[c] using a Probit model of condom use during last sexual intercourse with non-spousal/ non-cohabiting partner
[d] using Probit model of having greater than one sexual partner during last 12 months
[e] standard errors in parenthesis (with * significant at 10%; ** significant at 5%; *** significant at 1%)

On the contrary to changes in sexual behaviors among men, changes among women are not encouraging. The effect of survey round for girls' age at first sex is found to be positive, indicating that later survey round increases the probability of early sexual initiation. Hence, no change in delaying age of sexual initiation is observed, rather the probability of earlier sexual initiation is higher in 2005 data than in 2000 data. Change in condom use among women is also insignificant. The only significant behavioral change observed among women is reduction in number of sexual partner. To conclude, prevention campaigns are partially successful, as significant behavioral change are observed among men. But women are left with fewer changes in sexual behaviors. Though reduced probability of having greater than one sexual partner is observed among women in 2005 than in 2000 data, significant increase in earlier sexual initiation is observed in 2005 data.

Chapter five: Conclusions and recommendations

5.1 Conclusions

Progression and consequences of HIV/AIDS should be stopped, at least minimized, to overcome the problems and damages the society is confronting. Taking advantage of the 2000 and 2005 EDHS, this study has analyzed correlates of HIV status and risky sexual behaviors. In addition, the study has assessed changes in sexual behaviors occurred between the two surveys.

The study confirms that education and wealth (indicators of socioeconomic status) have some protective effect against HIV infection and sexual risk behaviors. In spite of this fact, education is observed to be a risk factor of early sexual debut for men, and primary and secondary educations are indicated to have positive association with HIV infection among women. Being in richest wealth quintile is also associated with higher women's HIV prevalence. In 2000 data, women of richest wealth quintile are observed to have early sexual debut and larger probability of having two or more sexual partners. These behaviors could have contributed to the positive association between richest wealth quintile and women's HIV infection in 2005 data. However, risky behaviors of richest women in the previous survey have shown changes in recent years, and women of richest quintile reveal lower risk behaviors than their counterparts in the recent survey of 2005.

Marriage (currently and formerly married) and urban residences are other risk factors of HIV infection and sexual risk behaviors. Marriage significantly increases HIV infection for women and aggravates the hazard of early sexual debut for both sexes. On the other

hand, urban residence is significantly and positively associated with HIV infection and early age of sexual initiation. In contrast to being a risk factor, marriage reduces the probability of having greater than one sexual partner among men and women, while urban residence is found to increase the probability of condom use.

Changes in sexual behaviors are more pronounced among men than women. Later age of sexual initiation, increased probability of condom use and having single or no sexual partner are observed among men in 2005 compared to 2000. But for women changes in sexual behaviors are not propagated well, rather earlier sexual debut is observed more in 2005 than in 2000. The only significant behavioral change achieved among women is lower probability of having greater than one sexual partner in 2005 than in 2000 data.

Findings of the study also confirm that poverty and illiteracy are risk factors of HIV infection and sexual risk behaviors in Ethiopia. Urban dwellers especially the poor and illiterate societies are vulnerable groups to HIV infection. Education is, however, a risk factor for men's early sexual debut, and hence it is important to promote later age of first sex among male students of primary and secondary education. The results also confirm that primary and secondary educations are positively associated with HIV infection among women, whereas higher education significantly reduces the likelihood of HIV infection. To strengthen the protective effect of higher education and reduce the infection among women of primary and secondary education, promoting behavioral change among women students is crucial. Frequencies to mass media are found to be insignificant in many of the regressions, indicating poor effects of media prevention programs. Prevention campaigns can be more successful if it targets the poor and uneducated

society. Since women have higher HIV prevalence and experience little changes in sexual behaviors, programs which promote condom use, later age of first sex, later age at marriage and marriage among comparable age group should be more disseminated among women.

This study, however, is limited to analyze the correlates of HIV infection and sexual risk behaviors using independent cross sectional data. HIV prevalence Data is only available in the 2005 DHS, making longitudinal analysis impossible. Longitudinal or panel data analysis is very important to derive possible causal relations than single cross sectional analysis. Correlates of changes in sexual behaviors are also not examined. As a result, the study fails to see the impact of different factors on changing sexual behaviors. However, the study has carefully analyzed the correlates of HIV infection and risky sexual behaviors using the independent cross sectional data and appropriate econometric models. Though correlates of the changes of sexual behaviors are not examined, the study also has watchfully examined whether changes in sexual behaviors are apparent in response to the epidemic or not.

Assessing correlates and changes of sexual behaviors faces different problems. Amongst, self reporting natures of sexual behaviors, sample composition bias and social desirability bias/within cohort inconsistence are some of them. With exception of correction for sample composition bias, other biases are not corrected while analyzing changes and correlates of sexual behaviors. The problems are natural and less likely to be corrected. In addition, studying changes in sexual behaviors independently for regions and type of residences (urban and rural) could have great importance than treating changes across the

country. Thus, analyzing correlates of HIV infection and risky sexual behaviors using longitudinal models, testing behavioral changes across regions and type of residencies, and determining sexual behaviors that largely contribute to HIV infection can be among the possible future researchable topics.

5.2 Recommendations

HIV/AIDS prevention programs are more interested to reduce sexual risk behaviors and HIV infection among the vulnerable and highly affected groups. According to results of this study, the more vulnerable groups to HIV infection and sexual risk behaviors are the illiterate, poor and urban societies. Following the results, in order to reduce the dissemination of HIV infection successfully and quickly, the following policies are recommended to play a significant role in the rescuing campaign of the society from HIV/AIDS pandemic:

- ✓ Targeting and empowering the poor, marginalized, and illiterate society
- ✓ Promote girl's later age at first sex among uneducated, poor and urban dweller; and boy's later age of first sex among primary and secondary school students
- ✓ Promote later age at marriage and marriage with peers (the same age group)
- ✓ Encouraging education and designing school based HIV/AIDS and risky sexual behaviors awareness programs
- ✓ Promote condom use among illiterate, poor and rural societies
- ✓ Promote faithfulness and abstinence among uneducated and poor men and women

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Appendices

Appendix1- Results of Heckman Probit model for HIV result (with consent to give blood test being the selection equation)

	Coefficient	se(robust)	coefficient	se(robust)
HIV result				
age	0.063	0.020***	0.128	0.035***
Age squared	-0.086	0.027***	-0.002	0.001***
Education				
Primary	-0.079	0.063	0.182	0.109*
Secondary	-0.035	0.089	0.139	0.129
Higher	0.149	0.117	-0.575	0.296*
Wealth				
Poorer	-0.309	0.090***	-0.062	0.202
Middle	-0.296	0.084***	0.058	0.187
Richer	-0.160	0.085*	-0.008	0.194
Richest	-0.077	0.096	0.358	0.183*
urban residence	0.686	0.084***	0.372	0.144***
frequency to radio	0.056	0.053	0.169	0.094*
frequency to TV	0.011	0.074	-0.013	0.108
Religion				
Protestant	-0.137	0.073*	-0.071	0.116
Muslim	0.207	0.087***	-0.404	0.110***
Other	-3.040	0.105***	-5.497	0.278***
Marital status				
currently married	-0.073	0.081	0.337	0.131***
formerly married	0.126	0.130	0.792	0.138***
Constant	-2.228	0.357***	-4.588	0.503***
Consent to HIV blood test (selection variable)				
Age	-0.025	0.013*	-0.005	0.017
Age squared	0.033	0.018*	0.000	0.000
Education				
Primary	0.110	0.057*	0.076	0.059
Secondary	0.096	0.074	-0.016	0.074
Higher	-0.143	0.109	-0.219	0.120*

Wealth				
Poorer	0.251	0.076***	0.094	0.070
middle	0.375	0.081***	0.333	0.079***
richer	0.110	0.076	0.235	0.078***
richest	0.018	0.085	-0.070	0.085
urban residence	-0.609	0.078***	-0.400	0.078***
frequency to radio	0.016	0.048	0.209	0.059***
frequency to TV	-0.075	0.063	-0.193	0.067***
Religion				
protestant	-0.434	0.11***	-0.116	0.123
muslim	0.158	0.073**	0.043	0.064**
other	-0.387	0.046***	-0.297	0.046***
Marital status				
currently married	0.114	0.070*	0.018	0.065
formerly married	0.006	0.114	-0.070	0.081
labor market (employed)	0.115	0.045***	0.031	0.045
No of sexual partner	0.128	0.070***	-0.839	0.346**
constant	1.504	0.200	1.380	0.230***
Athrho	-3.107	0.748***	1.288	0.440***
Rho	-0.996	0.006	0.859	0.116
Wald test for independency (rho=0)[i]	chi2(1)=17.26 prob > chi2(1) = 0.000		chi2(1)=2.96 prob > chi2(1) = 0.0855	
Number of observation	5986		6781	
Log likelihood	-2621.171		-2980.883	
Wald chi2(17)	3632.43		789.19	

Appendix2: Test for sample composition bias (Test for equality of proportions of fixed sample characteristics between the two surveys)

	proportions and Z-test for equality of the proportions					
	Men			Women		
Fixed sample characteristics (variables)	2000 (prop.)	2005 (prop.)	Z-test[a]	2000(prop.)	2005(prop.)	Z-test
Education						
no education	0.49	0.40	7.5*	0.69	0.60	12.50*
Primary	0.30	0.32	1.69	0.16	0.21	11.20*
Secondary	0.18	0.23	4.81*	0.14	0.16	3.80*
Higher	0.03	0.04	0.81	0.01	0.03	12.24*
Wealth						
Poorest	0.15	0.20	5.03*	0.14	0.19	11.70*
Poorer	0.17	0.16	1.06	0.15	0.15	0.00
Middle	0.18	0.16	2.11*	0.18	0.15	6.93*
Richer	0.19	0.15	4.28*	0.18	0.14	9.35*
Richest	0.31	0.35	3.31*	0.35	0.37	3.57*
Residence (urban)	0.26	0.27	0.88	0.30	0.31	1.87
Labor market (currently working)	0.83	0.83	0.00	0.56	0.29	46.73*
Marital status						
Never married	0.41	0.41	0.00	0.26	0.27	5.56*
currently married	0.55	0.55	0.00	0.61	0.61	0.00
formerly married	0.04	0.04	0.00	0.13	0.11	5.27*
Religion						
Orthodox	0.46	0.48	1.57	0.47	0.48	1.71
Protestant	0.13	0.15	2.22*	0.14	0.16	4.80*
Muslim	0.37	0.34	2.47*	0.35	0.32	5.42*

[a] * Indicates significance at 5% (if the calculated Z value is greater than 1.96, it indicates that the proportions between the two samples are statistically different from each other, which indicates the existence of sample composition error).

Z is calculated as: $Z= (P_1-P_2)/(S_{P1-P2})$, where P_1 is proportion of a single variable in first sample (2000 survey) and P_2 refers for proportion of the same variable in the second sample (survey 2005). S_{P1-P2} is the standard deviation between the two samples and is calculated as: $S_{P1-P2}= \{(P^*(1-P^*)[(N_1+N_2)/(N_1*N_2)]\}^{1/2}$, Where $P^*=(N_1P_1+N_2P_2)/(N_1+N_2)$, Where N1 and N2 indicates the sample size of the respective surveys.

Appendix3: estimation results of change in sexual behavior occurred between the surveys adjusted for sample composition error (equation 13)

	age at first sex		condom use		number of sexual partners	
Variables	Men	Women	men	Women	men	Women
Survey	-22.61	-27.391	0.139	0.024	-0.037	-0.005
	[0.681]***	[0.564]***	[0.039]***	[0.032]	[0.008]***	[0.001]***
Education						
Primary	-0.113	0.066	0.366	0.126	0.003	-0.001
	[0.111]	[0.079]	[0.070]***	[0.050]**	[0.009]	[0.001]
Secondary	0.109	-0.205	0.467	0.096	0.042	-0.005
	[0.125]	[0.109]*	[0.065]***	[0.041]**	[0.014]***	[0.001]***
Higher	-0.125	-1.198	0.5	0.126	0.029	-0.006
	[0.233]	[0.237]***	[0.056]***	[0.090]	[0.024]	[0.001]***
Wealth						
Poorer	-0.416	-0.127	-0.012	-0.211	-0.018	-0.001
	[0.160]***	[0.100]	[0.119]	[0.022]***	[0.010]*	[0.002]
Middle	0.058	-0.135	0.093	-0.006	-0.016	0.001
	[0.146]	[0.101]	[0.103]	[0.134]	[0.010]*	[0.002]
Richer	-0.256	-0.228	0.187	-0.051	-0.001	0.003
	[0.157]	[0.111]**	[0.099]*	[0.117]	[0.011]	[0.002]
Richest	0.078	-0.228	0.4	0.209	-0.018	0.007
	[0.135]	[0.103]**	[0.072]***	[0.055]***	[0.011]*	[0.003]**
Religion						
Protestant	0.128	-0.302	-0.013	-0.03	0.036	-0.001
	[0.117]	[0.094]***	[0.065]	[0.050]	[0.013]***	[0.002]
Muslim	0.035	-0.1	0.045	0.007	0.031	-0.001
	[0.096]	[0.073]	[0.051]	[0.041]	[0.008]***	[0.001]
Others	0.449	0.008	0.072	-0.093	0.073	0.009
	[0.201]**	[0.193]	[0.106]	[0.068]	[0.026]***	[0.005]*

Marital status						
Currently married		3.445		-0.05		-0.059
		[0.109]***		[0.041]		[0.015]***
Formerly married		3.509		0.033		-0.002
		[0.140]***		[0.032]		[0.001]*
Labor market status		0.064		-0.045		0.003
		[0.072]		[0.027]		[0.001]***
Number of observation	2265	2606	816	710	5548	13714
Log Likelihood	-542.34	411.27	-437.90	-351.70	-1339.06	-727.15
LR chi(df), where df=11 for men, and df=14 for women	1168.45	2704.74	253.81	123.47	66.64	270.36
Pseudo R^2			0.25	0.15	0.24	0.2

N.B. * significant at 10%; ** significant at 5%; *** significant at 1%

[a] Base categories are those indicated in Table 4.1

Note: variables Marital status and Labor market status are included in the estimation of behavior change in men because proportion of these variables are not significantly different between the two surveys and are not indicators for sample composition error among men

The thesis is my original work, has not been presented for a degree in any university and that all sources of materials used for the thesis have been duly acknowledged.

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