SCHOOL OF ECONOMICS AND MANAGEMENT
Lund University

Department of Economics
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Socio-economic determinants of HIV in Zambia: A district-level analysis

Author: Katarina Öjteg

Supervisors: Carl-Hampus Lyttkens and Therese Nilsson

Abstract

HIV/AIDS is one of the largest obstacles to development in many countries and is destroying the lives and livelihoods of millions of people around the world. Nearly 95 percent of all infected individuals are found in developing countries and the situation is especially problematic in sub-Saharan Africa. In Zambia, around 17 percent of the population is infected with HIV and AIDS is the most common cause of death. The study of HIV and AIDS has been dominated by two approaches; the biomedical and the ethical. This thesis turns to the field of economics in an attempt to widen the understanding of the spread of the epidemic. According to the empirical literature little attention has been given to the socio-economic context in which people live when it comes to understanding the disease. This thesis uses an economic model of risky sexual behaviour to investigate the correlation between different socio-economic attributes and HIV prevalence at district-level in Zambia. The empirical findings show that district HIV prevalence is positively correlated to expenditure, education and the proportion of female headed households, and negatively correlated to the proportion of women and fertility. Further research in this field is essential to establish what makes people susceptible to HIV infection. This research should preferably use individual data.

Key words: HIV/AIDS, economic theory, sexual behaviour, socio-economic determinants, district-level analysis, Zambia.

Preface

I would like to specially thank people who have made this thesis possible. First of all, my supervisors Carl-Hampus Lyttkens and Therese Nilsson for all the support, advice and sound points of view. Special thanks to Yves Bourdet and SIDA for believing in my research and giving me the opportunity to travel to Zambia on a minor field study. It made this thesis possible, and gave me an experience of a lifetime. I would also like to thank my contact in Zambia, Eva Dalekant at Forum Syd, for information, guidance and advice, Anu and Petter for their hospitality, as well as Eta at CSO for all the time and effort she put into helping me with the data collection. Finally, to my mom and many friends, thanks for all the support, energy and joy you bring into my life, enabling me to fulfil my dreams.

Picture taken at campus at University of Zambia (UNZA)

List of Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
CSO	Central Statistical Office
DHS	Demographic Health Survey
HIV	Human Immunodeficiency Virus
LCMS	Living Condition Monitoring Survey
NDPZ	National Development Plan for Zambia
NHASF	National HIV and AIDS Strategic Framework
OLS	Ordinary Least Squares
RGAE	Report on the Global AIDS Epidemic
STD	Sexually Transmitted Disease
STI	Sexually Transmitted Infection
TFR	Total Fertility Rate
UNAIDS	The Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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1. Introduction

This chapter contains a background to the topic, along with the aim and method, as well as an outline of the thesis.

1.1 Background

The HIV/AIDS epidemic is one of the largest obstacles to development in many countries and is destroying the lives and livelihoods of millions of people around the world. According to the former US foreign minister Colin Powell, HIV/AIDS is today the largest threat to mankind – the greatest weapon of mass destruction (Redcross). At the global level it is the fourth largest cause of death (Gaffeo, 2003).

It is estimated that approximately 15,000 people are infected with HIV every day (Collins and Rau, 2000). The situation is worst in regions and countries where poverty is extensive, gender inequality is pervasive, and public services are weak. Almost 95 percent of the people infected with HIV live in developing countries and the situation is especially critical in sub-Saharan Africa where around 68 percent of all adults and 90 percent of all children infected with HIV live (UNAIDS). In Zambia, which is the case study of this thesis, around 17 percent of the population is infected with HIV and AIDS is the most common cause of death. Zambia also suffers from deep and persistent poverty – around 87.4 percent of its population lives below the $2 a day poverty line (UNAIDS).

The HIV/AIDS epidemic is the most discussed public health crisis of the 21st century. According to Philipson and Posner (1993) the discussions as well as the study of the epidemic are dominated by two approaches; the biomedical and the ethical. The biomedical approach seeks to determine the behaviour of the HIV virus and to find a vaccine or cure for it as well as treatments to prolong the lives of HIV-positive individuals. The other approach, the ethical, is used in a broad sense to describe the variety of moral, legal and political perspectives of the epidemic. An economic approach to the HIV/AIDS epidemic has, in contrast, received little attention. Economic theory can be used to examine the private and public responses to the epidemic. The economics of sexuality predicts that individuals choose between safe and risky sex as a rational decision subject to their response to changes in incentives.

Yet, much of the theoretical and empirical work on the HIV/AIDS epidemic within the field of economics has emphasized industrialized countries. Even though human beings are expected to behave similarly regardless of the society they live in, there is still a great difference between industrialized and developing countries. This is especially true when it comes to the surroundings in which populations live. The demographic, social and economic context in which people live may, and presumably does, highly influence the individual risk of HIV virus infection.

According to Casale and Whiteside (2006) little recent research explores the influence of socio-economic variables on the risk of contracting HIV. Shaikh and Bhorat (2005) also state that there is very little empirically robust information on the social and welfare correlates of the HIV/AIDS pandemic. Collins and Rau (2000) write that efforts of HIV/AIDS prevention have sought to change the behaviours of individuals, paying too little (if any) attention to the socio-economic context in which people live. Social and economic realities constrain individual actions and this is most likely the main reason for the gap between what people know and how they act.

There is an increasing need to study what socio-economic context HIV infected people are living in. Even if the HIV/AIDS epidemic in its early stage was associated with urbanized, more mobile individuals, there is evidence today of increasing HIV transmission in poorer, more rural parts of populations and a declining trend among the better-off. A declining trend is of course positive, but as the more well-educated, richer parts of the population suffer decreasingly from HIV infections, there is a risk that the rich will lose interest in the disease as it becomes a problem of the poor.

1.2 Aim

This thesis aims to investigate the correlation between socio-economic factors and HIV prevalence in Zambia using district-level data. The aim is to analyze the drivers of the epidemic and to find out what socio-economic factors make people susceptible to HIV infection.

1.3 Method

Theory is conducted by reviewing already existing theoretical approaches to sexual behaviour in the field of economics. Since there already exists a simple, well structured, economic model of risky behaviour (the work of Philipson and Posner, 1993) and because this model is easy to interpret in terms of socio-economic factors, I choose to use it as my theoretical base. The literature review contains a large range of studies, giving me a great platform to work from. Finally, the empirical study is carried out using nationally representative population-based surveys like the Living Conditions Monitoring Survey (LCMS) and the Census of Population and Housing. I also use the Epidemiological Report to find HIV prevalence at district-level. All datasets were collected from the Central Statistical Office (CSO) during my field study in Lusaka, Zambia.

1.4 An overview of the thesis

The second chapter introduces HIV/AIDS by describing the biology and epidemiology of the disease. A preamble to the great problems of HIV/AIDS facing mainly the developing world is given, and most essentially the situation in Zambia. Chapter three elucidates the theoretical framework of the thesis. It includes the economic approach to human behaviour and an economic model of risky sexual behaviour. This is used to explain how different socio-economic factors can be crucial in people's choice between safe and unsafe sex. Further, chapter four contains a literature review, with a short summary of other theoretical approaches and earlier empirical evidence of the importance of socio-economic factors in the spread of HIV/AIDS. In chapter five the empirical analysis and its results are presented. The thesis is concluded with a discussion of the topic and suggestions for future research in chapter six.

2. HIV and AIDS

In this chapter the biology and epidemiology of HIV and AIDS is introduced. A preamble to the great problems of HIV/AIDS facing mainly the developing world is given, and most essentially the situation in Zambia.

2.1 The Biology of HIV and AIDS

Human Immunodeficiency Virus (HIV) and AIDS (Acquired Immunodeficiency Syndrome) are not the same things. HIV is a virus which belongs to a group of viruses called lentiviruses (from Latin "lentus" which means "slow"). HIV damages the immune system, hence its name. AIDS is the common term for the condition that arises when the HIV virus has damaged a person's immune system severely. By that time that person has a high risk of contracting a large number of infections and tumours. When a person has AIDS, the immune system barely exists and a cold, otherwise innoxious, can be life threatening (Moberg, 2007a). Full-blown AIDS is determined by how far the immune system has deteriorated, which is defined by the presence of opportunistic infections and tumours (Chirambo, 2008).

Infection occurs when the virus enter the body and attaches itself to host cells. Lentiviruses have the capacity to infect a large number of different cell types in the body (Moberg, 2007a). The virus enters a type of white blood cell known as the T-helper cell, which is a disease-fighting antigen and contains a specific antigen called CD4 (Philipson and Posner, 1993). This is the main reason for the spread of the virus and for the course of the disease (Moberg, 2007a). These white blood cells are present in our mucous membranes, bloodstream, lymph nodes and nearly all organs of the body. Once the virus has penetrated the wall of a white blood cell, it copies the cell's DNA and the immune system cannot therefore identify it and destroy it (Barnett & Whiteside, 2006).

A battle between the virus and the immune system commences when a person becomes infected. This period is usually called "the window period", because during this period the person's HIV status cannot be detected using standard tests. This period can last from several weeks to several months (Barnett & Whiteside, 2006). Epidemiologically, this fact is of great

importance since the more people there are in the early stage of infection (the window period), the greater the chance of HIV transmission between people (Barnett & Whiteside, 2006). The window period is followed by a long incubation stage. HIV has a slow disease progression. Even in the absence of effective treatment, it generally takes many years for the immune system to become severely damaged and for the person to become seriously ill. The time between the moment of infection and the occurrence of AIDS is usually long; commonly said to be approximately ten years (Moberg, 2007a). During these years the infected person may feel well and have no or only a few symptoms of disease. Thus, testing for HIV is extremely important since people can live many years without knowing that they carry the virus and are contagious. After being infected by HIV, the person will be contagious for the rest of her/his life. A person may be more contagious when recently infected, since an immune response to the virus has not yet been started. This person may have very high levels of the virus in her/his body fluids. Individuals that undergo effective treatment have very low levels of the virus and are therefore considerably less contagious (Moberg, 2007b).

There is no vaccine against HIV, nor is there a cure for it. However, treatment is very effective; it nearly completely blocks the replication of the virus which means that the immune deficiency of AIDS no longer is irreversible and that the immune system may recover (Moberg, 2007a). Today, there is a high degree of international consensus concerning the treatment of HIV infection. Treatment should be given upon the presence of symptoms that HIV is considered the cause of, or when the number of T-helper cells has fallen below 350-250, and absolutely when it has fallen below 200. On the negative side, effective treatment of HIV is associated with a risk of certain side-effects, usually long term with varying degrees of seriousness (Moberg, 2007a).

Tests for HIV have been available since 1985. There is however a lag between when an individual becomes infected and when an HIV test can detect infection. This is because HIV tests check for the presence of HIV antibodies rather than for the presence of the virus itself (Philipson and Posner, 1993).

There is a risk of transmission every time the HIV virus comes into contact with cells it can infect, so-called target cells. HIV can be transmitted by unprotected sexual intercourse, unprotected oral sex, blood transfusions, when intravenous drug users share injection tools and mother-to-child transmission (primarily during delivery and through breast-feeding).

There is no risk of HIV infection through ordinary social contacts (Moberg, 2007a). The focus of this thesis is transmission through unsafe sexual practices. Individuals differ in infection risk depending on the nature of the exposure, the condition of the immune system and the tissues being exposed to risk. The transmission risk also differs greatly depending on the person transmitting the virus and the stage of infection of this person. Soon after the carrier has become infected and shortly before that person covert to the active status of the disease appear to be peak periods of transmission. Women are, biologically, more exposed than men since vaginal tissues are delicate and because women receive much more fluid in vaginal intercourse than men do (Philipson and Posner, 1993).

2.2 The epidemiology of HIV/AIDS

The terminology of epidemiology distinguishes between incidence and prevalence. The number of new infections which occur over a period of time is called incidence. Hence, the incidence rate is the number of infections per specified part of population in a given time period. Prevalence refers to the absolute number of infected people in a population at a given time. The percentage of the population which exhibits the disease at a particular time is called the prevalence rate (Barnett & Whiteside, 2006).

2.3 HIV/AIDS in developing countries

When analysing the HIV/AIDS epidemic it is of great importance to notice the fact that developing countries differ greatly from industrialized countries on a variety of dimensions relevant to analysis. Philipson and Posner (1993) state that they have no reason to believe that the assumption of rationality in sexual behaviour is any less applicable to developing countries. The hypothesis that the epidemiology of sexually transmitted diseases is similar in all societies is supported by most observations (Burnham and Ronald, 1991). However, there is a lack of availability of good data on HIV/AIDS in the Third World. Also, the objectives and constraints individuals face differ greatly from wealthy countries. Prostitution is much more widespread. They also differ in income, education, the availability of condoms and the prevalence of other sexually transmitted diseases (STDs) which are widespread in many parts of Africa and appear to increase the risk of HIV (Philipson and Posner, 1993). There are also differences in the existence and effectiveness of control programs and the availability of testing and treatment services.

2.4 Zambia at a glance

2.4.1 Introduction

Zambia is a landlocked country in south-central Africa with borders to Angola, Congo-Kinshasa, Malawi, Mozambique, Namibia, Tanzania and Zimbabwe. It is a republic under the regime of president Levy Mwanawasa[1], who was elected in 2002. Approximately 12 million people live in Zambia (WHO), whereof just over 1 million live in Lusaka, the capital. The country is divided into nine provinces and 72 districts. Zambia is one of the most urbanized countries in sub-Saharan Africa, with about 38 percent living in urban areas (UNAIDS).

Figure 1: Map of Zambia

In recent years, Zambia's economy has experienced modest growth with real GDP growth between 5-6 percent per year (CIA world factbook). The country qualified for debt relief under the Highly Indebted Poor Country Initiative in 2005, consisting of approximately USD 6 billion in debt relief. Poverty levels remain high with 63.7 percent of its population living below the $1 a day poverty line (WHO) and as many as 87.4 percent living below $2 a day (UNAIDS). Although poverty continues to be a significant problem in Zambia, its economy has strengthened,

[1] President Levy Mwanawasa died on 19th of August 2008 after suffering a stroke. The vice president, Rupiah Banda, will continue acting as president until a new election, which will decide who will succeed Mwanawasa. Elections must be held within 90 days under Zambia's Constitution (BBC news).

featuring single-digit inflation, a relatively stable currency, decreasing interest rates and increasing levels of trade (CIA world factbook). According to UNAIDS, in spite of an improvement in the GDP growth rate, it is still inadequate to bring about significant changes in the standard of living and health status of Zambians. The life expectancy at birth (for both males and females) is as low as 40 years (WHO), a result of a severe HIV/AIDS epidemic.

2.4.2 The HIV/AIDS situation

The first case of HIV/AIDS in Zambia was reported in 1984, followed by a rapid rise in HIV prevalence. By the early 1990s, the HIV prevalence was already at high levels, but it has remained quite stable at the current level for many years. A big problem is that the majority of infected people still do not know their HIV status. Prevalence rates are higher among women than men (Chirambo, 2008).

The HIV/AIDS epidemic continues to cause health, economic and social impacts in Zambia. HIV prevalence has remained high, estimated to approximately 17 percent among adults and AIDS is the most common cause of death in the country. Deep inequalities based on gender and age have contributed to an increase in the incidence of domestic violence and, as a result, exposure to HIV has been exacerbated (UNAIDS).

The HIV epidemic is characterized by a wide geographic variation. The highest rates are found in densely populated urban areas such as Lusaka, Copperbelt and Southern provinces. The prevalence rate in the urban population is about double the rate of the rural population (NHASF, 2006). The rates tend to be highest in cities and towns such as Kabwe, Livingstone and Ndola where there are major transport routes (RGAE, 2006). The HIV epidemic also varies across gender, with women 1.4 times more likely to be HIV-infected than men (NHASF, 2006). Young women are especially vulnerable. Further, women are taught from a young age to never refuse their husband sex regardless of the extra sexual partners he may have or his non-willingness to use condoms (NHASF, 2006). This perpetual dominance of male interests puts both women and men at greater risk for HIV infection.

Sexually transmitted infections (STIs) account for 10 percent of all documented outpatient attendances in public health facilities in Zambia, and constitute one of the major health problems in the country (NDPZ, 2005). When a person is infected with an STI the infection

forms ulcers and sores that smooth the progress of the transfer of HIV, which is why the probability of transmitting HIV during unprotected sex rises dramatically if either partner has, for example, syphilis or gonorrhoea. More than 50 percent of people with a history of STIs become infected with HIV (NDPZ, 2005).

Knowledge of HIV remains low; only around 45 percent of young people aged 15-24 years correctly identified ways of protecting themselves against sexual transmission of HIV. Among the same age group, of those who had had sex with a casual sexual partner during the last 12 months, only 38 percent of young men and 26 percent of young women reported use of a condom. Mother-to-child transmission is also common, since only 25 percent of HIV-positive pregnant women received a complete course of prophylactic antiretroviral drugs (which reduce the risk of mother-to-child transmission). Still, only 20 percent of all HIV-positive people in Zambia received antiretroviral drugs and only 1 in 10 people have ever been tested for HIV and know their status (UNAIDS).

Socio-economic spheres such as health, education, agriculture and human development are taking knocks from the HIV/AIDS epidemic. Chirambo (2008) states that in Zambia *"poor productivity has been entrenched; mortality and morbidity rates for both infants and adults have worsened; and sectors such as health, education, agriculture, transport, and the economy in general, have been adversely affected as the labor force is bogged down by the epidemic"*. According to the same author Zambia's health system is on the brink of collapse after historically suffering from years of under-investment. Health facilities are lacking adequate personnel, drugs, and/or equipment, and the physical infrastructure is poor. Also the education system is affected by the HIV/AIDS epidemic in the country through the drop in quality of education, mostly caused by the absenteeism of teachers (due to frequent illness) (Chirambo, 2008).

3. Theoretical Model

This chapter contains the theoretical framework of the thesis. The economic approach to human behaviour and an economic model of risky behaviour are presented. The theoretical base is used to explain how socio-economic factors can influence people's choice of engaging in unsafe sexual practices.

3.1 The Economic Approach to Human Behaviour

Gary Becker was one of the pioneers to include new fields of human behaviour. In his book "The Economic Approach to Human Behavior" (1976) he argued that most types of human behaviour can be seen as rational and utility maximizing. He defined an economic approach to human behaviour as having four main assumptions. First, human behaviour is interlinked in market systems in which choices of individuals are shaped by costs and benefits in the context of stable preferences. Second, resources are scarce and desirable, and they are allocated by market influences, for example price shifts. Third, there is competition among sellers of goods or services. Buyers also sometimes compete for goods or services, but not as much. Fourth, individuals want to maximize their outcomes, meaning their utility.

The propensity of economists to insist that everything has a cost and to analyze human behaviour, even the most private, emotional and moral behaviour of individuals might seem misplaced. But if one detaches the emotional side of human behaviour, economic principles can be, and have been, applied to a wide range of social interactions by assuming that each party in an interaction gives something and gets something in return. A choice is rational if it maximizes expected utility, where "utility" refers to the individual outcomes of each party engaged in an interaction and "expected" refers to the fact that uncertainty is present in most interactions. Rationality implies that individuals make the best choices, as they see them, from the alternatives available to them subject to the information they have. Individuals estimate the nature, size and probability of the consequences of the options among which they can choose in an effort to maximize their utility.

By assuming rational choice, economic theory can be used to analyze human behaviour in, among others, the field of sexual behaviour. A "non-market market" like the market of sexual trades is much like other markets that economists study. Sexual trades are, in an economic sense, seen as activities where the persons engaged in them benefit mutually (Philipson & Posner, 1993). Note that most prices of non-market goods and services are shadow prices. That is, they are not necessarily money prices; they are costs, and not necessarily pecuniary costs. For example, in the case of an individual choosing between safe and unsafe sex; the shadow price of engaging in an unsafe sexual activity can be the expected cost of becoming infected with HIV or another STD or becoming pregnant. The expected cost can be both pecuniary and non-pecuniary, with the latter predominant in this example.

Naturally, all decisions are not rational or optimal ones. As Philipson and Posner (1993, p.7) put it: *"…impulsive, compulsive, forgetful, illogical, self-deceptive, weak-willed, short-sighted, even crazed behaviour is found in most domains of human activity, notably including the sexual"*. The laws of economics are presumably better seen as approximations of reality and economics does not explain the totality of individual behaviour, but predicts average behaviour. On the condition that we assume people randomly make falsely decisions, our model holds.

3.2 Epidemiological versus economic models of sexual behaviour

The fundamental difference between economic and epidemiological models of sexual behaviour is that the latter approach fails to consider the role of incentives in shaping private responses to not only the HIV/AIDS epidemic itself, but also to the programs aimed at controlling the disease. Philipson and Posner (1993) believe that the spread of HIV/AIDS has been exaggerated because of this failure. Economic models, on the contrary, recognize that the increase in the prevalence of a disease is (with certain qualifications) the same as an increase in the price of risky sexual behaviour; thus would behavioural responses limit further spread of the disease.

Epidemiological models usually assume away issues involving the choice of individuals to engage in either safe or unsafe sex to the risk of infection. Most of these models, for example, assume random sorting of HIV-positive individuals to HIV-negative individuals in sexual interactions and ignore the demand for safe sex. However, much of the effort in response to

the HIV/AIDS epidemic by governments and civil society has been to generate and spread information on risk, prevention and infectious status. This information can be and is used by people to avoid random sorting and unsafe sex. In contrast to epidemiological models, economic models explain the private and/or public demand for such information and behavioural responses to a changing setting of risk and information is central to economic analysis. Further, the fact that such information is actually used to guide behaviour falsifies the assumptions of the epidemiological models (Philipson and Posner, 1993). Even though some epidemiological models assume a declining amount of unsafe sexual activities as an effect of increasing knowledge of HIV/AIDS, most assume no change in sexual behaviour. Economic models, in contrast, assume that as the relative price becomes too high people will avoid unsafe sex. Therefore, in the extreme case in which all females are infected, the economic models predict no growth in the number of male HIV/AIDS cases as opposed to the epidemiological models which predict that all uninfected males will become infected.

3.2.1 Assortative matching

Distinctly separating economic models of sexual behaviour from epidemiological ones is the fact that economists account for assortative matching instead of random matching of infectious status. Choosing safer partners is one form of protective behaviour when it comes to reducing the risk of HIV infection. The extreme case of perfect assortative matching is when all HIV-positive individuals match each other and all HIV-negative individuals match each other since the growth of the disease then would be zero. Consequently, *"the degree to which incentives lead to growth in infection dependent matching of partners determines the growth of a sexually transmitted epidemic"* (Philipson, 2000, p.1773).

Philipson (2000) pictures an environment in which different classes of individuals exist (classes may be subpopulations stratified by observable demographic characteristics). The risk of HIV infection is known and equals the percentage of the class infected by the virus. Given this environment, the growth of the disease will be determined by who will engage in sexual activity with whom as well as what type of activity they will engage in. Most importantly, it will determine the demand for unsafe sex by pairs of individuals with different infection status. New cases of HIV-positives can only occur if infected individuals are matched with uninfected individuals.

In line with general theory of matching markets, high-quality traders will match among high-quality traders and low-quality traders among low-quality traders in a market with traders of different quality levels (Philipson, 2000). In other words, low-risk individuals will match up with each other, and high-risk individuals with each other. This is because low-risk individuals gain more than high-risk individuals do by choosing a low-risk partner.

3.3 An Economic Model of Risky Sexual Behaviour

Just as in any conventional market, risky sexual trades are transactions that take place under uncertainty. The uncertainty concerns the reliability of the transactors or the quality of the good or service. In the case of HIV/AIDS the uncertainty refers to the health of one's partner; a problem of uncertain quality in consumption (Gaffeo, 2003).

This thesis follows the theoretical framework established by Philipson and Posner (1993) on risky sexual behaviour. Their model assumes the choice between safe and unsafe sex, where "safe sex" means sex with condoms and is completely safe, and "unsafe sex" denotes all other forms of sex and is equally unsafe. Like Philipson and Posner I will denote the representative individuals considering a sexual trade with each other as *m*, for male, and *f*, for female. Naturally, risky sexual trades are also between individuals of the same sex. In developing countries, however, it is not as common; but still it is significant to point out that the analysis does not exclude homosexuality.

If safe and unsafe sex yielded the same amount of utility, the only rational choice, given the low price of condoms, would be to engage in safe sex. However, despite the often small cost of a condom people still engage in risky sex, so it seems to be the case that the use of a condom reduces sexual pleasure for many people (Levy, 2002). Further, in developing countries the use of condoms is sometimes restrained by religion or traditions. Thus, safe sex is not a perfect substitute for unsafe sex. If the costs of safe sex are considered higher than unsafe sex, the latter may be preferred despite the risk of HIV infection. The decision to engage in unsafe sex is modelled as a problem of making a rational choice under uncertainty. The expected utility (EU) of risky sex for *m* and for *f* is equivalent to the benefits (B) minus the expected costs (C) of risky sex. The two utility functions are defined as (Philipson & Posner, 1993):

(1.1) $EU_m = B - C(P_{tf}(1 - P_m)P_f)$

(1.2) $EU_f = B - C(P_{tm}(1 - P_f)P_m)$, where

EU = expected utility
B = benefit of unsafe sex
C = cost of becoming infected with HIV
P_{ti} = probability of transmission; i = m, f
P_i = probability that *m* or *f* is already infected; i = m, f

A risky sexual trade will only take place if both *m*'s and *f*'s expected utilities are positive, that is if $(EU_m, EU_f) > 0$, and the trade is mutually beneficial. Of course there are cases when *m*'s or *f*'s expected utility is negative but a risky sexual trade still takes place, for example in the cases of force or fraud. There is also the possibility for either *m* or *f* to compensate the other partner, pecuniary or non-pecuniary, to engage in unsafe sex; an example being a sex customer paying a prostitute more for an unsafe sexual activity. The equations assume risk neutrality, but that assumption is according to Philipson and Posner (1993) inessential to the analysis.

The benefit (B) of unsafe sex equals the disutility of using a condom due to the assumption that safe sex is sex with condoms. The benefit is assumed to be the same for both *m* and *f*, but they might of course have different utilities. They do not necessarily find sexual pleasure without a condom to be the same. Men and women do not necessarily experience the same disutility of using a condom during sexual intercourse.

C is the cost of becoming infected with the HIV virus. This includes both pecuniary costs such as medical expenses and loss of earnings and non-pecuniary costs such as the disutility of a painful and incapacitating disease and a premature death as well as possible social stigma (common in developing countries) and exclusion from sexual activity. Both *m* and *f* are assumed to be non-altruistic to each other, meaning that the cost to one's sexual partner if he or she becomes infected is not a cost to oneself. Altruism can both reduce and increase the cost of risky sex. An altruist is more likely to switch to safe sex to avoid infecting his or her partner than an egoist. On the other hand, an altruist may be more willing to engage in unsafe sex if it improves his or her partner's utility. C may also be interpreted as the discounted cost of HIV/AIDS given the span of time between infection and serious illness. Poor people are most likely to have a higher discount rate since discounting the future at a high rate

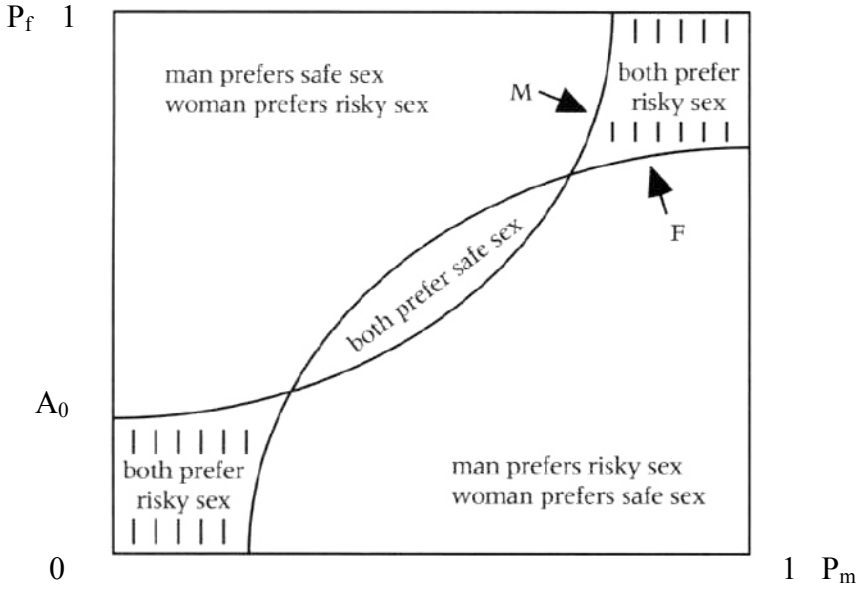
discourages investments in human capital and thus lowers income (Philipson and Posner, 1993).

The excepted costs of engaging in risky sex depend on the costs (C) of becoming infected with HIV and the probability of becoming infected. Equations 1.1 and 1.2 correspond to that probability as a function of three other probabilities: (1) P_m which is the probability that *m* is already infected, (2) P_f which is the probability that *f* is already infected and (3) P_{tm} and P_{tf} which are the probabilities of transmission, that is if *m* is infected, sex with him will result in *f* becoming infected and vice versa. The transmission probability is much lower than 1[2]. For biological reasons it is easier for a man to infect a woman in vaginal intercourse than vice versa and for the insertive partner to infect the receptive partner in anal intercourse than vice versa (Philipson and Posner, 1993). .

The two utility functions, portrayed by equations 1.1 and 1.2, create the joint demand for unsafe sex for all possible infection probabilities of *m* and *f*. Figure 1-1 pictures joint demand and shows how deadly diseases such as AIDS can be spread by voluntary utility-maximizing behaviour of rational individuals. The entire box signifies all possible pairs of infection probabilities of *m* and *f*. The curve marked M is the locus of probability pairs at which *m* is indifferent between safe and unsafe sex. The other curve, marked F, is the equivalent locus for *f*.

[2] The probability of an uninfected person to becoming infected by an infected person during an unsafe sexual activity has been estimated to be 0.08-0.2 percent (women) and 0.03-0.09 (men) in vaginal intercourse and 0.1-0.3 (receptive partner) and about 0.03 (active partner) in anal intercourse. Other estimates are both lower and higher. Important is that the contagiousness is greater if the partner has recently been infected with the virus (Moberg, 2007c).

Figure 2: Joint demand for risky sex



At the left hand corner of the box where $P_m = 0$, *m* is willing to engage in unsafe sex with *f* under the condition that $B/CP_{tf}P_f$, the benefit-cost ratio (to *m* of unsafe sex under the assumption of $P_m = 0$), is at least 1 – meaning that the benefits equal or exceed the costs. The benefit-cost ratio is more likely to be 1 or more the lower P_f is. At point A_0, P_f is positive but low enough to generate a benefit-cost ratio of 1 for *m* although $P_m = 0$. But if P_f were any higher, *m* would refuse to engage in risky sex with her. *M* becomes willing to engage in unsafe sex with her for increasingly dangerous *f*'s as the probability that he is already infected rises. He then has less to gain from safe sex; hence the shape of the curve for *m*. *F*'s curve can be analyzed correspondingly.

Because of the assumption that risky sex is a mutually beneficial exchange of services, it only takes place in the region in which both *m* and *f* gain a positive net expected utility from it. That region is illustrated in figure 1-1 by the two shaded areas. In the section at the lower left-hand corner of the box, the probability that either *m* or *f* is infected is small. The expected cost of risky sex is therefore small and outweighed by the benefit. In the upper right-hand section, the probability that either of the individuals is infected is great. Thus, the expected cost of unsafe sex is also small because risky sex creates only a small increase in the (already high) risk of being infected, so benefits dominate again.

Important to emphasize is that figure 1-1 is not drawn to scale. In reality A_0 would be much closer to the origin. Furthermore, the sections enclosed by the curves are not proportional to

the distribution of population. On a national scale, the upper-right corner contains only a small fraction of the population, while the majority of the population belongs to the lower-left segment. Naturally, in high-risk groups this skew may be less. In Zambia, which globally must be considered a "high-risk population", the figure accords with reality to a greater extent than in an industrialized "low-risk population". Another unrealistic feature of the diagram is the assumption, discussed earlier, that the risk of unsafe sex is the same for both individuals. If one were to modify the diagram to reflect asymmetric risk, *m*'s indifference curve would shift upwards and to the left. *M* would then be willing to have unsafe sex at higher levels of P_f since the probability of him becoming infected by *f* is lower. The total amount of unsafe sex will therefore increase, though, not necessarily implying that the incidence of HIV/AIDS will increase since the rate of transmission from *f* to *m* is lower. In this example the HIV prevalence for men is higher than for women, in Zambia it is the other way around.

3.4 Socio-economic determinants of sexual behaviour

According to economic theory the safe to unsafe sex ratio will be positively associated with any factor that increases the prevalence of HIV/AIDS; not only sexual preference but also socio-economic attributes such as location, gender and age. Combinations of adverse demographic factors are therefore expected to be correlated with a greater demand for safe sex (Philipson and Posner, 1993). Also, *"rational sexual choice under uncertainty further implies that knowledge about the transmission and prevention of AIDS will increase with the probability of infection,…"* (Philipson and Posner, 1993, p. 72). This is because the higher the risk of infection, the more people benefit from allocating time and other resources to gather more knowledge about the disease. However, it cannot be assumed that greater awareness of HIV/AIDS always generates a substitution of safe for risky sex.

The assumption of rationality supposes that individuals make the best choice, as they see them, from the alternatives available to them subject to the information they have. These options are determined by both the disease environment and the information the individual has about this environment (Gersovitz, 2002). Individuals value many things in addition to their health, and a decision affecting the health is influenced by both objectives and constraints. Individuals value, for example, physical intimacy with other persons, including sexual relations.

Following Caldwell (2000), even when people have great knowledge of the risk of becoming infected with HIV, a sense of disillusionment with their own future can easily help rationalize high-risk and unsafe sexual practices. Particularly, if the individual's future is uncertain to even exist (presumably because of general high mortality) or seems unattractive because of poverty, people may take on a "distinctly careless attitude to life". People that derive relatively little utility from living or have above-average discount rates are more likely to engage in unsafe sex despite its risks. In the case of HIV/AIDS, risky sex poses the danger of death, but in the relatively distant future (Philipson and Posner, 1993). A common saying among women in Zambia is "AIDS may kill me in months or years, but hunger will kill me and my family tomorrow". It is therefore plausible to assume that high mortality will decrease expected costs in equations 1.1 and 1.2. Under the assumption that it takes ten years between infection and for AIDS to erupt, I assume people that do not expect to live as long as ten years do not account for the expected costs of incurring AIDS, and are therefore more likely to have a positive benefit-cost ratio and consequently engage in risky sex. The expected cost of HIV/AIDS is reduced since the number of years of life that the individual is likely to lose when becoming infected with the virus is reduced. According to Philipson and Posner (1995, p. 837) this is in line with human-capital economics stating that *"the optimal investment in health human capital is lower the fewer the periods in which a return to the investment can be expected"*.

For people who are not poor, engaging in unsafe sex is largely a matter of power and choice. However, for poor people it may not be. Instead, poor may engage in risky sex because of a lack of livelihood (Hallman, 2004). They might have to adopt strategies that hasten the spread of HIV, such as migration because of employment opportunities in other areas (jobs are often found in urban areas where HIV also is more prevalent). Poor might have to engage in prostitution to make a living (especially true for women in developing countries), and they are likely to have a harder time accessing information or afford measures with which they can practice safe sex. For these reasons, the poor might be more susceptible to HIV infection to a larger extent then their better-off counterparts. However, the relation between income and sexual behaviour is not a one direction relationship. Referring to equations 1.1 and 1.2, I presume the expected costs for a person with low income to be relatively higher because they can not afford the risk of getting infected with the HIV virus (accessing and paying for medical care when getting sick with AIDS is presumably more or less impossible for the poor). This would indicate more risky behaviour, and therefore also a higher HIV prevalence

among people with higher income. On the other hand, the poor might benefit relatively more from unsafe sex as one benefit of unsafe sex is to escape the cost of accessing and paying for condoms (which presumably is relatively higher for the poor than for the rich). This would reverse the correlation. Philipson and Posner (1995) state that the price of condoms in Africa is high relative to income.

Age is an important variable in evaluating socio-economic determinants of HIV prevalence because sexual partner change rates are age dependent (Burnham and Ronald, 1991). Logically, youth, with their whole life ahead of them, have more to lose from getting infected with the virus. Thus, the costs of unsafe sex should be higher for young people. However, young people are empirically known to practice risky behaviours. Their sexual risky behaviour can be explained by the different time perspective they have relative to adults when they consider choices. According to Burtney and Duffy (2004) youth consider potential future dangers as less significant, and because of this, distant threats (such as AIDS) have little impact on their present behaviour. This could be seen as youth underestimating the potential costs of risky sexual behaviour and therefore engaging in unsafe sexual practices more often than adults. Their benefit-cost ratio is likely to be at least 1 more often – demonstrating benefits that exceed costs. The risk taking by youth may also be influenced by the fact that *"physical maturity occurs before youth have developed the intellectual, emotional, and social skills necessary to behave in ways that will limit their risk of exposure to HIV"* (Hoffman and Futterman, 1996, p. 241).

When an individual does not have accurate and/or enough knowledge about HIV it constitutes a constraint for the individual to make an optimal decision. The person may lack information about the disease itself as well as the infection status of oneself and/or the sexual partner. Consider the factors influencing the demand for safe sex. Philipson and Posner (1995, p. 837) state *"because the long incubation period of the disease retards a purely intuitive recognition of its dangers and how to avoid them, we can expect the demand for safe sex to be positively related to levels of education"*. In many parts of Africa there are several misconceptions of HIV/AIDS, for instance the belief in witchcraft, which reduces the perceived risk of unsafe sex (this is because people might for example believe that an infected person can become healthy by exorcism). Philipson and Posner (1995, p. 837) supplement; *"these misconceptions illustrate the general point, documented in the economic literature on health, that education increases wellbeing by reducing the costs of assimilation of information about proper health*

care". The demands for safe sex by individuals who lack adequate knowledge of HIV/AIDS may be lessened (or delayed) as the perceived benefits are reduced. Hence, education will decrease the benefit (B) of unsafe sex in the equations 1.1 and 1.2. Snelling et al (2006) point out that in theory people with higher levels of education should be better able to access and understand information about modes of disease transmission. Higher education enables people readily to access information about HIV/AIDS, including its modes of transmission, from many sources, including media and school itself. Only individuals who know they are at risk can adopt changing sexual behaviour, though, education might not automatically result in less risky behaviour as a change in behaviour induces a cost (the direct cost of a condom or an indirect cost of, for example, less pleasure during sexual activities). The decision will depend on how the individual perceives the risk of contracting the HIV virus. If the individual's perceived risk is small, the benefit is low and might be overruled by the costs.

Further, gender issues can influence the equations in some ways. First, *"low social and economic positions put young women at a disadvantage in sexual negotiations because they are more dependent on their partners for survival"* (Hallman, 2004, p.22). This can cause the benefit of engaging in unsafe sex to increase. If a woman is depending on her husband/partner for survival she will not refuse unsafe sex despite the possibility of becoming infected with HIV. Second, P_{tm} is higher since women's probability of getting infected is biologically higher than vice versa. Women are disproportionately infected with the HIV virus in most developing countries, that is, P_f is higher than P_m, increasing males' risk of getting infected. Here, it is also important to mention the general theory of gender differences in risk taking behaviour. Men are most commonly seen as the more risk taking sex, a statement also proved in empirical works. Harris et al (2006) find that men are more likely to adopt risk behaviours in, among others, the health domain.

Another socio-economic attribute that may be important in this case is marital status. A serious, long term relationship usually incorporates more trust between partners. The probability for a married woman or man to know her or his partners HIV status should therefore be relatively higher than for someone to know her or his casual or recently found partner's status. The decision of choosing between safe and unsafe sex is of course much easier taken if the person is aware of the partner's infection status.

In many developing countries, particularly in sub-Saharan Africa, fertility rates have remained high (compared to the rest of the world). According to Burnham and Ronald (1991) STDs seem to be a problem in regions where birth rates are high. Becoming pregnant requires sex without protection which entails the risk of HIV infection. If a woman wants to become pregnant her benefit of unsafe sex will increase. However, empirical studies have shown a negative relationship between fertility rates and HIV prevalence; most probably because HIV infection is known to decrease fertility in women (see e.g. Sandøy, 2006; Durewall and Lindskog, 2008).

Authors of empirical studies argue for a wider context of sexual behaviour. The extent to which the HIV/AIDS epidemic is self-limiting through voluntary behavioural change by persons at risk is largely depending on the options individuals face when choosing between safe and unsafe sex. As already argued, this choice depends greatly on the objectives and constraints the individual is facing. In a developing country, which is emphasized in this thesis, a majority of the population is poor, badly educated and face high mortality and morbidity rates. Hallman (2004, p.7) argues that *"despite knowledge that health behaviours may be affected by age, gender, and socioeconomic status, few quantitative studies of HIV risk disaggregate according to these factors"*. Hargreaves et al (2002, p.800) conclude that *"relevant behaviours may be sexual, marital, social, health seeking or recreational, and SES may affect the opportunity for, timing and patterns of such behaviours*" and add that *"...less work has been carried out to understand the link between socioeconomic status and risk of HIV infection within the worst affected, often the poorest populations"*.

4. Literature Review

This chapter contains a literature review, including a short summary of other theoretical approaches, but mainly earlier empirical evidences of the importance of socio-economic factors in the spread of HIV/AIDS.

4.1 Other theoretical models of sexual behaviour

I have chosen to focus on Philipson and Posner's model of risky behaviour from 1993 for the main reason that it is easy to interpret the importance of individuals' environment – here socio-economic factors – in the model. However, other theoretical frameworks have been presented in the field of the economics of sexual behaviour. To account for them, and especially bring forth the similarities and differences from the model used in this thesis, I summarize a few other frameworks below.

Levy (2002) has analysed a portfolio of risky and risk-free sexual practices and the prevalence of AIDS within a group of rational people. Similar to Philipson and Posner, Levy (2002, p. 994f) states that *"rational people incorporate the trade off between the extra satisfaction from having unrestrained sex and the associated costs of risk bearing into their decision-making process and may prefer a portfolio of risky sex and risk-free sex to a corner solution of exclusive engagement in risk-free sex"*. The key features of his model are, first of all, the assumption of an inducement factor which denotes a "positive marginal instantaneous-utility differential" between safe and unsafe sex. Secondly, an individual's probability of continuing living is weakened by the relation between the amount of unsafe sex practiced by the individual and the prevalence of HIV in the individual's reference group. Third, the prevalence of HIV/AIDS is strengthened by the intensity of risky sexual practices and restrained by attrition.

Theoretical work in the field of sexual behavioural change in a world of HIV has been carried out by Emily Oster (2007). Her model incorporates individuals living in a maximum of two periods. All individuals live for certain in period one and have a chance of living in period two. Individuals derive utility from certain income (which is fixed and the same in both

periods), and from sexual partners in each period. Since income is fixed, individuals only make choices about sexual behaviour. Further, Oster assumes that if an individual becomes infected with the HIV virus in period one, there is no chance of surviving through period two. The risk of infection will depend on the choice of sexual behaviour in period one, the HIV rate and the transmission rate. The choice of sexual partners in period two does not affect survival. Her findings are that behavioural response is greater for individuals with higher non-HIV life expectancy and individuals who are richer, which is consistent with rational choices of sexual behaviour (Oster, 2007).

Similarly to Oster, Bhattacharya et al (2007) define a two-period model of sexual behaviour; individuals live potentially for two full periods. In period one, when young, individuals work for a fixed wage and save for the future in a fixed return asset, as well as engage in different sexual practices (both risky and risk-free sex). Individuals derive utility from both safe and unsafe sex even though the latter raises the risk of contracting HIV/AIDS. They find that even though people are fully aware of the connection between their own sexual behaviour and their risk of contracting the HIV virus, they might still choose to engage in risky behaviour. This is because individuals *"internalize the effect of their decision to have unsafe sex on their probability of reaching the future"* (Bhattacharya et al, 2007, p. 1). Their results indicate that safe sex is a normal good and consequently, as countries become richer, the total amount of safe sex practiced increases.

Michael (2004) approaches the research of sexual behaviour by extending Grossman's concept of health capital to sexual capital. He discusses two components of sexual capital; the prevention of sexually transmitted diseases, and the achieving of sexual intimacy. Individuals acquire these embedded assets by strategic choice and experience, just as any other form of human capital. The definition of an individual's sexual capital is *"the present value of the flow of benefits from sexual enjoyment over the remaining lifetime"* (Michael, 2004, p.644). Individuals acquire sexual capital through the expenditure of resources, efforts, experience and strategy. The choice a sexually active individual makes about the risk of unprotected sex is made in the context of prior decisions that constitute his/her sexual capital.

4.2 Previous empirical studies

4.2.1 Poverty and income

Good health is of profound importance to people. Health is important to economic and social development – healthy societies are likely to become wealthy societies. At the global level, there is a strong correlation between HIV and the absolute poverty rate (for both the $1 a day and $2 a day) (Bloom et al, 2001). In other words, HIV/AIDS has become a life destroying epidemic in the developing world, but has been controlled for in developed rich countries. At regional level in Africa, however, the association between HIV and poverty level is significantly negative – poorer countries have less HIV and the epidemic is disproportionately affecting richer, more mobile populations (such as South Africa and Botswana) (Bloom et al, 2001). This relationship has also been found within countries, for example in Burkina Faso (Lachaud, 2007). Lachaud (2007) states that the fight against poverty is not necessarily a means of reducing HIV/AIDS prevalence, an assertion based on several elements of empirical analysis.

However, a few studies have shown poverty to be a key factor in HIV transmission. Bloom et al (2001) find that the poorest young women are 50 percent more likely to have had sex than their wealthier counterparts, that the wealthiest women are twice as likely to practice safe sex and twice as likely to know how to prevent HIV infection and almost four times more likely to know where to get tested. Consequently, knowledge and behaviour are radically different among the poorest and wealthiest quintiles of the society. In South Africa imputed HIV positive women come from poorer households than imputed negative women, even though the observed difference is small (Shaikh and Bhorat, 2005). These findings may be the result of the fact that while HIV infection rates are highest among urban, relatively well-educated people during the early stage of the epidemic, the spread of the disease is today mainly occurring among the poor, while declining among the better-off (De Vylder, 1999).

According to Collins and Rau (2000) poverty is a key factor leading to behaviours that expose people to risk of HIV infection. Poverty increase vulnerability to HIV/AIDS transmission through several channels such as increased migration, limited access to health care, nutrition and other basic services; limited access to education and information, sexual exploitation and gender inequality (Casale and Whiteside, 2006). According to Bloom et al (2001) poor health is disproportionately concentrated among the poor. Poor individuals are also less able to deal

with health shocks and often have limited access to health services. Limited health service access can worsen the spread of HIV. Poor people are also more likely to make sub-optimal choices. Poor individuals have limited access to education and information about HIV/AIDS and also limited access to condoms (Clark and Vencatachellum, 2003). Accordingly, Snelling et al (2006) find that household wealth is strongly positive associated with condom use.

Under-nourishment and the lack of hygienic conditions (such as clean water) are consequences of impoverishment. Malnourished individuals are more susceptible to illness and therefore infectious diseases such as HIV/AIDS (Collins and Rau, 2000). Poor people are more likely to be malnourished. Chapoto and Jayne (2005) find that, in line with findings in the early stages of the epidemic, men in the upper half of the assets distribution are more likely to die from disease-related causes than poorer men. In contrast, poor women and better-off women are equally likely to die.

4.2.2 Gender

Women meet a disproportionate risk of HIV infection. In a nationally representative rural Zambian sample between 2001 and 2004 more than 60 percent of the prime-age deaths observed were women. Young, single women are at most risk (Chapoto & Jayne, 2005). The disadvantage of risk of infection for women exists party because of biological reasons and partly for social reasons. Women are biologically more susceptible to HIV infections, but they are also, particularly in developing countries, facing social and economic inequality.

4.2.2.1 Gender Inequality

De Vylder (1999) states that enhanced social and economic equality between the genders is a key factor in battling HIV/AIDS in the long run. This is because women who are absolutely or relatively poorer than men will find it harder to control their sexual behaviour and decision-making when it comes to saying no to sex or demanding condom use. Thereto, women in poverty and with a lack of education and opportunities may be forced into sexual relationships for survival. Pettifor et al (2004) find that for many young women, the choice to delay first sex is not a decision over which they have control. Gender-power imbalances, pervasive in many African countries, mean that many women are unable to refuse unwanted sexual advances; and when they have sex, have limited control over condom use. Moreover, the younger the woman, the greater the power imbalance is likely to be. Gender inequality also

leads to young women often having less access to HIV and other STI prevention information or to health care services, including access to condoms, increasing their risk of infection. Also, coercion and rape are common in many sub-Saharan African countries meaning that many young women are unable to negotiate condom use or to refuse unwanted sexual advances.

4.2.3 Marital Status

Sandøy et al (2006) find that single pregnant women in Zambia tended to have a higher risk of being HIV infected than married pregnant women. Divorced and widowed women had a significantly higher risk of being HIV positive than married women did, also after adjusting for age. Accordingly, Chapoto and Jayne (2005) find that for both relatively poor and non-poor women, being married and/or the head or spouse of the household significantly reduces the likelihood of death in Zambia. Single and relatively young women are more likely to die than married women. Single men are also more likely to die from disease-related causes than married men.

4.2.4 Education

Fylkesnes et al (1997) find that among both urban and rural residents in Zambia the seroprevalence[3] of HIV is rising significantly with increasing educational attainment. In Cote d'Ivoire educated people run a higher risk of HIV infection because they are more likely to have several sexual partners. However, this effect is partly offset by a higher probability of condom use relative to less educated people (Cogneau and Grimm, 2006). Given the relevance of a theoretical assumption that the process of behavioural change takes place through diffusion of innovation from higher social-status groups and downwards, well-educated are expected to be the first to receive and to employ information on HIV protection. Consequently, Fylkesnes et al (1997) indicate that it is likely that the socio-economic pattern in infection rates will gradually change. Accordingly, Fylkesnes et al (2001) find a prominent decline in prevalence of HIV associated with higher education and stable or rising prevalence with low education and Sandøy et al (2006) find a decline among urban women with high education – a decline in prevalence is seen earlier among the more highly educated groups

[3] The HIV seroprevalence rate is almost the same as the rate of HIV infection in a given population, mainly not including those who were recently infected (Online Medical Dictionary).

than among individuals with limited school attendance. Individuals with high education status are generally known to be more concerned about their health and are thus more prone to react to the messages of HIV prevention campaigns by changing their sexual risk behaviour. Education exhibits strong positive associations with condom use (see e.g. Snelling et al, 2006 and Fylkesnes et al, 2001). Bloom et al (2001) state that low levels of education raise the risk of HIV infection.

4.2.5 Residence

In many developing countries urbanization is a major social trend. Sexually transmitted diseases are normally classified as density-independent infectious diseases, but it appears that STD incidence and prevalence rates are higher in urban areas compared to rural ones. According to Burnham and Ronald (1991) this could be because of the environment of urban areas which many times imply long working hours, relative isolation from the family and geographical and social mobility. Pursuant to De Vylder (1999) HIV infection rates are highest in urban areas, but the spread of the epidemic is today mainly occurring among the poor (and therefore increasingly also in rural areas) and HIV incidence is declining among the better-off.

A few studies have found safer sexual behaviour to be associated with urban residence. Snelling et al (2007), Sandøy et al (2006) and Fylkesnes et al (2001) all find urban residency strongly associated with condom use, and in the latter study there was higher likelihood of rural residents reporting barriers to condom use related to availability constraints and religious beliefs. Fylkesnes et al (2001) also find a delay in age at first birth among urban women aged 17-22 years in Zambia, but no similar change among rural women. Further more, the authors find that urban men and women reported less sexual activity and fewer multiple sexual partners, while, in contrast, no evident change was revealed in most behavioural indicators in the rural population.

As a result, it is believable that as more educated, better-off individuals are increasingly protecting themselves against HIV transmission, a shift in increasing HIV infection among rural populations is likely.

4.2.6 Age

Young people account for approximately 60 percent of new HIV infections worldwide (Da Ros and Da Silva Schmitt, 2008). Sexual partner change rates are age dependent. Young age is therefore a particularly important variable in the epidemiology of STDs in developing countries where the proportion of the population between the ages of 15 and 30 years is high (Burnham and Ronald, 1991). Da Ros and Da Silva Schmitt (2008) suggest that the high-risk behaviour of youth can be influenced by the opportunity to engage in risky behaviour and point out the importance of the amount of time they are unsupervised by adults. If risky behaviour is related to the amount of time adolescents spend with their parents or other adults there is a risk for increasing risky sexual behaviour among young. This is because in Zambia and many parts of sub-Saharan Africa in general, the number of orphans is becoming a huge problem. Orphans are vulnerable to HIV transmission through, for example, street life, and child abuse or child prostitution (when children have no one to care for them, they must find other ways of getting some kind of income). Orphans are also likely to suffer from trauma and depression. The increasing number of orphans can mostly be explained by the young losing their parents to AIDS.

4.2.7 Mortality

As argued in an earlier chapter, a negative approach to the future can enhance risky sexual practices. If mortality rates are high, individuals are more likely to have a sense of disillusionment of their own future and might engage in risky sexual activities despite the danger (Caldwell, 2000).

4.2.8 Fertility

Developing countries have much higher birth rates than industrialized countries. In sub-Saharan Africa birth rates have remained the same since 1950, in striking difference to the rest of the world where birth rates have declined (Burnham and Ronald, 1991). Whether pregnancy can facilitate STD transmission is unknown, but in regions where birth rates are high STD rates seem to be a problem. However, empirical studies like those carried out by Sandøy et al (2006) and Durewall and Lindskog (2008) have found an association between high number of births and lower HIV risk. This result is in line with the fact that fertility is reduced by HIV infection. Durewall and Lindskog (2008) also find that the preferred number of children is negatively associated with district HIV-prevalence rates.

4.2.9 Mobility

Mobility is not inherently risky, but it is a marker of increased risk. Gillespie (2005) finds that in Zambia, low-income men living away from home one month or more per year are more than twice as likely to die as men living at home. The HIV virus is able to spread when two individuals of different infectious status met and engage in unsafe sexual practices. Mobility enables these meetings between individuals.

5. Empirical Analysis

This chapter contains the empirical analysis of the thesis. I go through the data and variable descriptions to modelling the socio-economic variables, testing their significance and presenting the results.

5.1 Introductory remarks

The statistical analysis has been conducted using the statistical program Stata version 9. I have undertaken regression analyses to investigate the association between HIV prevalence and a set of variables. The variables denote different socio-economic factors, such as income, education and mortality, which are in line with earlier literature that identified characteristics associated with the risk of HIV infection. A table of descriptive statistics is presented below.

Table 1: Descriptive statistics

Variable	Obs.	Mean/prop	Std Dev.	Min	Max
HIV prevalence	72	12.61	6.07	5	29.1
Expenditure	72	128668	45944	58820	316885
Mortality	72	9.93	4.48	2.9	30.6
Average age	72	21.04	.96	19.3	22.9
Prop youth	72	33.19	2.99	24.9	41.6
Education	72	62.28	11.90	36.0	90.3
Married	72	43.13	5.13	27.7	54.2
Women	72	50.86	1.60	46.8	56.9
Female head	72	22.99	5.54	11.8	44
Urban res	72	42.77	24.11	0	100
Mobility	72	.67	.47	0	1
Fertility	72	6.45	.77	4.4	7.8

5.2 Structure and source of data

Most of the estimates presented in this thesis are made on the basis of original analysis of available survey data. I have sought datasets from nationally representative population-based surveys in Zambia undertaken during the 21st century. Values have been aggregated at district-level from these household surveys. The variables I have constructed are average

monthly per capita expenditure, proportion of households experiencing deaths, average age, proportion youth, ever attended school, proportion married, proportion women, proportion female headed households and proportion living in urban areas. The dependent variable, HIV prevalence, and the independent variables fertility and major trunk roads were already aggregated values.

The empirical analysis of this thesis is mainly based on data from the Living Conditions Monitoring Survey (LCMS) 2006.[4] This survey has a nationwide coverage on a sample basis and covers both rural and urban areas. The survey was designed to provide data on the various aspects of the living conditions of households for each and every district in Zambia.

District-level HIV prevalence are estimated figures from the Epidemiological report published in 2000, which contains epidemiological projections for the period 1985 to 2010. As I could not find proxies for mobility anywhere else, I have used information on Zambian trunk roads at district-level as presented in the Epidemiological report. Data on adjusted total fertility rates comes from the Census of Population and Housing in 2000. Unfortunately, data on fertility rates for later years did not exist at district-level.

Developing countries have a hard time gathering and updating a good database because of high costs and organization problems. High quality data is therefore a luxury article in countries like Zambia. However, good quality data can be enhanced by using well designed questionnaires and well trained interviewers – more common when dealing with large surveys such as LCMS.

5.3 Variable descriptions

5.3.1 The dependent variable

The dependent variable is the projected HIV prevalence (HIV prevalence). Unfortunately, actual HIV prevalence rates were not available at district-level. The projections were applied to the mid year base population in order to come up with the desired indicators at future points

[4] The variable "average monthly per capita expenditure" has however been calculated from the LCMS 2004. This is because the dataset from 2006, which I received during my field study in Zambia, had not yet been structured, and figures on average monthly per capita expenditure were therefore hard to calculate. There is no apparent reason to believe that any large changes in differences between districts took place between the years of 2004 to 2006.

in time. Data on HIV was obtained from sentinel surveillance data, modelled to fit the prevalence observed in the 2001/2000 Zambia Demographic and Health Survey (DHS). A component method was used to obtain provincial epidemiological projections; projections at district level were obtained by prorating the provincial estimates (Epidemiological report, 2000).

Using projected figures is of course risky as it might skew the results if the figures are not well estimated. However, I believe the credibility of the projected estimates to be relatively high. The mean value (corresponding to the national level) of HIV prevalence used in this thesis is more or less the same as the figure reported by UNICEF the same year (my mean is 16.6 percent, while UNICEF reports an adult HIV prevalence of 17 percent in 2006).

5.3.2 The independent variables

Poverty/income

The proxy used to measure monetary resources is average monthly per capita expenditure (measured in kwacha) (expenditure). Since a large part of the population in developing countries is often autarkic, expenditure is a better proxy for the economic status of households than income. The variable has been calculated by dividing monthly per capita expenditure by the number of household members. There is however an even better, more precise, way of calculating this variable. Due to economies of scale in consumption, the needs of a household do not grow in a proportional way with each additional member. The need for electricity etc. will not be five times as high for a five-member household than for a single person. Adjusting for this is possible by using an equivalence scale. Each household type is then assigned a value in proportion to its needs. For example, the OECD-modified scale assigns a value of 1 to the household head, of 0.5 to each additional adult member and of 0.3 to each child. The square root scale divides household income by the square root of household size, that is, a household of four members has needs that are twice as large as a single person's needs (OECD). However, this scale has not been used, partly because I have no reason to believe that using it would significantly change the results and partly because of time limitation.

In theory this variable can be both positively and negatively correlated to HIV prevalence. Empirically income has been positively related to HIV prevalence, even though some studies have found risky sexual behaviour to be negatively linked to income (positively to poverty).

The lack of consensus regarding the relationship between income and HIV/AIDS can presumably be explained by the sensitivity to the choice of proxy (Fortson, 2008).

Gender

Gender is an important factor in the study of HIV in Zambia since women are disproportionately infected with the virus. To measure the importance of gender on HIV prevalence I use the proportion of women in each district (women). In all probability, gender inequality is more important. Generally, gender inequality has proved a vital variable in health outcomes, but also in the field of sexual health. The suppression of women puts them in vulnerable situations, for example when negotiating with their partner(s) about sexual practices. However, data on gender inequality was very hard to find at district-level; most available proxies were only accessible at provincial level. I have used the proportion of female headed households in each district (female_head) as a proxy for gender inequality. This is far from a perfect proxy of gender inequality, but rather than not including any variable, it might tell us something about the imbalances between genders and its association with HIV prevalence at the district-level.

Marital status

Theoretically this variable is of less importance, but is has proven significant in empirical studies; unmarried or single individuals tend to have more casual sexual relationships and more sexual partners (that is, married individuals are more likely to practice safe sex). The variable is measured as the proportion of married individuals in each district (married).

Education

Education is both theoretically and empirically a significant factor in HIV research; yet evidence tends to strive in different directions. Theoretically, individuals with higher education should more easily obtain knowledge of HIV/AIDS and take measures for protection against the virus. Empirically, many studies have confirmed education to be positively correlated to HIV infection in many developing countries, including Zambia. Nevertheless, some empirical studies have found declines in HIV prevalence in higher educated and an increase in prevalence among less educated. The variable controlling for education in the empirical analysis is the proportion of individuals in each district that has ever attended school (education).

Residence

To test whether residence is correlated to HIV prevalence I use the proportion living in urban areas in each district (urban_res). An urban area is defined by the population size (minimum of 5,000 people) and economic activity (the main activity must be non-agricultural). In addition, the area must have basic modern facilities such as piped water, tarred roads, health facility etc (LCMS, 2004). Empirically, living in an urban area has proven both positive and negative to the risk of HIV infection. While some studies found HIV prevalence to be significantly higher in urban areas, others found safer sexual behaviour positively correlated to urban hood. Perhaps this is indicating a change over time, where individuals in rural areas show tendencies for more risky behaviour (presumably because of less accessibility to condoms etc.) and consequently, rising HIV prevalence in rural areas compared to urban ones.

Age

I consider age a central factor, in line with both theoretical and empirical evidence. Two different variables are used to measure the importance of age; average age in the district (ave_age) and the proportion of young adults (prop_young), where young adults are defined as individuals between 15-30 years of age.

Mortality

The proxy used for mortality is the proportion of households experiencing deaths (mortality) during the last 12 months. In theory, mortality can play an important role for people's sexual behaviour since people's attitude toward the future is important to the theory of risky behaviour.

Fertility

Adjusted total fertility rates (fertility) are used to test whether fertility is significantly linked to HIV prevalence at district-level in Zambia. The total fertility rate (TFR) refers to the number of children that a woman would have by the end of her childbearing period if she were to experience the presently observed age-specific fertility rates. The reason for not using "normal" fertility rates (that is, the frequency of incidence of live births among women in the district) is simply because the TFRs were most accessible. However, since this is a district-level analysis it does not matter which measure of fertility I use as long as the difference between the districts are the same.

Mobility

The variable for mobility is a dummy variable indicating whether there exists a major trunk road in the district or not (mobility). This variable is included to be able to measure people's mobility to some extent. Districts with trunk roads have a more portability population, which consequently is more susceptible to infection. Mobility enables meetings between human beings; those meetings can enable sexual practices between people, and unsafe sexual practices can ultimately enable the transmission of HIV. This proxy is not self-evident. There are plenty of other proxies that could have been used to measure mobility, such as means of transport (if households have access to a car, motorbike, bike etc.). However, some proxies were not available, and due to time limitation I chose to go with the one I already had.

A summary of the variables and their definitions are presented below.

Table 2: Variable definitions

Variable	Definition
expenditure	average monthly per capita expenditure (in kwacha)
women	proportion of women
female_head	proportion of female headed households
married	proportion of married individuals
education	proportion of individuals that has ever attended school
urban_res	proportion of individuals living in urban areas
ave_age	average age
prop_young	proportion of young adults (15-30 years of age)
mortality	proportion of households experiencing death(s) the last 12 months
fertility	adjusted total fertility rate; the number of children a women would have by the end of her childbearing period if she was to experience the presently observed age-specific fertility rates
mobility	if there exists a major trunk road in the district or not

5.4 Results

I use Ordinary Least Squares (OLS) in all equations with the aim to find the coefficients and t-statistics of the variables I am interested in. The regressions allow for heteroskedasticity and calculate the robust standard errors. The problem with heteroskedasticity is that the OLS

estimator will not be the best linear unbiased estimator anymore, meaning there are better estimators out there (Westerlund, 2005). According to Stock and Watson (2006) you should always use these robust standard errors. I start by analysing the socio-economic variables of HIV prevalence I assume to be the most important, and then consistently add variables in the following equations to control for other factors thought to affect HIV prevalence. The results from the different equations are compared to check their robustness.

The first equation is conditioned on expenditure, mortality, age and education:

Equation 1:
$HIV\ prevalence = \beta_1 + \beta_2 Expenditure + \beta_3 Mortality + \beta_4 Ave\_age + \beta_5 Prop\_young + \beta_6 Education + \varepsilon$

Because OLS is a linear model, if the relationship between the explanatory variable and the dependent variable is non-linear there is a problem of non-linearity. In my model, there is a possibility for the relationship between expenditure and HIV prevalence to be quadratic, meaning it is rising on a curve up to a certain point and then decreasing. I address this problem by adding a new variable; expenditure-squared (expenditure2). If there is a positive sign on the expenditure coefficient and a negative sign on the expenditure-squared coefficient, both coefficients significant, the relationship is quadratic.

Equation 1.2:
$HIV\ prevalence = \beta_1 + \beta_2 Expenditure + \beta_3 Mortality + \beta_4 Ave\_age + \beta_5 Prop\_young + \beta_6 Education + \beta_7 Expenditure2 + \varepsilon$

The results from the equations 1.1 and 1.2 are presented in the table below.

Table 3: Results equation 1 and 1.2

	Equation 1	**Equation 1.2**
	HIV prevalence	HIV prevalence
Expenditure	0.000***	0.000
	[2.94]	[1.28]
Mortality	-0.058	-0.057
	[0.51]	[0.50]
Ave_age	1.185**	1.189**
	[2.27]	[2.24]
Prop_young	0.287	0.300
	[1.26]	[1.30]
Education	0.136**	0.132**
	[2.37]	[2.20]
Expenditure2		-0.000
		[0.32]
Constant	-34.754***	-35.866***
	[2.91]	[2.84]
Observations	72	72
R-squared	0.5019	0.5023
Adjusted R^2	0.4641	0.4564

Robust t-statistics in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

First of all, I can conclude that the relationship between expenditure and HIV prevalence is not non-linear since the coefficient for neither expenditure nor expenditure-squared is significant. There is a small decline in adjusted R-squared in the second equation indicating that by adding expenditure-squared I have detracted from rather than added to the explanatory power of the model. In other words, I gain nothing by adding expenditure-squared to my model.

Expenditure is strongly positively significant with HIV prevalence in our first equation (significance at the 1% level). The independent variables average age and education are both significant and positively correlated to HIV prevalence at the 5 % level. The other proxy for age (proportion young) is not significant. The same goes for the proxy of mortality.

R-squared is the variation in HIV prevalence that is explained by the regression; here 50 percent. In other words, the variables accounted for in this first regression can explain about 50 percent of the variation in the dependent variable HIV prevalence. This naturally indicates that there are still variables missing in our model since the first model's explanatory power of HIV prevalence is "only" 50 percent. The constant is also quite large, which also indicates there is more to include in our model.

I continue by controlling for gender and marital status by adding the variables proportion women, proportion female headed households and proportion married in each district.

Equation 2:

$$HIV\ prevalence = \beta_1 + \beta_2 Expenditure + \beta_3 Mortality + \beta_4 Ave\_age + \beta_5 Prop\_young + \beta_6 Education + \beta_7 Married + \beta_8 Women + \beta_9 Female\_head + \varepsilon$$

Table 4: Results equation 1 and 2

	Equation 1	**Equation 2**
	HIV prevalence	HIV prevalence
Expenditure	0.000***	0.000***
	[2.94]	[2.88]
Mortality	-0.058	-0.065
	[0.51]	[0.58]
Ave_age	1.185**	1.225**
	[2.27]	[2.23]
Prop_young	0.287	0.277
	[1.26]	[1.28]
Education	0.136**	0.165***
	[2.37]	[3.33]
Married		0.054
		[0.34]
Women		-0.931***
		[3.21]
Female_head		0.301**
		[2.38]
Constant	-34.754***	0.616
	[2.91]	[0.03]
Observations	72	72
R-squared	0.5019	0.5697
Adjusted R^2	0.4641	0.5151

Robust t-statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

By controlling for gender and marital status we can see that expenditure and average age are robust variables; still significant at the 1% level and 5% level respectively. Education has become even more significant in the second equation. Marital status appears to have no significant correlation to the dependent variable. The proportion of women is significant and negatively correlated to HIV prevalence at the 1% level. This is a bit surprising since women are disproportionately affected by the virus in Zambia, but it might indicate a more risky sexual behaviour in men – who theoretically are seen as the more risk taking gender (see for example Harris et al, 2006). The proportion of female headed households in each district is positively correlated to HIV prevalence at the 5% level. This too is a surprising result, since

the literature reveals a negative relationship with gender inequality and health outcomes. However, the result might be influenced by, first of all, the fact that the variable "female headed households" is far from a perfect proxy of gender inequality. Secondly, there might be (and probably is) a reverse causality between the variable and HIV prevalence. Women who are heads of the households in Zambia have probably lost their husbands to AIDS or other diseases or accidents.

Finally, I control for the last three variables included in my empirical analysis; residence, mobility and fertility. The full regression model and its results are demonstrated below.

Equation 3:

$$HIV\ prevalence = \beta_1 + \beta_2 Expenditure + \beta_3 Mortality + \beta_4 Ave\_age + \beta_5 Prop\_young + \beta_6 Education + \beta_7 Married + \beta_8 Women + \beta_9 Female\_head + \beta_{10} Urban\_res + \beta_{11} Mobility + \beta_{12} Fertility + \varepsilon,$$

where β_1 is the intercept, $\beta_{2\text{-}12}$ is the effect of the variable given that all other variables are held constant and ε is an error term, which includes the effects of other missing socio-economic attributes.

A problem when doing multiple regression analyses is that the explanatory variables may covariate. If they do, we have a problem with multicollinearity. Multicollinearity causes trouble because it gives us a hard time separating the effect of the individual parameters. If, for example, the variables expenditure and education are perfectly correlated, we can no longer decide whether the variation in HIV prevalence is caused by a change in expenditure or a change in education. According to Westerlund (2005) a thumb rule is to take measures if the correlation between two variables is over 0.8. A correlation matrix of all variables is presented in appendix B, and we can see that there are no variables with a correlation over 0.8. However, since there is a theoretically strong relationship between being rich and attending school and both of the variables expenditure and education are strongly significant, there is still a concern that there might be a problem with multicollinearity. A simple test to see whether education adds anything new to the model is to redo the model without education.

I redo the equation by dropping the variable education. The results are shown in appendix C. From the table we can see that the explanatory power of the model, R-squared and adjusted R-

squared, decreases when dropping education from the model. Since expenditure and education are not perfectly correlated, I am better off with the model including both of the variables.

The results from the three correct models are displayed in the table below.

Table 5: Results equations 1, 2 and 3

	Equation 1	Equation 2	Equation 3
	HIV prevalence	HIV prevalence	HIV prevalence
Expenditure	0.000***	0.000***	0.000*
	[2.94]	[2.88]	[1.99]
Mortality	-0.058	-0.065	-0.149
	[0.51]	[0.58]	[1.57]
Ave_age	1.185**	1.225**	-0.139
	[2.27]	[2.23]	[0.17]
Prop_young	0.287	0.277	-0.043
	[1.26]	[1.28]	[0.24]
Education	0.136**	0.165***	0.097**
	[2.37]	[3.33]	[2.02]
Married		0.054	0.101
		[0.34]	[0.76]
Women		-0.931***	-0.771**
		[3.21]	[2.64]
Female_head		0.301**	0.202*
		[2.38]	[1.68]
Urban_res			0.002
			[0.07]
Mobility			2.045
			[1.66]
Fertility			-3.964***
			[3.60]
Constant	-34.754***	0.616	63.088***
	[2.91]	[0.03]	[2.81]
Observations	72	72	72
R-squared	0.5019	0.5697	0.6834
Adjusted R^2	0.4641	0.5151	0.6254

Robust t-statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

We can see that R-squared has increased from around 0.50 in equation one to 0.57 in equation two and finally to 0.68 in the third and final equation. Hence, the last model can explain 68 percent of the variation in HIV prevalence. Naturally, I was hoping for a greater explanatory power of the model. The reason that R-squared is not higher than 0.68 might be because some of the proxies used are not perfect proxies of what I am trying to measure, and therefore cannot explain the variation in HIV prevalence accordingly. Variables are often sensitive to

the choice of measure. It may also indicate that there are other socio-economic factors missing in the model. Migration could be one of those important missing factors. Migration may put people in vulnerable situations as they, for example, migrate in search of work and are consequently away from home and family members. Moreover, the sample size is rather small, which may indicate a problem (especially when dealing with multiple regressions). Large samples will increase the precision in estimates, while too small samples may lead to inaccurate results.

Starting off with expenditure, we can see that it is positively correlated to HIV prevalence at district-level in Zambia. The coefficient is strongly significant in the first two models but drops in significance in the third model (from being significant at the 1% level to 10% level), but is still significant. According to the theory, the poor should be more susceptible to HIV transmission since being poor discourages investments in health capital (therefore also sexual capital). Poor people may not be able to consider the risk of HIV infection – they are more concerned about today than about tomorrow, and even less concerned about developing AIDS in years ahead. The rich however, should theoretically, and probably do practically, be concerned about the future to a greater extent. But in the economic theory of risky behaviour costs must exceed benefits for individuals to choose safe sexual practices. Risky behaviour is relatively less costly for the rich as they are able to afford treatment if they acquire HIV/AIDS, and perhaps this is one of the main reasons why we observe a positive link between expenditure and HIV prevalence in the dataset.

Further, education is also positively correlated to the dependent variable. Apparently, there is a gap between what people know and how they act. Earlier empirical studies have found a positive relationship between higher education and the number of sexual partners, but studies have also found a stronger association with condom use among the well educated. The educated can more easily take in new information and disregard misconceptions about HIV/AIDS, but this may not automatically represent less risky sexual behaviour. They might still perceive the risk of acquiring HIV as small. Lundborg and Lindgren (2002) found in their study of alcohol consumption among the young that education in alcohol consumption etc. actually led individuals to have lower risk beliefs. If this is true also in the case of HIV and in a developing country such as Zambia, where HIV prevalence is remarkably high, is not explored. But it might be a factor explaining why education is positively correlated to HIV prevalence. Individuals who have received correct information about HIV might feel that they

are aware of the means of protection (that it is possible to protect oneself and how to do it), but we might still find a gap between what people know and how they act.

We can see that average age (ave_age) is positively correlated to HIV prevalence in the first two models, but not in the last. The result from the final, all-embracing, model might be an outcome of the fact that fertility is strongly significant in this model and that fertility and age are naturally correlated to each other. The other age variable (prop_young) is insignificant in all three models.

The variable "prop women" is strongly negatively related to HIV prevalence, indicating that districts with a high proportion of men are at greater risk of a high HIV prevalence. This finding is despite the fact that women in Zambia are 1.4 times more likely to be infected with the virus. Females are also, biologically, more vulnerable to HIV infection. As more females are infected, men should have a greater probability of contracting the virus, but this might be partly or fully offset by the fact that men are less vulnerable to the virus. Women are seen as more risk averse than men. The finding may therefore indicate that men engage in risky sexual behaviour more often than women.

The variable female headed households is positively correlated to HIV prevalence. This means that districts with a higher proportion of female headed households have higher prevalence than districts in which males are heads of households to a larger extent. I was expecting this variable to be negatively significant, in accordance with both theoretical and empirical works, though, as mentioned earlier, this is not a very good proxy for gender inequality. The results might have been more consistent with the literature if a more appropriate proxy had been used (e.g. violence against women or women's participation in economic activities). In addition, there might be a reverse causality between female headed households and HIV prevalence; the female head may have lost her husband to AIDS (or another disease or accident), something that is actually quite common in Zambia.

There is a strong negative relationship between fertility and HIV prevalence. Theoretically it could just as well be a positive relationship (as becoming pregnant requires unsafe sex). However, this result is in line with previous empirical studies. The HIV virus is known to reduce fertility and this is presumably the main reason for the result discovered in the regression.

Urban residence shows no significance in the model, despite the fact that HIV prevalence is much more widespread in urban areas in Zambia, such as in big towns like Lusaka, Choma and Livingstone. The significance of urban residence might be offset by other variables in the regression such as expenditure or education (both of which are strongly correlated to urban areas).

Mobility is not significant in the model despite the facts that HIV prevalence is known to be higher around major transport routes, good roads are rare in Zambia and portability of people enables meetings between individuals, which can enable HIV transmission. Insignificance may be the result of a bad proxy for mobility and/or a small sample size. A district-level analysis does have its limitations; there are 72 districts in Zambia and accordingly only 72 observations in the empirical analysis.

6. Discussion

The final and closing chapter of the thesis contains a discussion of the topic and suggestions for further research.

The economic literature has established the relevancy of socio-economic factors in sexual behaviour among individuals. The message is that the environment, the context that people live in, will and does affect how they behave and what choices they make. Socio-economic dynamics affect the opportunity for, timing and patterns of individual behaviour. Yet, relatively little research has been conducted in this field and relatively few studies disaggregate for these factors. In this thesis I have tried to widen the understanding of how the risk of HIV infection is linked to socio-economic attributes in one of the worst affected, poorest populations.

The empirical findings tell us that socio-economic factors may very well contribute to or prevent the spread of HIV. Socio-economic attributes may very well put a strain on people's choices, but the results also tell us that HIV is not only a disease of the poor. Globally, we can see that it is clearly a disease of the poor; HIV is a much greater problem in populations lacking relevant funding for free HIV testing, condoms, guidance and information, antiviral drugs etc. However, within Zambia expenditure is positively correlated to HIV prevalence. It is important to stress that the virus is everywhere – in all types of subpopulations. The poor might acquire the HIV virus because they are poor. The poor may lack information about the disease, ways to protect themselves and may not have access to protective measures, such as condoms, or are not able to afford them. The choice of engaging in risky sexual behaviour may not be, and probably is not many times, voluntary. The rich, on the contrary, may choose to take the risk of HIV infection when engaging in sexual activities. We must then approach the question of why. For sexual pleasure? As mentioned during the theoretical framework, it is apparent that sex with condoms does not yield the same sexual pleasure as sex without condoms. Prostitution? The rich can obviously afford to pay for prostitutes, and furthermore, having many girls is seen as a sign of status in Zambia. Obviously, these factors are dependent on gender. Women have less negotiating power and men are therefore often the ones setting the rules of a sexual act. In Zambia, young girls are often taught to obey their

male partner/husbands. The fact that the virus seems to be everywhere in society, regardless of monetary status, leads me to an additional question: are people being ignorant? Maybe.

Maybe people are being ignorant, but it is also important to let the discussion fall back to what sexual practices *most often* are about; physical intimacy, recreation and pleasure. A topic so personal and intimate may be hard, and is often hard, to talk openly about. Behavioural interventions often seek to achieve behavioural change through the promotion of abstinence, condom use, and a lower number of partners or avoidance of high-risk groups such as prostitutes. Abstinence, popular among religious organizations, is clearly not a very sound solution to the problem. People will continue having sex. Promoting condom use is a good start, but it is not likely that condom use alone can prevent the spread of the HIV virus.

As mentioned earlier in the thesis an alternative of safe sex is to choose safe partners. In order to choose a safe partner, an individual must be aware of the infectious status of the partner. Not only does that require people to be open and honest about their status, but also that they actually know about their status themselves. Only individuals who know they are at risk can adopt changing sexual behaviour. If people are ignorant, they are presumably ignorant because of stigma and the lack of testing. Stigma is very common in sub-Saharan Africa generally, not least in Zambia. The presence of stigma incapacitates openness of HIV status within the population. During my field study in Zambia I soon noticed that people easily talk about HIV and AIDS, but get uncomfortable as soon as the discussion enters a more personal level. Most people state they know someone who has died from AIDS, but obituaries usually state “infection” or “tumour”. In stopping the transmission of HIV I believe it is essential for policy makers and religious leaders to be open for HIV discussions. Testing rates are low – of all HIV positives, only one in ten is tested and are thus aware of their status.

Moreover, knowledge levels remain low; as few as 45 percent of young people (15-24 years of age) in Zambia could identify two correct ways of protecting themselves from HIV infection. This means that the majority of the young people in the country cannot correctly identity two ways of protecting themselves against the virus. There can be several explanations for this, for example; HIV education and campaigns are few or do not reach out and misconceptions of the disease are many and widespread. The empirical findings in this study are, however, that education and HIV prevalence have a positive relationship. This does not necessarily mean that education increases the risk of HIV (it might decrease individuals’

perceived risk of getting infected), but it does mean that there is a gap between what people know and how they act. Whatsoever, I do believe that information is essential in the fight against the spread of the disease, and it is important for policy makers and religious leaders to spread correct HIV information to their listeners.

Assortative matching, assumed in economic models, is a silver lining of the future compared to the darker future computed by epidemiological models. Neither is fully realistic. However, economic models can be used to analyse behavioural factors underpinning the disease and consequently add to the understanding of the spread of the epidemic. The importance of investigating and finding determinants of the spread of HIV can not be emphasized enough. The impacts of HIV/AIDS are many and they are threatening to knock out whole economies south of the Sahara.

Zambia is one of the sub-Saharan counties that have been politically and economically stable since its independence. Political and economic stability is crucial for development, and theory has proven development to be important in the battle against HIV/AIDS. Even though poverty is not positively linked to HIV transmission in Zambia, there is a strongly positive relationship between poverty and HIV infection at the global level. Development is a key factor. But development, a single word on paper, incorporates so much in reality. The spread of the HIV virus has already had devastating results in countries like Zambia and if these countries are going to have any possibility to hasten development, the HIV epidemic must be mastered and its spread hindered. Today, the life expectancy in the country is as low as 40 years. For this reason a large part of the able bodied population dies at an early age and cannot contribute to productivity and development. In addition, Zambia's health system has suffered from under-investment for a long period and is now taking some hard knocks as it cannot fulfil the needs of the population.

The aim of this thesis is to widen the understanding of the spread of the HIV virus. Authors of studies in the same field have talked about an increasing prevalence among the poor and decreasing prevalence among the rich. My empirical findings do not support this notion, but it does not necessarily mean it is not true. It might be the case that even though the richer part of the population still has more HIV infected individuals (prevalence is still high), incidence might be higher in the poor part of the population. This would indicate a change over time. Also, my analysis is made at the district-level. Naturally, it would be optimal to use individual

data, but this is unfortunately not available. If future studies are able to collect individual data through surveillance, empirical findings may tell us more accurately what situation we are looking at and what makes people susceptible to HIV infection.

Further, there are many ways of carrying this field of research forward, but I would like to mention three things I find especially interesting and relevant. First, an economic model of risky sexual behaviour that incorporates the fact that women are more risk averse than men could be quite interesting to follow through. A second appealing field would be to investigate the sexual behaviour of orphans and if they are more likely to engage in risky sexual activities. This is especially important because of the increasing number of orphans in Africa. Third, an interesting study would be to examine how stigma correlates to HIV prevalence and to see whether, and if so how, stigma-related interventions can help hinder the spread of the disease.

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8. Appendix

A. Correlation matrix

	HIV prev	Expend	Mortality	Ave_age	Prop_yo	Educa	Married	Women	Female h	Urban	Mobility	Fertility
HIV prev	1.0000											
Expend	0.5910	1.0000										
Mortality	-0.2691	-0.2241	1.0000									
Ave_age	0.4333	0.3181	-0.3001	1.0000								
Prop_yo	0.5334	0.4913	-0.3144	0.3720	1.0000							
Educa	0.5983	0.5923	-0.2236	0.3235	0.6145	1.0000						
Married	-0.3608	-0.1648	0.2382	0.4352	0.4725	0.3032	1.0000					
Women	-0.1381	-0.0721	-0.1936	0.1499	0.0238	0.0456	-0.1821	1.0000				
Female h	-0.0115	-0.2711	-0.1200	0.0817	0.0799	0.2653	-0.5043	0.4080	1.0000			
Urban	0.5868	0.5907	-0.3344	0.4266	0.6372	0.5724	-0.3803	-0.1355	-0.2408	1.0000		
Mobility	0.4060	0.2916	0.0981	0.2019	0.3258	0.3573	-0.1145	-0.1970	-0.2276	0.3868	1.0000	
Fertility	-0.7319	-0.5048	0.2621	0.6288	0.6120	0.5562	0.5332	-0.0879	-0.1254	0.6290	-0.2904	1.0000

B. Drop education

	Equation 3	**Equation 3.1**
	HIV prevalence	HIV prevalence
Expenditure	0.000*	0.000**
	[1.99]	[2.34]
Mortality	-0.149	-0.166*
	[1.57]	[1.80]
Ave_age	-0.139	-0.252
	[0.17]	[0.31]
Prop_young	-0.043	0.042
	[0.24]	[0.22]
Education	0.097**	
	[2.02]	
Married	0.101	0.054
	[0.76]	[0.41]
Women	-0.771**	-0.732**
	[2.64]	[2.46]
Female head	0.202*	0.133
	[1.68]	[1.07]
Urban res	0.002	-0.001
	[0.07]	[0.03]
Mobility	2.045	2.266*
	[1.66]	[1.89]
Feritlity	-3.964***	-4.373***
	[3.60]	[4.08]
Constant	63.088***	72.287***
	[2.81]	[3.21]
Observations	72	72
R-squared	0.6834	0.6678
Adjusted R^2	0.6254	0.6133

Robust t-statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%