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EXPLORING DETERMINANTS OF HIV/AIDS IN AFRICA

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"Let us not equivocate: a tragedy of unprecedented proportions is unfolding in Africa. Aids today in Africa is claiming more lives than the sum total of all wars, famines and floods, and the ravages of such deadly diseases as malaria."

Nelson Mandela, Durban, 2000.

"**No longer is Aids just a disease, it is a human rights issue**. For the sake of Africa and the world, we must act now."

Nelson Mandela, Paris, 2003.

Source: BBC and 46664: 1 minute for Aids in Africa. Picture from Google maps of Africa.

Abstract

HIV/AIDS affects people all over the world. Since it first was discovered in 1981 it has been the cause of death of 25 million people. However, a disproportional burden of the virus has been on the developing countries, in particular the African countries. There is still controversy among what determines the prevalence of HIV/AIDS. This is the underlining cause to why this thesis has been written. The aim is to examine which, of the chosen variables, correlate with HIV/AIDS rates in 37 African countries. The independent variables have been chosen on basis of a theoretical framework, constructed by earlier empirical research. All independent variables are connected to the assumption that viral transmission and sexual behaviour are essential for understanding the transmission rates of the virus. Through multiple regressions the variables were examined. The results indicate that the most significant variables are circumcision and proportion of women in the population. Circumcision showed a significant, negative correlation to HIV/AIDS while proportion of women showed a significant positive correlation.

Keywords: HIV, AIDS, Africa, regression analysis, determinants

Number of words: 166

Abbreviations

ABC – Abstain, Be faithful and use a Condom
AIDS - Acquired Immunodeficiency Syndrome
CLT – Central Limit Theory
DHS – Demographic and Helath Surveys
DR Congo – Democratic Republic of Congo
GDP – Gross Domestic Product
GNI – Gross National Income
HAART - Highly Active AntiRetroviral Treatment
HIV - Human Immunodeficiency Virus
LDC – Least Developed Countries
MC – Male Circumcision
NGO – Non-Governmental Organization
OLS – Ordinary Least Square
PWA – Person With AIDS
Prevalence – part of the population infected with HIV/AIDS
PPP – Purchasing Power Parity
SNA – System of National Accounts
STI – Sexually Transmitted Infection
TED – Technology, Entertainment, Design
UNAIDS – United Nations AIDS organ
WHO – World Health Organization
WDI – World Development Indicator
WWI (WWII) – World War one (two)

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1 INTRODUCTION

This first chapter will expose the reader to the complex area of HIV/AIDS and provide the reader with an introduction of the contest of the thesis. An introduction to the background, aim and formulation of the question of the thesis, method and a presentation of the outline will make the reader prepared to proceed the reading.

"It is more important to understand where HIV/AIDS is heading, then to understand its origin"*

Kenneth Kaunda, ex-president Zambia
(Palmberg 1993: 33)

This quote is a fair reflection, however, to understand in which direction HIV/AIDS is heading it is of essential significance to understand which factors affect its prevalence. This is essential for the understanding of how it affects people and to comprehend why it differs to a great substance between countries. It is also, only by understanding its prevalence that we can fully understand the economic effects. These are the underlining discussions to why this thesis has been written.

The epidemic, which has affected countries all over the world, is sometimes labelled "the disease of globalization". Since it was first discovered in 1981 it has, 28 years later, been the cause of death of approximately 25 million people worldwide. The virus is unique in many aspects, e.g. no other disease kills people in the prime of their lives to the extent that HIV/AIDS does. (UNAIDS Report 2008:31,38)

Furthermore, the economic consequences the virus has caused are huge. Considering the amount of people affected by the epidemic, the economic growth and macroeconomic development of many developing countries are believed to be severely affected. Macro-level consequences, such as the growth of GDP per capita, is claimed to be reduced, as is the income per capita significantly decreased by infection of the virus. (Lovasz&Schipp 2009: 254f) Other macro-level effects are the public finances, particularly the health sector, which is heavily burdened. Health, in terms of human capital, has e.g. significant impact on the national income of a country. Never before in history has a mobilization of financial, political and human resources of the kind the epidemic has created been witnessed. (UNAIDS Report 2008; Fox et al 2004:322)

* own translation, see bibliography.

For today, 33 million people are living with HIV/AIDS and a disproportionate share of them, approximately 67%, in sub-Saharan Africa. A common belief is that African countries are the worst effected countries in the world, this is only partly true. There is a great variation within Africa, especially between south and north. However, substantial variations are even between neighbouring countries. One might ask oneself why peaceful Zambia has significantly higher rates of HIV/AIDS, approximately 15% (2007), than its neighbouring and troubled DR Congo with 2-3% in the same year. Why have rich and, compared to other African countries, developed South Africa higher rates of HIV/AIDS than poor countries like e.g. Niger? These variations of prevalence remain, still today, poorly understood. **(**TED - Rosling**)**

It is due to these discussions this thesis will examine factors that understandable affect the rate of HIV/AIDS in Africa. The choice of geographical area is established in the importance of increasing the knowledge of HIV/AIDS in Africa. The common knowledge of many African countries is generally low. One example is that people tend to believe that all African countries are badly infected. Another example is how people discuss the continent in terms of one single country. We ought not to forget that Africa consists of 53 countries. Furthermore, there have been rather few researches of HIV/AIDS focusing on the African continent as a whole. (Fuller 2009:21f) The aim of the thesis is to examine which of the chosen factors are of significance for the rate of HIV/AIDS in 37 of the African countries. The question for the thesis is: Which of the independent variables correlates with HIV/AIDS in Africa?

To accomplish the aim, the independent variables will be examined. The independent variables are chosen and motivated based on the theoretical framework of earlier empirical researches. Each independent variable is connected to the assumption of the thesis, that viral transmission rates and sexual behaviour to a great extent explains the variation in prevalence of HIV/AIDS. (Oster 2005:468) The independent variables will be examined through multiple linear regression models whereby the method used is a cross-national regression. The variables are mainly based on data (estimations) from WHO and UNAIDS.

The paper is structured as follows. The first section provides the reader with a background of HIV/AIDS, followed by the particular situation in Africa. Thereafter the different independent factors, that will be examined, are divided in three sub-groups, presented and motivated in the theoretical framework. The theoretical framework is summarised with a presentation of the theoretical model. This is followed by a section on method, where the procedure is thoroughly presented. Next section consists of the actual research and the empirical analysis where the result is presented. The result will be analyzed in the discussion and the paper is summarised and completed with a brief conclusion.

2 BACKGROUND

This chapter presents a background to HIV/AIDS, necessary for the rest of the research. The first section focuses on HIV/AIDS in general while the second part gives the reader an overall view of the situation among the African countries.

2.1 HIV/AIDS

HIV is an abbreviation of "human immunodeficiency virus", a retrovirus which infects key components of the cellular human immune system. Once infected with the virus the condition of the immune system badly weakens, leading to "immune deficiency", a condition where the person gets hyper sensitive to infections. AIDS is the surveillance term and an abbreviation for "acquired immunodeficiency syndrome", a stage of symptoms, signs, infections and cancers developed after carrying the HIV virus. (Fast facts about HIV, UNAIDS Report 2008) The most frequent transmission is through sexual contact. The second major way of transmission is vertical transmission; mother-to-child, while in the womb, at birth, or breastfeeding. Other routes of transmission are sharing of needles, usually by intravenous drug users, poor hygiene in hospitals or transfusions of infected blood. Risk of infection is higher for anal than vaginal sex, even higher for vertical transmission, and very high for blood transfusions. (Oster 2005: 470)

2.1.1 The effects of HIV/AIDS

During the first 20 years, since its discovery, the virus infected approximately 1 percent of the world population; metaphorically almost the whole population of Great Britain. During the same period of time, as much as 0.37 percent of the world population deceased due to infection. The result has been severe consequences, such as demographic changes for the most heavily affected countries. (UNAIDS Report 2008:31; Levy 2002:993)

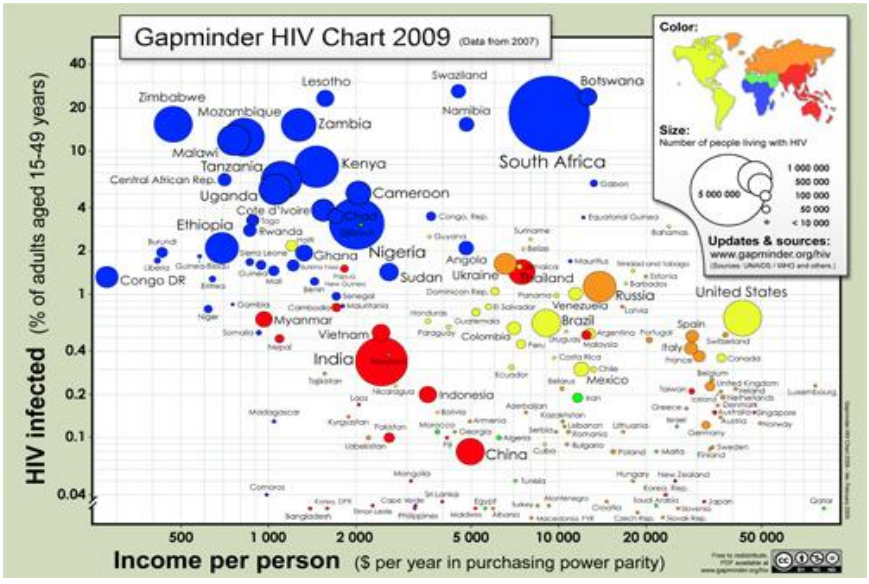
In the year of 2007 approximately 33 million people were living with HIV/AIDS. However, recent studies report a decline in the annual number of new infections, in 2001 an estimated 3.0 million were reported infected while in 2007 the figure had declined to an estimated 2.7 million. (UNAIDS Report 2008:32) The last 2-3 years, the epidemic has reached a steady-state. This steady-state is approximately 1 % of the adult population of the world. The interpretation of the notion steady-state is that it is not getting worse but nevertheless is it getting better. (TED Rosling)

HIV/AIDS, understandable, has a great impact on the economic prosperity of a country. The labour sector gets heavily burdened. Labour supply is decreased since people are enabled to work and the productivity among workers infected by the virus decreases significantly. The labour market is also affected since workers with the virus are more often absent from work and therefore transferred to less productive functions. (Fox et. al 2004:322) Key sectors like manufacturing and agriculture are labour-intensive sectors, where a lack in the labour force has a large impact. The effects result in reduction in production and consumption. Consumption decreases, since prevention and treatment are prioritized and fewer resources are left for other consumption goods. The macro-level effects are substantial but as are the micro-level effects. The macro-level impact is witnessed over generations while the impact on households is unfolding directly in the affected countries. (Veenstra&Whiteside 2005:199ff)

Alongside these short-run effects the long-run impacts are potentially even higher. Decreased life expectancy and increased number of orphans is believed to decrease incentives for investments in human capital and savings for the future reduces. (Fuller 2008:3; Economic effects of HIV/AIDS, 2009-09-02)

2.1.2 Treatment and prevention

Distribution of anti-retroviral drugs offers the best available possibility for curtailing the worst effect of the disease. However, this anti-retroviral is no cure. As for today no cure exists. Treatment is expensive and many poor developing countries are not capable of treating all infected. Focus is therefore on prevention, vital in the long-run. Many prevention programmes are established on ABC, Abstain, Be faithful and use a Condom. (UNAIDS Report 2008:161; Fuller 2009: 21; TED Rosling) Next section introduces the situation of HIV/AIDS in Africa.



The dark bubbles and the light green represent the African countries. The size of the bubbles represent numbers infected per country. The graph show that many of the African countries have high rates of HIV e.g. Swaziland and Botswana. However, countries like Comoros and Egypt have lower levels of HIV than Sweden. Source: Gapminder.org 2009

2.2 HIV/AIDS in Africa

The burden of HIV/AIDS has heavily affected many African countries, with a disproportional share on southern Africa. Of all people with HIV/AIDS, 67% live in sub-Saharan Africa. Sub-Saharan Africa is an area where the epidemic has infected more people than the victims of WWI and WWII together. However, even if southern Africa is most afflicted by the epidemic many other parts of Africa are also heavily affected. Seven countries in Central and East Africa (the Central African Republic, Tanzania, Malawi, Mozambique, Gabon, Uganda and Cameroon) exceeded 5% of adult HIV prevalence in 2007. Several countries in the horn of Africa, central and western parts of Africa, had prevalence below 2% for the same year. The rates of HIV/AIDS remain high with low implications of declining and in several of the countries in southern Africa the peak of prevalence has not yet been reached (Fuller 2009: 13; UNAIDS Report 2008: 32; Lovasz&Schipp 2009:246).

TABLE 1. HIV/AIDS IN AFRICA

REGION	Adults (15+) and children living with HIV	Adult (15+) and children newly infected with HIV	Adult (15+) and child deaths	No. of Orphans
Sub-Saharan Africa	22 million	1.9 million	1.5 million	11.4 million
World	33 million	2.7 million	2.0 million	15.0 million
Africa's burden	**66.70%**	**70.40%**	**75%**	**76%**

Source: The World Bank 2009

Derived from table 1. the proportion of HIV cases, infected, deaths and orphans both total in the world as for sub-Saharan Africa. Figures from table 1. are for the age of 15 and older, however, the number of children, under the age of 15, living with the disease has increased since 2001, from estimated 1.6 million to 2.0 million in 2007, whereof close to 90% live in sub-Saharan Africa. (UNAIDS Report 2008:32)

As mentioned, HIV/AIDS has a great impact on the economic growth. One study of South-Africa and the macro-economic consequences shows that the virus will result in lower production, reduced labour force, costs, both indirect and direct, on the business sector, health and social welfare will increase government expenditure and household's spending. For the most afflicted countries the costs brought by the virus are huge, many wealthy countries have achieved to control the death rates by e.g. investing in expensive drugs that cost around $ 1,000 each month. These wealthy countries and their PWAs (persons with AIDS) only

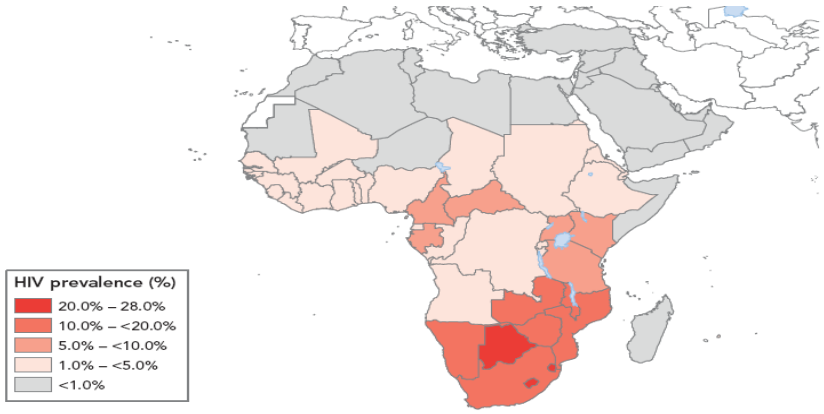
represent around 10% of all PWAs. In sub-Saharan Africa, Peter Piot, director of UNAIDS, estimates the cost to be at least $ 3 billion each year to stop the tide of the epidemic. (Fuller 2009: 13)

The differences in transmission rates of HIV/AIDS can be explained by differences in sexual behaviour and viral transmission. Studies show that almost the entire variation in transmission rates between United States and sub-Saharan Africa can be derived from differences in viral transmission. If Africa would have the same transmission rate as the developed countries the HIV rate in Africa would be 0.25% rather than the observed transmission rate of 12%. This is due to e.g. other untreated sexual diseases (STIs). Concerning sexual behaviour differences in numbers of partners and varied sexual patterns are essential. (Oster 2005: 468ff)

There are many preconceptions about HIV/AIDS, some in line with reality others not. That Africa is badly afflicted by HIV/AIDS is true. However, as mentioned in the introduction, the widespread public view, that the whole of Africa is suffering from the highest rates of HIV/AIDS in the world, is wrong. Differences within the African continent are substantial (see map below). In Madagascar the prevalence is below 1% while in e.g. Zimbabwe and Botswana it is more than 20%. The reasons for the huge variations are even today controversial and poorly observed (Oster 2005:467).

Despite the African continent being the far most afflicted continent there has not been many studies surrounding HIV/AIDS in Africa. Some reports on HIV/AIDS have not mentioned Africa, while other publications are specific for one African country. (Fuller 2009: 21ff)

HIV prevalence (%) in adults (15–49) in Africa, 2007



As seen from the map the prevalence of HIV is very diverse among the African countries. The northern parts are mostly grey or light pink which means prevalence rates of less than 5%, while in the southern parts the prevalence is close to 20% and even above 20% in some areas.
Source: UNAIDS PPT 2008

3 THEORETICAL FRAMEWORK

The theoretical framework is based on the assumption that sexual behaviour and viral transmission are most essential for understanding the transmission rates of HIV/AIDS. Simple changes in the transmission can result in significant changes in the prevalence rates. Higher transmission rates in the first time period can double the prevalence in next time period. (Oster 2005:468). Since these two routes of transmission are of importance for determining the prevalence of HIV/AIDS they are of significance and closely connected to the independent variables of this thesis. Each independent variable is either connected to viral transmission or to sexual behaviour. The nine independent variables are divided in three sub-groups - economic variables, human interaction variables and demographic variables. The independent variables are GNI, literacy, globalization, concurrency, circumcision, migration, urbanization, women as percent of the population and percent of population younger than 15 years old. These independent variables cover both the macro- and micro-level, which are both of importance in the understanding of the prevalence of the virus.

The study of HIV/AIDS in Africa is essentially done by scientists in anthropology, sociology and public-health, not in economy. The common explanation to the variation of the prevalence of HIV/AIDS has been cultural differences. However, an economic perspective would rather imply that most people are fundamentally alike and what makes people take different decisions are instead linked to circumstances. (Oster 2009; TED Rosling)

Based on initial empirical studies hypothetical relationships between the independent variable and HIV/AIDS will be presented and motivated. The chapter is finished with presenting the theoretical model, which summarizes the theoretical framework and the hypothetical correlations between the variables.

Picture taken in Zambia, 2008

3.1 Economic variables

This first section presents the economic variables that are considered having an impact on the prevalence of HIV/AIDS. The chosen economic variables are GNI, globalization and education. GNI and globalization are assumed to affect the viral transmission rate of HIV/AIDS, while education is believed to affect sexual behaviour which, in turn, affects the rate of HIV/AIDS.

Health and economy are correlated. The risk of early death and illness is increased when living in poverty and the risk of poverty is increased by illness and early deaths in the family. In the globalized world we live in economics affects everyone. The wealth of people, e.g. their income and well-being, is affected by the economy, e.g. government expenditures and employment. The development of HIV/AIDS will be affected by economic growth. Poverty and income equalities can also affect human behaviour leading to e.g. riskier sexual activities. (Lovasz&Schipp 2009: 245; Venstra&Whiteside 2005: 197)

Each of the economic variables is described based on empirical literature, which constitutes the foundation of the assumption of their correlation to HIV/AIDS.

3.1.1 Gross national income per capita

GNI (Gross National Income) per capita is the most common measurement for determining the level of economic activity in a country. (BNI, 2009-07-29) This measurement is commonly used as a summary index of the relative well-being of the population of a country and is used for income-based classification by the World Bank. Instead of using exchange rates as conversion factors scientists use PPP, purchasing power parity, to compare relative GNIs. When using the PPP the income gaps between the richer and poorer nations tend to decrease. Measurements are made by using a general set of international prices for all services and goods that are produced and valuing them at prices of U.S dollar. (Todaro&Smith 2009:43-49)

There is assumed to be a correlation between GNI and HIV/AIDS. According to diagrams presented by Doctor Hans Rosling it seems, on the macro-level, that higher income correlates positively with HIV/AIDS in Africa. On the country-base e.g. Tanzania it shows that when split the country in parts due to income the level of HIV/AIDS within the country differs between approximately 4-11%. Higher levels of HIV/AIDS are consistent with higher levels of income. (TED Rosling) This relationship can also be derived from the Gapminder HIV chart above, where e.g. South Africa and Botswana with fairly high incomes per person are consisted with high rates of HIV.

In general, there seems to be a positive correlation between HIV/AIDS and income levels in Africa. One possible explanation is that both demand for travel

and demand for prostitution seems to be correlated positively with income. Another aspect is that in a society with prosperous men, with high levels of income and where women tend to be poor, the "price" for sexual services tends to be low. (Philipson&Posner 1995:841)

These assumptions can be questioned by features related to poverty e.g. lack of health treatment, education and so forth, which assumingly correlates positively with HIV/AIDS. Another argument is that many poor developing countries can not afford the costs of treatment for all the infected whereas many developed countries in a larger scale can provide this life-long treatment.

The multiple regressions will examine if, based on discussions by Rosling, Posner and Philipson, the hypothesis that there is a positive relationship between prevalence of HIV/AIDS and GNI holds.

3.1.2 Globalization

As mentioned early on in the thesis HIV/AIDS is sometimes referred to as "the disease of globalization" and the spread of the virus to the global pandemic of today might partly due to globalization. Globalization is one of the most common notions in the debate concerning development, international political economy and trade. It refers to increased openness of economies and an emerging "global culture". The concept of globalization is, however, rather diffused and can be translated in many different ways. One interpretation is that people all over the world consume similar services and goods; an effect of increased interaction between countries and peoples associated with the globalization trend. (Todaro&Smith 2009: 589; Hunt 2004:7)

One effect of globalization is the increased flow of information through radio, television and print media. This might lead to an increased consciousness of protection, family planning and empowerment of female status. (Hunt 2004:476)

Economic globalization is a development which has been a step towards to the capitalistic international economic system, which connects many nations of today through e.g. trade. Even if this is connected to increased living standards, another side is increased prostitution and sex-trade, products of the system. (Hunt 2004:475) Oster has witnessed a positive correlation between trade and HIV/AIDS. This would imply that the more open a country is towards other countries the more mobility and influence. (TED Oster)

The proxy used for globalization is the KOF index. Measurements of three different areas: economy, politics and the social atmosphere constitute the index. (Internationella index, 2009-08-11) The figures composing the data are based on 23 different variables from 123 countries over a time period of 1970-2003. The social element of the index is based on the spread of information, ideas and images while the political measure is based on government policies. The economic activity is calculated by flows of capital, services and goods and captivates to what extent a country control for capital and trade flows. The 2006 KOF ranking the top-three nations were USA, Sweden and Canada while the

bottom constituted the African countries Togo, Chad and Central African Republic. (KOF Index of Globalization 2006)

There is no consensus regarding the correlation between globalization and HIV/AIDS. However, based on the assumptions of information and improved life conditions the hypothesis is that there is a negative correlation between HIV/AIDS and the rate of globalization.

3.1.3 Education

Increasing the knowledge about HIV/AIDS is considered a fundamental public health strategy. It is generally known that education has a positive impact on health. Information about the virus is vital due to e.g. formation of perceptions of risk and response mechanisms. Information campaigns about HIV/AIDS are also linked to education, e.g. commercials (see picture above) often requires literacy. Education is also of importance to contest myths and rumours about the transmission route. (Snelling et al. 2007:422)

A common point of view is that better educated bear less risk of attaining HIV/AIDS. In fact it might be more complex then that. Factors accompanied with the socioeconomic position of education such as travelling and postponed marriage, might increase risky sexual behaviour which increase the risk of being HIV infected. (Glynn et al. 2004:5) Public expenditure on education about HIV/AIDS has increased the knowledge among the public, however, it has not necessarily caused a decrease in the prevalence of HIV/AIDS. (Philipson&Posner 1995:35)

However, to return to the common point of view. One aspect is that lack of education is associated with poverty which can lead to e.g. sex in exchange for money, behaviour associated with higher risk of HIV/AIDS. A research of four African cities showed support of the consumption that increasing levels of education were associated with less risky sexual behaviour and therefore lower rates of HIV/AIDS. One explanation might be that the most educated may react easier to health programs. (Glynn et al. 2004:4f) Since it is more common for boys to attend school, whilst girls are home caring for sick family members or performing household duties, girls are especially vulnerable in the sense of lack of education and information. (Türmen 2003:414)

Based on most of the empirical studies above the hypothesis is that the correlation between education and HIV/AIDS is negative.

3.2 Human interaction variables

This second section presents the variables linked to human interaction. Most of the variables in this section are to a great extent determined by human decisions and individual's actions. Urbanization, concurrency (also included prostitution) and mobility are linked to sexual behaviour. However, the variable circumcision could affect sexual behaviour but is assumed to a greater extent affect the viral transmission rate.

The basic understanding of economic behaviour is summarised by rational choice and utility. Individuals assume to make rational decisions based on their individual preferences and utility functions. A person's choice is a result of rational consideration where maximizing utility and reducing costs are essential. (Rubinstein 2006) Risk aversion is one important factor that is assumed to affect human behaviour. Milton Friedman and Leonard J. Savage, founders of the conception of univariate "risk aversion", meant that a person facing an option with comparable returns chose the less-risky alternative. (The theory of risk aversion, 2009-07-27) When deciding on one's risk portfolio, rational individuals make choices based on the trade off between the extra utility from risky sex and the costs linked to risky behaviour. Rational behaviour of engaging in sexual behaviour can also be considered as part of the evolutionary development, each generation maximize Darwinian fitness, and their offspring. (Granger&Price 2009:793f). An economic agent faces a trade-off between the marginal benefit from the sexual behaviour and the costs brought by the marginal risk of being HIV infected. (Auld 2002:366)

Each of the variables of human interaction are described based on empirical literature, which constitutes the foundation of the assumption of their correlation to HIV/AIDS.

3.2.1 Male circumcision

One important factor, complement, for HIV/AIDS, common in Africa, is male circumcision. Male circumcision is a surgical procedure due to medical, religious, social or cultural reasons and one of the world's oldest procedures. Since the middle 80s epidemiological studies have presented data indicating that circumcised men show less risk of being HIV infected. (WHO Male circumcision 2009:5) In 2007 WHO concluded, based on trials in South Africa, Kenya and Uganda, that the risk of being infected, female to man, decreased by 60 % after having the procedure. WHO expressed themselves: "This is an important landmark in the history of H.I.V. prevention" (Dugger 2009)

These surveys have resulted in prevention programs where circumcision is considered an intervention. (WHO Male circumcision 2009:3) South Africa, one of the worst HIV/AIDS effected countries in the world, is one example of a

country where the difficult task of circumcising millions of men is especially complicated since no governmental support is received, a government that has been criticized for their long-term ignorance of the virus. (Dugger 2009)

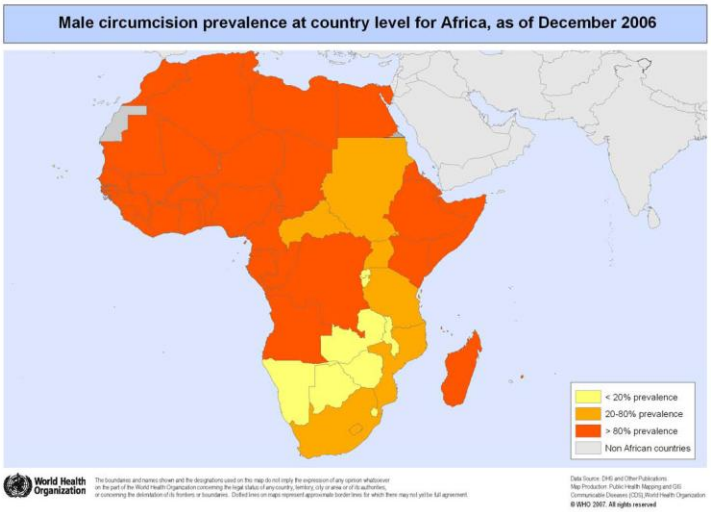
> "Africa has a severe shortage of doctors and nurses, and circumcision is potentially a political and cultural minefield in countries where some ethnic groups practice it but others do not." (Dugger 2009)

Despite difficulties Botswana is an example of one country where circumcision has been efficient. However, unlike South-Africa there is a political will in Botswana, the president has made official statements about the importance of circumcision. Daniel Halperin from Harvard University explains that the Zulus, which is the largest ethnic group in South Africa stopped circumcision as early as in the early 19th century due to protracted warfare. (Dugger 2009)

Concerns have been raised of the previously circumcised men and the risk of their sexual behaviour turning more risky due to the reduced risk of being infected. Data published by the WHO could, however, not derive any signs of this assumption and the effect of this sort of behaviour at a population level would be at no-account. Only if riskier behaviour would be attended by the whole population the effect would get significant. (WHO Male circumcision 2009:8)

The rate of circumcision among the African countries varies between countries as well as within countries. Many of the countries in north of Africa such as Morocco, an Islamic country, has much lower rates of HIV/AIDS compared to the south of Africa where many of the countries are Christian. Religion is linked to the culture of circumcision and might present an explanation to differences within countries as between countries. (Granger&Price 2009: 793)

The figures for circumcision are based on a three scale record. The African countries were divided in three groups, < 20% prevalence, 20-80% and > 80% prevalence of male circumcision at country level. These figures are estimates but implicate the correlation between HIV/AIDS and rate of circumcision. The hypothesis is that the correlation is negative between circumcision and HIV/AIDS.



Prevalence of circumcision:

Yellow: < 20%
Orange: 20-80%
Red: > 80%

Source: Malecircumcision.org

3.2.2 Urbanization

”Cities will increasingly become the main players in the global economy.”

- Kofi Annan, former secretary general of the United Nations.
(Todaro&Smith 2009: 320)

People move into the cities in a larger extent than ever before. Alongside the positive correlation between globalization and development the most positively established relationship is confirmed to be between per capita income and urbanization. The notion of urbanization is a definition of the process when people move from the country-side to live in the growing cities. (Todaro&Smith 2009: 321; Macmillian dictionary)

However, this progress is not without consequences. One region where this is especially witnessed is in sub-Saharan Africa. Consequences like emerging problems of over-crowdedness and lack of sanitation and water have been effects of urbanization. All which are factors that negatively affect the rates of HIV/AIDS. (Todaro&Smith 2009:325) In the African countries with high prevalence of HIV/AIDS urbanization is considered to be a key determinant to the spread of the virus. (Manning)

People leave rural areas for the urban areas in hope for better living conditions and increased work possibilities. Northern Africa is the only developing area where the conditions in the urban areas are getting better. (Todaro&Smith 2009:325)

Urbanization gives an indication of living-conditions. When people move from rural to urban areas this increases the mobility in the country. Based on this the hypothesis is that the relationship between urbanization and HIV/AIDS is positive. The mobility among people will be presented further in the next section, migration.

3.2.3 Migration

As mentioned the mobility within a country, for example from rural to urban areas is assumed to impact the rates of HIV/AIDS. Migration on the other hand is the notion for the development of migration to another place or country. (Macmillian dictionary)

The huge differences in rates of HIV/AIDS within Africa, e.g. between southern and eastern Africa whom are worse affected compared to western Africa, could be explained by geographical causes. These geographical differences make the people in south and east of Africa move in a greater extent than in western Africa. (Palmblad 1993: 50)

One important cause to the increased mobility is the emergence of the Trans African Highway. The Trans African Highway has increased the exchange of labour force between countries as well as increased migration and trade. An

increase which is especially witnessed between the countries Zaire, Uganda, Zambia, Kenya and Tanzania. (Palmblad 1993: 22)

Migrating men tend to, in a larger extent than others, visit prostitutes when away from their home and their wives who are left back home. Once getting back to their families they put their wives at risk of also getting infected. Same argument holds for migrating women, who also are exposed to the risk of being forced to sexual activities at border crossings or in exchange for services like protection. (Türmen 2003:416)

Since movement among people accordingly tend to increase the rates of HIV/AIDS the correlation between migration and HIV/AIDS would hypothetically be positive.

3.2.4 The culture of concurrency

Concurrency, multiple sexual behaviour, people with more than one sexual partner at the same time is not uncommon in many African countries unlike in western societies. Sexual behaviour is not merely a biological act rather, sexual behaviour is a 'culturally informed experience' (Croteau et al. 1993). This section also includes prostitution, a risky choice of behaviour linked to HIV/AIDS.

The culture of concurrency differs between the African countries. There are a lot of myths surrounding the epidemic of HIV/AIDS. One includes the assumption that “minority adolescents are more sexually active and less sexually responsible than other adolescents”. (Croteau et al. 1993) Many campaigns in the 80 and 90s focused on distribution of condoms, the campaigns were linked to stereotypes like sexual promiscuity. However, African people, in general, do not have more sexual partners than other people. The outburst in Africa could be explained by the culture of sexual networks. In many African societies it is common to have a few sexual relationships at the same time. These might last for years or life-times. Since people do not tend to use protection for long-time relationships this results in unsafe intercourse. Colonial and postcolonial stories about e.g. poverty and labour migration have encouraged these sexual networks. (Prince 2009:237)

One contribution to the peak of the epidemic in Africa is due to prevalence of female prostitution. Considering there are approximately as many men as women infected verifies that men tend to have more sexual partners than women, seeing as women more prone to get infected. This is a result of poverty, men are incapable of supporting their wives and poor women have no other option. (Philipson&Posner 1995: 838, 840)

When having multiple sexual partners there is an increased risk of getting infected. Men purchasing sex take in account not only the nominal price but also the risen, because of the risk, real price. Since prostitutes have poor alternative earning prospects, making the supply inelastic, they adjust to the reduced demand by reducing the nominal price. Therefore despite of the increased risk there are no signs of decreasing prostitution. Women of high-risk of infection tend to enter prostitution and for women, who did not begin practice safe sex, e.g. because of

poverty, have reduced incentive to start since they assume to already be infected. (Philipson&Posner 1995: 839;842)

Hypothetically there would be a positive relationship between the variables, meaning an increase in the independent variable would lead to an increase in the prevalence of the virus.

3.3 Demographic variables

The third section consists of the demographic variables which assumingly affect the prevalence of HIV/AIDS. The two variables are women as percentage of the population and percentage of the population younger than 15 years old. Both of these macro-level variables are assumed to affect the transmission rates of the virus. The dynamics of human populations like e.g. age structure and gender structure influence the features of economic and social progress. (UNFPA 2005)

Each of the demographic variables is described based on empirical literature, which constitutes the foundation of the assumption of their correlation to HIV/AIDS.

3.3.1 Women in the population

In many countries the woman are the most vulnerable and the ones worst affected by the virus. Of people living with HIV/AIDS women account for 61% and are three times more likely to be infected by the virus than men. In many societies women are, because of their sex, the ones with the lowest status, both socially and economically. This puts them in a vulnerable position incapable of negotiating safe sex and demanding condom use. For prostitutes there is hardly any possibility to affect the decision of condom use and many are too afraid to even mention safe sex. This is a result of violence and discrimination, factors which tend to get worse in times of conflicts. One example is the democratic republic of Congo where the sexual abuse and violence against women has become a way to exercise war. (World Bank 2009, The associated Press NYT 2009)

Women tend to get infected in much younger ages than men. In many sexual relations the man is older than the woman which increase the risk of men being infected by STIs or HIV/AIDS and therefore increasing the risk of infecting younger women. Biologically the transmission to women is higher than to men. The transmission of HIV between male to female is somewhere between two to four times more efficient than it is from female to men. Women are also often infected with other STIs, e.g. making them even more vulnerable towards the virus. It is neither unusual for poor women to have sex for material benefits. One survey in Malawi showed that of 168 sexually active women two-thirds had sex in exchange for, e.g. gifts. (Türmen 2003:411ff)

In many cases women are ashamed of being infected because the disease is associated with prostitutes and therefore they do not dare to test themselves. Not uncommon is for women to be abused or ostracized if infected. This makes many women wait for a long time before being tested, if ever being tested. (Türmen 2003:416)

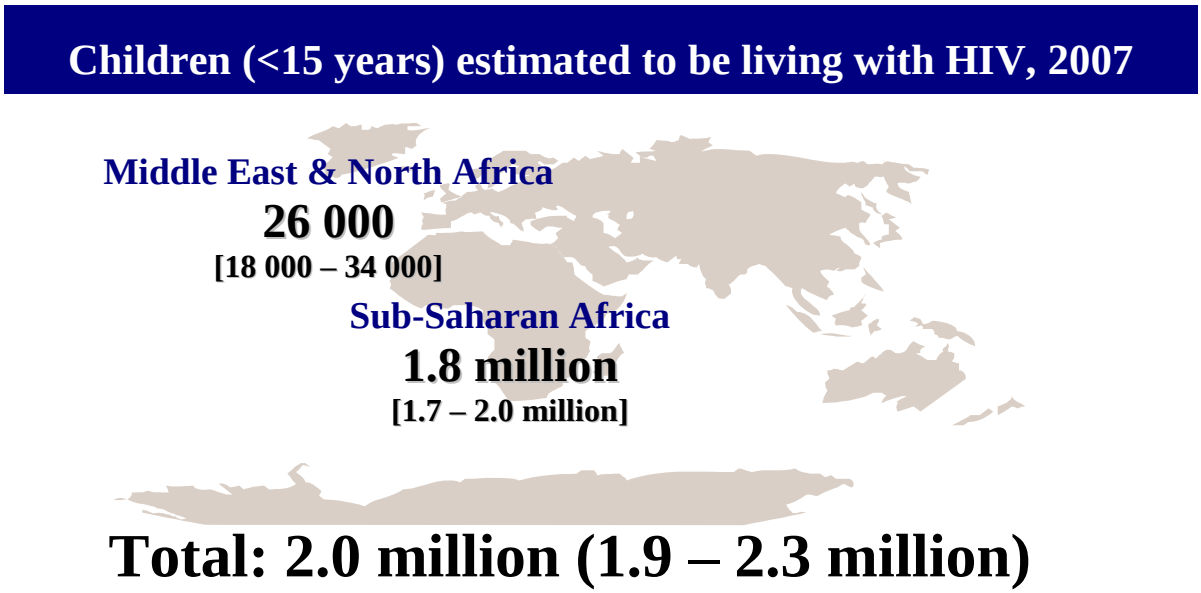
The hypothesis, based on the empirical material, is that the more women in a society the higher rates of HIV/AIDS and therefore the correlation is assumed to be positive.

3.3.2 Young people in the population

In many developing countries there is an increasing number of HIV/AIDS infected in the ages 15-24. One of the most common ways of transmission is the transmission from mother-to-child, which result in many children being born carrying the virus. Since it is not until the child is around 18 months that the HIV-tests give a trustful result, because of the mother's anticropes, the treatments begin late. For children, whose immune system is not developed the incubination time varies but AIDS could be developed only one year after infected by HIV. (Palmberg 1993:108ff)

Studies show that substantial number of boys and girls in the age 14 or younger has practised unprotected intercourse, some forced. Most children unaware of risks and condoms. (Dixon-Mueller 2009:100) The data wary between countries and needs to be seen as estimates, bearing in mind that this might be an embarrassing topic to young boys and girls. According to DHSs there are especially huge differences between the countries in sub-Saharan Africa. In Gabon approximately 48% of 15-19 year old boys claimed they had practised sex before the age of 15, the same figure for Rwanda was 3%. A problem is that information of HIV/AIDS and safe sex usually does not reach the younger part of the population. (Dixon-Mueller 2009:102)

Hypothetically there will be a positive relationship between the share of young people in the population and the prevalence of HIV/AIDS.



Source: PPT Summary of AIDS 2007

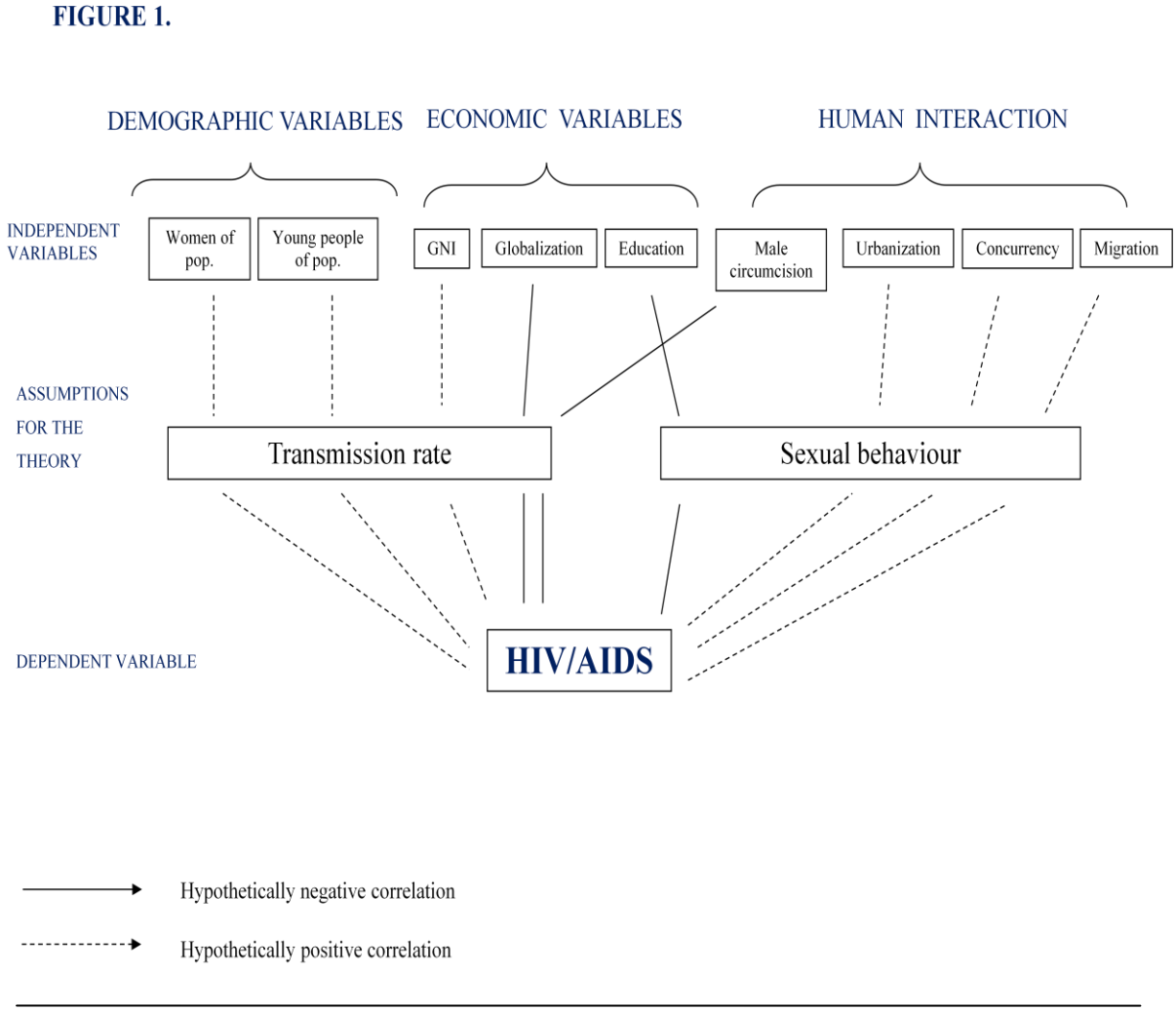
The map shows the distribution of children (younger than 15 years old) estimated to be infected with HIV. Of the total sum of 2 million as many as 1.8 million live in sub-Saharan Africa.

3.4 The theoretical model

Based on the theoretical framework, the empirical literature and the assumptions of sexual behaviour and viral transmission, the relationship between the dependent and independent variables can be summarized by figure 1.

The model shows the independent variables and their sub-groups demographic variables, enomiv variables and human interaction. Whereas they are assumed to affect the HIV/AIDS through the viral transmission rate or the sexual behaviour is shown as well is the hypothetical correlation towards HIV/AIDS.

FIGURE 1. THE THEORETICAL MODEL



4 METHOD

The aim of this thesis, as already mentioned, is to examine a few chosen factors and their correlation towards the rate of HIV/AIDS. This will be accomplished by using the linear regression model. In this section the model will be introduced followed by the basic and most important conceptions of the regression model, e.g. hypothesis testing, f-test and p-value which will be discussed thoroughly in the empirical analysis. Although most of the described tests will be performed automatically by SPSS it is important to understand how the regressions work.

4.1 The linear regression model

To solve environmental problems the most common method is the statistical technique of linear regression models which probably is the most useful and most commonly used model. The notion "regression" intimate that the observed data usually "regress" towards their mean. The technique explains complicated relationships between observations of a dependent variable, labelled y, with observed values of an independent variable, usually known as x_1, x_2 and so on. An error term (ε) is added to receive a more correct result, which function is to capture sources of errors that have proceeded unnoticed by the other variables. (Linear Regression chapter 8:1)

The linear regression model is usually expressed as:

$$y = \beta_1 + \beta_2 x + \varepsilon \qquad (3.1)$$

Where y represents the dependent variable, β_1 (the intercept) and β_2 represents the parameters (constants), x represents the independent variable and ε represents the random error term. (Westerlund 2005:71ff)

The model is named *simple linear regression model* because there is only one independent variable, x. For wider research, like this study, with several independent variables the correct model is the *multiple linear regression model*, which can be expressed as:

$$y = \beta_1 + \beta_2 x_1 + \beta_3 x_2 + \beta_4 x_3 + ... + \varepsilon \qquad (3.2)$$

The parameters reveal the relationship between the independent variables and the dependent variable y. In this research there will be nine different x's, factors that

believably can affect the prevalence of HIV/AIDS (y-value). To examine the relation between y and the x-values estimation is proceeded. One indication of the correlation is whether the parameter is positive or negative. A negative parameter shows that an increase in the variable will reduce the HIV/AIDS rate and the other way around. (Westerlund 2005:71ff)

There are a few ambushes with the regression model. One example is the risk of heteroskedasticity, which means that the error terms do not have constant variance. The second is multicolineality, which means that there is a high correlation between the variables. These will be examined in the empirical analysis based on the figures from the research. (LTH 2008 PPT)

4.2 Testing the significance of the parameters

To know if an estimation of the parameters give a reliable result there are a few tests to be made. For a correct result the random error term, ε, most be assumed to be normally- and independently distributed, with a variance of $\sigma 2$ and a mean of zero. (Hypothesis Tests in Multiple Linear Regression) To know if the result is reliable it is essential to understand the hypothesis test and f-values.

4.2.1 Hypothesis Test

The hypothesis test consists of four important notions, a null hypothesis, an alternative hypothesis, a teststatistika and a critical region. First step is to determine the null hypothesis, which specifies a special hypothesis, e.g. whether the null hypothesis is equal to the constant α.

$$H_0: \beta_2 = \alpha \qquad (3.3)$$

If the sample can not prove the contrary the null hypothesis is assumed to be correct. If the sample indicates that the null hypothesis is wrong the null hypothesis is rejected.

The alternative hypothesis includes all the conditions besides when the null hypothesis holds, which means that when the null hypothesis is rejected the alternative hypothesis assumes to alter. With a null hypothesis like equation 3.3 the alternative hypothesis can adopt three different forms:

$$H_1: \beta_2 \neq \alpha \qquad (3.4)$$

$$H_1: \beta_2 < \alpha \qquad (3.5)$$

$$H_1: \beta_2 > \alpha \qquad (3.6)$$

The equation 3.4 is a doubled sided hypothesis while equation 3.5 and 3.6 are one sided hypothesis. If the parameter is strictly less than α, in case of equation 3.5, the null hypothesis will be rejected and the same for equation 3.6 when the parameter is strictly larger than α. (Westerlund 2005:115ff)

Concerning multiple regression the same system is used:

$$H_0 : \beta_2 = \beta_3 = ... = \beta_k = \alpha \quad (3.7)$$

$$H_1 : \text{At least one } \beta \neq 0 \quad (3.8)$$

To test the null hypothesis the tool needed is a teststatistika, which when working with the multiple regression model is the f-test. (Westerlund 2005:151f)

4.2.2 The f-test

Since there is more than one variable, the tool for determining whether to reject or accept the hypothesis is the f-test. (For one variable the tool is the t-test, which will be used for each variable in each regression model but works in the same way.) If the f-value is situated in the critical region then the null hypothesis is rejected. The probability of the f-value to fall into the range of the critical region is equal to α and is named the level of significance. Another possibility to reject or accept the null hypothesis is through using the p-value. If the p-value is lower than the chosen value of significance than the null hypothesis is rejected. If $\alpha = 0.05$ and the p-value > α than this means that we cannot reject the null hypothesis. (Westerlund 2005:124ff)

Most common is $\alpha = 0.05$ meaning that the value of significance is 5 %. If a larger number of the significance value is chosen the larger is the chance to reject the null hypothesis and the risk to wrongly reject a true null hypothesis increase with an increase in the significance value. Through this thesis the significance level will be $\alpha = 0.1$, which is common in this sort of research (Westerlund 2005:118ff,151-156)

In case of a null hypothesis where the parameter is being equal to zero is accepted, this means that there is no significance and therefore there is no relation to the dependent variable. This will be examined in the empirical analysis to show that the regression models used are useful. (Westerlund 2005:123)

5 EMPIRICAL ANALYSIS

This part contains the empirical analysis. The data and variable descriptions are presented as is the regression models for each group of variables. One regression concluding all variables besides concurrency and one regression including all the independent variables complete the analysis.

5.1 Data source and variables

Originally the data was obtained from 47 of the African countries and consisted of 14 independent variables. Due to lack of data the sample size decreased to 37 of the African countries (n=37) (see Appendix 1) with complete data information for 8 independent variables. For all 9 independent variables the sample size decreased to 27 countries (n=27) with complete data information. Most of the data used have been published by the UN and are based on figures from 2007.

There are mainly three tools that UNAIDS and WHO use to generate HIV/AIDS estimates for countries: Spectrum, Workbook and the Estimation and Projection Package (EPP). The estimations are based on data from sources like surveys, sentinel surveillance and specific studies, which are regularly updated on basis of the most recent available research. (Report on the Global AIDS Epidemic 2008: 31)

The first regression, *the economic regression*, is based on 37 countries that provided complete data information. The next regression, *the human interaction regression*, which includes the variable concurrency, is based on a decreased sample of 27 countries. This is due to the variable concurrency, which only has complete data information for these 27 African countries. The third, *the demographic regression*, is based on 37 countries. The last two regressions uses all variables excluding concurrency in the last regression making them consist of a sample of 27 as well as 37 countries. Much of the data used is fairly new, which gives an implication of the difficulties associated with collecting data from many developing countries, however, makes the data information of more interest. It is also due to the lack of data that all data is not based upon the same year; most of the variables are based on 2007 while a few are based on most recent available figures as well as figures from over a short time period. Important to bear in mind is that the figures should rather be seen as estimates.

The following table shows the variables used for the regression, their proxy and their source.

TABLE 1. DEPENDENT AND INDEPENDENT VARIABLES

Dependent variable	*Data source*
Adult (15–49) prevalence of HIV percent 2007*	WHO

Independent variable	*Proxy*	*Data source*
Income	lnGNI per capita 2007 (PPP)	WHO
Globalization	KOF Index, 2006	KOF
Education	Adult literacy rate in percent over the time period 2000-2007	WHO
Circumcision	Proportion of male circumcision, divided in three categories, 2006	WHO
Urbanization	Percentage of population living in urban areas in 2007	WHO
Migration	Net migration rate per 1000 over the time period 2005-2010	UN population Division
Concurrency	Percentage of population aged 15-49 who have had sexual intercourse with more than one partner last year, 2007	UNAIDS
Rate of females	Women, as percentage of population, 2005	World Bank
Rate of young people	Percentage of population under age 15, 2007	WHO

* Egypt did not have information about the prevalence of HIV/AIDS in percent but per 100 000 and was therefore converted to percent.

5.2 Descriptive statistics and correlation

The statistical software SPSS statistical analysis was conducted on 37 African countries. The descriptive table below present an overview of the sample. Each variable's mean, maximum- and minimum value and the standard deviation for each variable can be derived. Valid N, is interpreted that there are 27 of the African countries with complete data information. Besides concurrency all other variables have complete data for the 37 African countries.

TABLE 2. DESCRIPTIVE STATISTICS

	N	Minimum	Maximum	Mean	Std. Deviation
Adult (15–49) HIV prevalence percent 2007	37	0.1	26.1	5.4622	7.10725
GNI per capita 2007 (PPP)*	37	330	13080	3149.73	3537.292
Percentage of pop women 2005	37	49.2	53.1	50.438	0.8108
Percent of pop younger than 15 2007	37	24	49	40.46	6.436
Percent living in urban areas 2007	37	10	85	39.24	17.366
Net migration rate (per 1000) 2005-2010	37	-3.5	8.1	-0.224	1.9513
Adult literacy rate in percent 2000-2007	37	23.3	88	61.841	19.2379
People between 15-49 with more than one sex. partner last year 2007	27	1	43	14.07	10.414
Male circumcision 2006	37	0	2	1.43	n/a
KOF 2006	37	34.91	69.26	49.9865	9.18028
Valid N (listwise)	27				

*for the regressions lnGNI per capita is used, which has a min of 5.8, maximum of 9.48, mean of 7.5419 and std. dev. of 0.99756

Concerning the dependent variable, HIV/AIDS prevalence, there is a huge variety between countries, which can be derived from the minimum and maximum values. The variety between the countries range from 0.1% to 26.1% of the population infected with HIV/AIDS. In general there is a rather wide range between the minimum and maximum values, which can be explained by the large differences between the African countries, e.g. GNI differs between 330 and 13080 GNI per capita in 2007, for the regression the logarithm of GNI is used. Regarding percent of population younger than 15 years old in 2007 the data varies between 24 and 49 but the mean is as high as 40,46 meaning that in general most countries have a rather high rate while a few have much less. The standard deviation tells us how much the sample varies around its mean and differs rather a lot between the variables. The male circumcision variable, which is not a numerical value but an ordinal value is coded as either 0, 1 or 2. The minimum is 0 and the maximum is 2. The mean is derived at a rate of 1,46 meaning that in general the circumcision rate is closer to 2 than to 0. Since this variable is coded, which is presented in the theoretical framework circumcision, this means that in general the percentage of circumcision is closer to >80% (2) than to < 20% (0) Considering circumcision the standard deviation can not be attributed because of it being an ordinal value.

Next step, after collecting the data and chosen the variables, is to examine the correlation between the variables. Examine the association between each

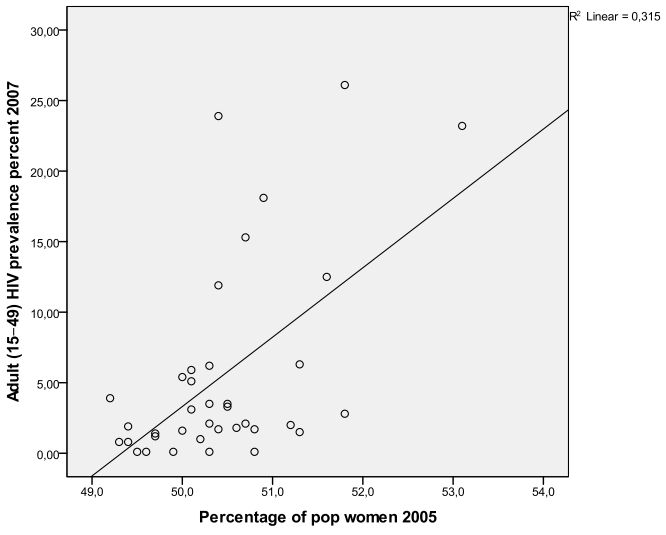
independent variables and the dependent variable as between each other. The relationship can be derived from table 2. The figures are Pearson correlation with figures of Pearson's r, which represent the correlation between the variables. A value of 1 means that the variables are perfectly correlated. As seen the diagonal of 1 is each variable correlated to itself. To bear in mind is that if any Pearson value is above 0.8 this is a caution, however, this is not a problem in this sample, however, the correlation between e.g. lnGNI and KOF is close with 0.799.

TABLE 3. CORRELATION MATRIX

	HIV	Women	< 15 years	Urbanisation	Migration	Literacy rate	Concurrency	Circumsition	KOF 2006	lnGNI
HIV	1	,561***	-0,075	-0,035	-0,001	,434***	0,029	-,656***	0,204	0,3*
Women	,561***	1	0,119	-0,289*	-0,041	0,126	-0,001	-,439***	-0,097	-0,121
< 15 years	-0,075	0,119	1	-,625***	-0,033	-,531***	-0,336*	-0,092	-,728***	-,797***
Urbanization	-0,035	-0,289*	-,625***	1	-0,046	,410**	,705***	,391**	,606***	,732***
Migration	-0,001	-0,041	-0,033	-0,046	1	0,08	0,23	-0,324*	-0,129	-0,076
Literacy rate	,434***	0,126	-,531***	,410**	0,08	1	0,267	-0,281*	,460***	,627***
Concurrency	0,029	-0,001	-0,336*	,705***	0,23	0,267	1	0,338*	,450**	,486***
Circumsition	-,656***	-,439***	-0,092	,391**	-0,324*	-0,281*	0,338*	1	0,164	0,064
KOF 2006	0,204	-0,097	-,728***	,606***	-0,129	,460***	,450**	0,164	1	,799***
lnGNI	0,3*	-0,121	-0,797***	,732***	-0,076	,627***	,486***	0,064	,799***	1

NOTE.—The Correlation Matrix shows pairwise correlation coefficients for the variables listed. *** p<0.01, ** p<0.05, * p<0.10 (2-tailed) Pearson correlation.

Next step is deriving if the relationship between the dependent and each independent variable is linear, positive or negative, weak or strong and if there are any outliners of the sample. This is examined by scatter-plots. If the result is shaped like a curve this implies that there is no linear relationship. The scatter-plot below shows the relationship between the dependent variable HIV/AIDS and the independent variable percentage of population women. The R-square linear co-efficient, between 0-1, implies if there is a weak or strong relationship. The r-square below is 0,315, which is rather weak, a R-square of 1 would indicate perfect correlation. (see above) The same procedure as the scatter-plot below has been made for all variables



and there is no reason to believe that there would be problems with non linear relationships.

5.3 Result

To this point all the statistics has been conducted from the statistical software SPSS but since this program is unable to, in an easy way, adjust for heteroskedasticity all regressions have been conducted with the data analysis and statistical program Stata. The regressions are therefore made with robust standard errors. The descriptive tables and the model summaries are, however, from SPSS.

This section presents the different steps of the regression analyses. The regressions are divided in four sections where the first regression is made for the economic variables, the second for the human interaction variables and the third for the demographic variables. The last section consists of two regressions, one is including the variable concurrency and one is excluding it.

5.3.1 Economic regression equation

This equation shows how you would explain the HIV/AIDS prevalence if only including the economic variables; in that case there would only be three explaining variables. Derived from table 4 the regression equation is as follows:

$$\hat{Y} = - 6.568 + 0.148X_1 + 0.663X_2 – 0.042X_3 + \varepsilon$$

The first figure, the constant, is the intercept, which is the value of y when everything else is equal to zero. Since this is not possible there is no reason for interpretation of this intercept. The figures in front of the x's are the parameters, each b_i indicates the average change in y given one unit change in x_i when all the other x's are held constant. The sign of the parameter indicates if the relationship is positive or negative. The ε is the error term, which is suppose to seize everything the model has missed. This equation is based on the sample of the 37 African countries.

TABLE 4. COEFFICIENT TABLE

HIV	Coef.	Robust St. Err.	T	Sign.	[95% Conf.	Interval]
(Constant)	-6.568095	10.16723	-0.65	0.523	-27.25349	14.1173
Literacy rate	.1482824	.0568755	2.61	0.014	.0325684	.2639965
lnGNI	.6635722	2.530747	0.26	0.795	-4.485271	5.812415
KOF index	-.042892	.2242885	-0.19	0.850	-.4992104	.4134264

To examine if this model is useful the ANOVA test will examine if it is possible for

$$H_0: \beta_1 = \beta_2 = \beta_3 = 0$$

If the null-hypothesis is accepted it indicates that the model is not useful, none of our variables have a relationship with the dependent variable. The alternative hypothesis indicates that at least one of the independent variables is not equal to zero.

$$H_1: \beta_i \neq 0$$

For the test the f-value which is 2.596 (derived from table 5) is considered and the p-value (the significance level) which is 0.069. Based on a 10% significance level, $\alpha = 0.1$, the conclusion is to reject H_0 since $0.001 < 0.1$. The model is therefore useful.

Next part consists of estimating the t-value. This is done by a t-test, which follows a t-distribution, for each independent variable, this to examine if the relationship with the dependent variable is of significance.

$$H_0: \beta_i = 0$$

$$H_1: \beta_i \neq 0$$

If the significant value is $< \alpha$, which is 0.1, then it is significant. The significance level for each variable can be derived from table 4. Unfortunately the significance levels are high, which is not surprising considering the low sample size, the only significant value is adult literacy rate.

TABLE 5. ANOVA TEST

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	347.253	3	115.751	2.596	.069[a]
Residual	1471.214	33	44.582		
Total	1818.467	36			

a. Predictors: (Constant), KOF 2006 , Adult literacy rate in percent 2000-2007 , GNI per capita 2007 (PPP)
b. Dependent Variable: Adult (15–49) HIV prevalence percent 2007

Derived from the model summary, table 6, our adjusted R-square is given as 0.117 meaning that 11.7% of the variability of the dependent variable was explained by the variability of the independent variable. This is a low explanatory variable, which is not surprising considering the low set of variables in this first regression and should not be considered an issue. Standard error of the estimate, S_{yx}, indicates that there exist some fluctuations along the regression line, negative as positive. Our S_{yx} is estimated to 6.67699.

TABLE 6. MODEL SUMMARY

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.437[a]	0.191	0.117	6.67699	2.318

a. Predictors: (Constant), KOF 2006 , Adult literacy rate in percent 2000-2007 , GNI per capita 2007 (PPP)

b. Dependent Variable: Adult (15–49) HIV prevalence percent 2007

The Durbin-Watson value is 2,330, which is rather close to 2, indicates that the residuals are independently of each other, there is assumingly no problem with autocorrelation. This is one of the assumptions which is elaborated further down in this section.

5.3.2 Human interaction regression equation

This next section examines the second regression, which includes the variables of human interaction. This group include four different variables, male circumcision, concurrency, migration and urbanization. Important to observe is that this regression consists of 27 countries unlike the two other regressions.

$$\hat{Y} = 12.059 + 0.118X_1 - 0.940X_2 - 7.944X_3 - 0.000X_4 + \varepsilon$$

The parameters are derived from table 7.

TABLE 7. COEFFICIENT TABLE

HIV	Coef.	Robust St. Err.	t	Sign.	[95% Conf. Interval]	
(Constant)	12.05942	3.022287	3.99	0.000	5.90322	18.21561
Urbanization	.1189814	.0487744	2.44	0.020	.0196311	.2183317
Migration	-.940732	.6025844	-1.56	0.128	-2.168156	.2866922
Circumcision	-7.944096	1.580587	-5.03	0.000	-11.16365	-4.724545

Concurrency	-.0003501	.0021109	-0.17	0.869	-.0046498	.0039496

By following the same procedure as above, one can derive, from the anova test, that the f-value is 4.222 and the significance level for the model is therefore 0.011, which is significant. Therefore the model is useful. The next section includes the t-values and the significance level for each variable. If the significant value is < α, which is 0.1, then it is significant. The significance level for each variable can be derived from table 7. The significance levels show that the values for urbanization and circumcision are of significance.

TABLE 8. ANOVA TEST

	Sum of Squares	df	Mean Square	F	Sig.
Regression	385.67	4	96.417	4.222	.011[a]
Residual	502.453	22	22.839		
Total	888.123	26			

a. Predictors: (Constant), Male circumsition 2006, Net migration rate (per 1000) 2005-2010, People between 15-49 with more than one sex. partner last year 2007, Percent living in urban areas 2007

b. Dependent Variable: Adult (15–49) HIV prevalence percent 2007

Derived from the model summary, table 9, our adjusted R-square is 0.331 meaning that 33.1% of the variability of the dependent variable was explained by the variability of the independent variable.

The standard error of the estimate is 4,77899. The Durbin-Watson value is 2,131, which is close to 2 and therefore indicates that the residuals in this regression are independently of each other and there is probably no problem with autocorrelation.

TABLE 9. MODEL SUMMARY

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.659[a]	0.434	0.331	4.77899	2.131

a. Predictors: (Constant), Male circumsition 2006, Net migration rate (per 1000) 2005-2010, People between 15-49 with more than one sex. partner last year 2007, Percent living in urban areas 2007

b. Dependent Variable: Adult (15–49) HIV prevalence percent 2007

5.3.3 Demographic regression equation

The last variables, the demographically linked variables, will be examined in this regression. This group includes two variables, percent of the population younger than 15 years old and percent of the population who are women. This regression is based on 37 countries and is derived from table 10.

$$\hat{Y} = - 243.708 + 5.067X_1 – 0.158X_2 + \varepsilon$$

TABLE 10. COEFFICITENT TABLE

HIV	Coef.	Robust St. Err.	T	Sign.	[95% Conf. Interval]	
(Constant)	-243.7083	62.47135	-3.90	0.000	-370.6654	-116.7512
% women	5.06756	1.272811	3.98	0.000	2.480897	7.654223
% < 15 years	-.1588334	.1623401	-0.98	0.335	-.4887482	.1710813

By following the same procedure as above the conclusion can be drawn that this model is useful. The Anova test shows that the p-value for the regression is 0.001, which is highly significant. Estimation of the t-value is the next important value to examine. This to examine the p-values, the significance, if the significant value is $< \alpha$, which is 0.1 then it is significant. The significance level for each variable can be derived from table 10. The significance level for percent of population who are women is highly significant while the other variable, percent of population younger than 15 years old is not significant.

TABLE 11. ANOVA TEST

	Sum of Squares	df	Mean Square	F	Sig.
Regression	609.402	2	304.701	8.568	.001[a]
Residual	1209.065	34	35.561		
Total	1818.467	36			

a. Predictors: (Constant), Percent of pop younger than 15 2007, Percentage of pop women 2005

b. Dependent Variable: Adult (15–49) HIV prevalence percent 2007

Derived from the model summary our adjusted R-square is given as 0.296 meaning that 29.6% of the variability of the dependent variable was explained by the variability of the independent variable. Since there are only two variables it is not surprising that the R-square is low, since HIV/AIDS prevalence can not be explained merely by these two variables. S_{yx} is estimated to 5.96328. The Durbin-Watson value is 2.283, indicates that there is probably no problem with autocorrelation.

TABLE 12. MODEL SUMMARY

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.579[a]	0.335	0.296	5.96328	2.283

a. Predictors: (Constant), Percent of pop younger than 15 2007, Percentage of pop women 2005

b. Dependent Variable: Adult (15–49) HIV prevalence percent 2007

5.3.4 Regression equations 1 and 2

The choice to make two regressions instead of one is based on the low sample size, which occurs when including all variables. Since there is a lot of missing data for concurrency one regression excludes this independent variable.

EQUATION 1.

This regression is based on 36 countries and includes eight of the independent variables.

$$\hat{Y} = - 191.498 + 3.034X_1 + 0.428X_2 + 0.022X_3 - 0.370X_4 + 0.017X_5 - 5.255X_6 + 0.122X_7 + 3.435X_8 + \varepsilon$$

TABLE 13. REGRESSION EQUATION 1

HIV	Coef.	Robust St. Err.	t	Sign.	[95% Conf. Interval]	
(Constant)	-191.498	69.14646	-2.77	0.010	-333.1381	-49.85792
% women	3.034715	1.254432	2.42	0.022	.4651274	5.604303
% < 15 years	.4280899	.2512571	1.70	0.099	-.0865869	.9427667

Urbanization	.0227344	.0552151	0.41	0.684	-.0903687	.1358375
Migration	-.3703915	.4414769	-0.84	0.409	-1.274716	.533933
Literacy	.0175347	.0407684	0.43	0.670	-.0659755	.1010449
Circumcision	-5.255001	1.346798	-3.90	0.001	-8.013791	-2.496211
KOF index	.1227614	.1417272	0.87	0.394	-.1675537	.4130765
lnGNI	3.435181	1.705895	2.01	0.054	-.0591862	6.929549

Derived from table 14 the f-value is estimated to 9.573, which means that the p-value is 0,000, the model is therefore useful. The adjusted r-square is 0.656, which means that 65.6% of the variance of y can be explained by the independent variables. The Durbin-Watson value is 2.217, which is fairly close to 2 and should therefore not cause any problems with autocorrelation.

TABLE 14. RESULTS FOR REGRESSION EQUATION 1

F-value	Sign.	Adj. R-square	Durbin-Watson
9.573	0.000	0.656	2.217

EQUATION 2.

This regression is based on 27 countries and include all of the nine independent variables.

$$\hat{Y} = -193.99 + 3.070X_1 + 0.444X_2 + 0.272X_3 - 0.392X_4 + 0.016X_5 + 0.000X_6 - 5.275X_7 + 0.128X_8 + 3.375X_9 + \varepsilon$$

TABLE 15. REGRESSION EQUATION 2

HIV	Coef.	Robust St. Err.	T	Sign.	[95% Conf. Interval]	
(Constant)	-193.99	71.81284	-2.70	0.012	-341.3378	-46.64225
% women	3.070275	1.271647	2.41	0.023	.4610697	5.67948
% < 15 years	.4447462	.2919734	1.52	0.139	-.1543336	1.043826
Urbanization	.0272623	.0592906	0.46	0.649	-.0943921	.1489166
Migration	-.3926234	.4651478	-0.84	0.406	-1.347028	.561781
Literacy	.0162274	.0434064	0.37	0.711	-.0728352	.1052901
Concurrency	.0004169	.0019821	0.21	0.835	-.00365	.0044839
Circumcision	-5.275201	1.364743	-3.87	0.001	-8.075423	-2.474979
KOF index	.1285256	.1519344	0.85	0.405	-.1832181	.4402693
lnGNI	3.375069	1.64675	2.05	0.050	-.0037836	6.753922

The f-value is estimated to 3.745, which means that the p-value is 0.009 which means that the model is useful. The adjusted r-square is 0.487, which means that 48.7% of the variance of y can be explained by the independent variables. The Durbin-Watson value is 2.043, which is fairly close to 2 and therefore there is no signs of autocorrelation.

TABLE 16. RESULTS FOR REGRESSION EQUATION 2

F-value	Sign.	Adj. R-square	Durbin-Watson
3.745	0.009	0.487	2.043

The most compelling difference between the two regressions is the differences in significance levels for the independent variables. As shown, the significance levels are higher in the second regression, which is explained by the decreased number of countries in that regression due to including the variable concurrency. An effect of this is that when having high p-values it is difficult to make conclusions. This is why it is to recommend having as large sample sizes as possible when working with multiple regressions. However, the differences between the results are not as high as expected.

Before entering next section, where the variable results are introduced and discussed there are a few assumptions that need to be fulfilled for receiving the most correct result from the regressions.

5.3.5 The assumptions for regression analysis

There are a few assumptions that are required to be fulfilled for the estimates to be held accurate:

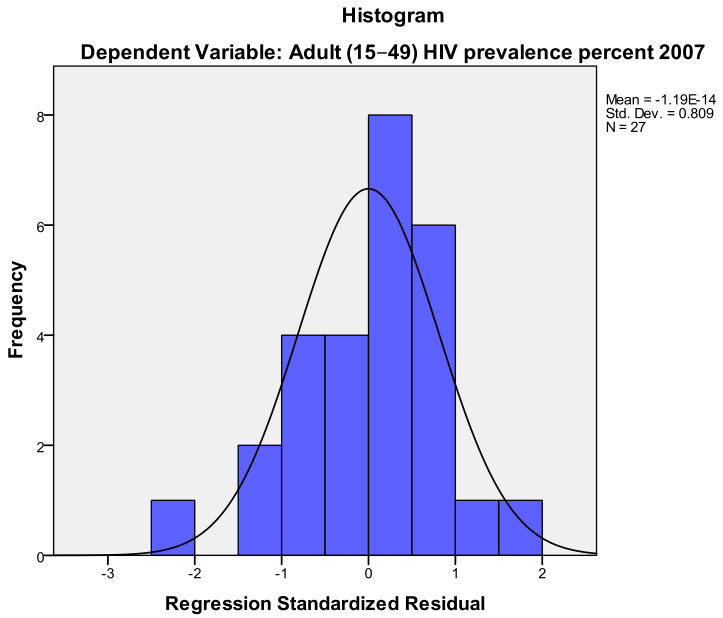
- **Normally distributed data**

  The assumption of normally distributed data is tested by the Central Limit Theorem, CLT. If the sample size is larger than 30 this assumption is assumed to hold. Since the sample size for the regressions including the variable concurrency is 27 (n=27) this assumption is not quite fulfilled. However, for the other regressions, excluding concurrency, the sample size is 37 and the CLT theorem is therefore fulfilled. This is not a huge problem, however, should be detected.

Residual Analysis:

♦ Normally distributed residuals

Most tests are rather robust regarding this assumption but to examine that all the residuals are normally distributed, histograms or normal probability plots are used. The histogram below shows that there is most likely no problem with normal distributed residuals, considering the low sample size this result can be interpreted as reliable. (Multiple Regression)



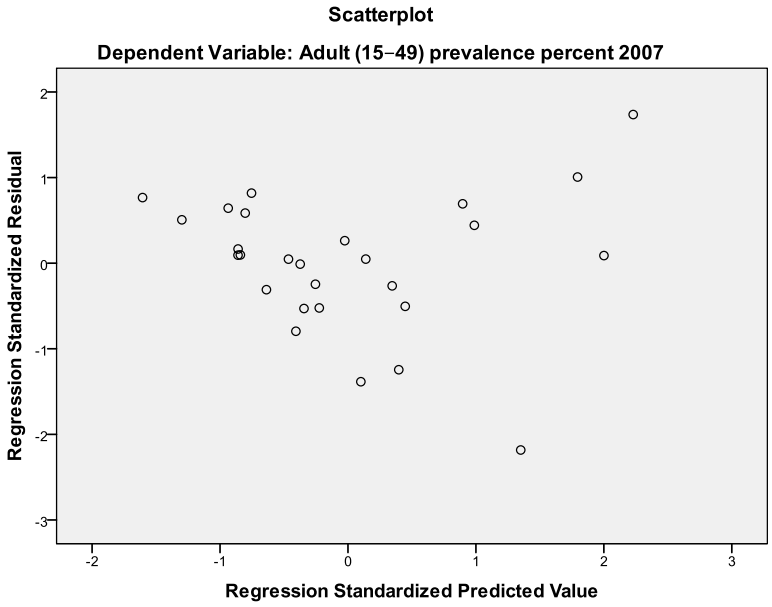
♦ Independent residuals

To examine independent residuals the tool used is the Durbin-Watson test which is a test for the first-order autocorrelation in the residuals. If the value is close to 2 this indicates that the residuals probably are independently of each other. Since all of our DW-values are close to 2 there should be no problem with autocorrelation. Usually problems with autocorrelation occur when working with regressions over time, which only confirms the conclusion. (Westerlund 2005)

♦ Homoskedasticity

The risk of having heteroskedasticity, that the error terms do not have the same variance, represents a problem. This was examined graphically by plotting the regression standardized residuals against regression standardized predicted values. If there is any kind of systematic pattern occurring then there is a risk of heteroskedasticity. The scatter-plot show that there is a weak pattern of heteroskedasticity. This might be a warning

that the t-values might not be correct resulting in unreliable significance levels. (Westerlund 2005:173,180 Since the pattern is rather weak this should not be a huge problem but has been adjusted by using robust standard errors for the regressions accomplished by using the statistical software Stata as mentioned earlier.

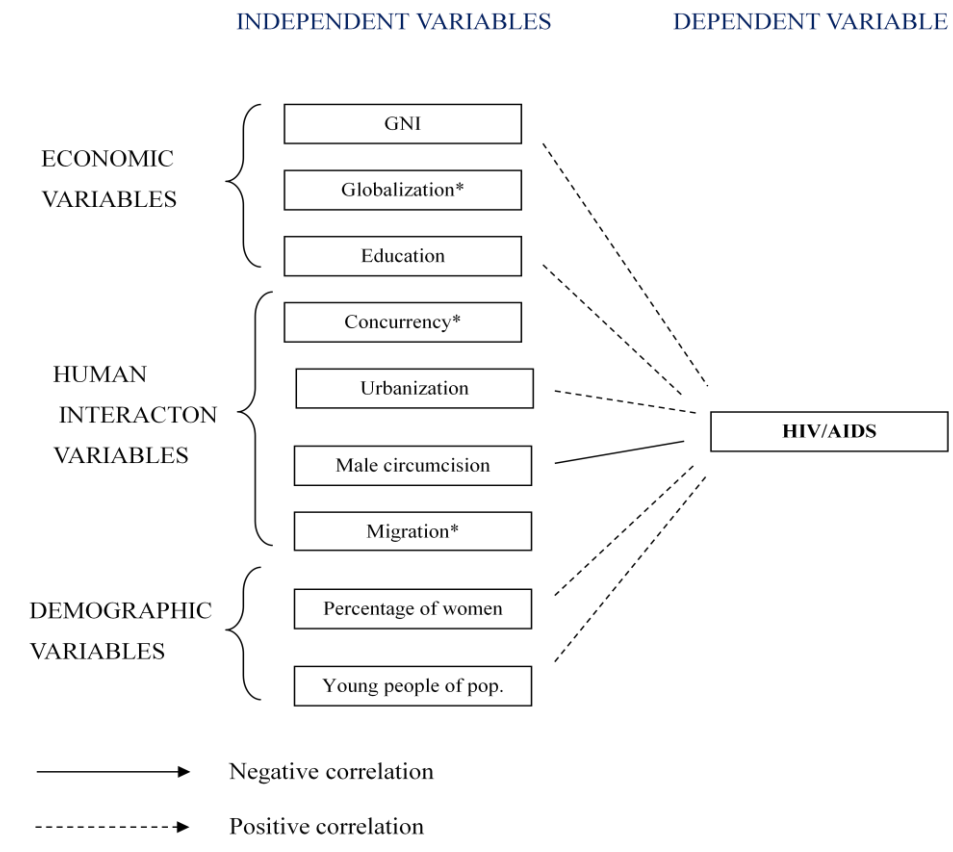


After controlling for these assumptions, discussing the risk for each of them and controlled and adjusted for heteroskedasticity by using robust standard errors the multiple regression models seem to be useful enough to be used for analysing, which the next section will precede.

6 DISCUSSION

In this section the result for each variable will be presented and discussed. Differences between the regressions will be highlighted and the hypothesis based on the theoretical framework is either rejected or accepted. Based on the result from the regression equations figure 2 shows the correlations between HIV/AIDS and each independent variable. It is based on the correlations which are of significance.

FIGURE 2. MODEL FOR THE RESULT



The lines represent the correlations to HIV/AIDS based on the result. The independent variables marked with * did not present correlations of significance and it is therefore difficult to make any conclusions about their correlation towards HIV/AIDS.

6.1 The economic variables

The economic variables are GNI, education and globalization. The hypotheses were that GNI had a positive correlation with HIV/AIDS while the other two had negative correlations with the dependent variable.

6.1.1 GNI

For variable GNI the economic regression showed a weak positive correlation towards HIV/AIDS, however, not significant. Regression equation 1 showed a significant, positive correlation to HIV/AIDS and regression equation 2 also shows a positive correlation with a significant p-value. The conclusion is that the correlation is weakly positive, which was in line with the literature. Therefore the hypothesis is accepted. This would imply that countries with higher GNI assumingly would have higher rates of HIV/AIDS. This might seem surprising, however, one prospect is that the economic development follows an inverted u-shape curve. After reaching a certain point of economic development the rates of HIV/AIDS would perhaps decrease. According to earlier studies the result might be due to e.g. the increased demand for travelling, which seem to be in line with increased levels of income, which assumingly affects the viral transmission rate but also could affect the sexual behaviour.

6.1.2 Globalization

Considering this variable the economic regression showed a negative correlation although not significant. The last two regressions showed weak positive correlations towards HIV/AIDS but neither of them were of significance. This makes it difficult to make any conclusions concerning globalization. The hypothesis can not be rejected or accepted based on the result.

6.1.3 Literacy rate

Literacy rate show, in the economic regression, a weak positive correlation to HIV/AIDS, which is of significance. The last two regressions show both weak positive correlations but neither of significance. The hypothesis which was based on the literature is therefore rejected. This might be explained by the correlation between for example mobility, which might be a result from higher education and is therefore, based on the result, assumed to increase sexual behaviour.

6.2 The human interaction variables

The variables of human interaction are concurrency, circumcision, migration and urbanization. The literature indicated that the hypothetical correlation would be positive for concurrency, urbanization and migration while the correlation between HIV/AIDS and circumcision would be negative.

6.2.1 Male circumcision

From the human interaction regression, male circumcision shows a strongly negative correlation, which was highly significant. Male circumcision, from regression equations 1 and 2, also showed strongly negative correlations to HIV/AIDS, highly significant for both regressions. This result was in line with the literature and the hypothesis was verified and accepted. This is one factor which seems to be of great importance considering the prevalence of the virus. That the significance levels are as high as presented despite the low sample size for regression equation is an indication that this result is fairly reliable. Rate of circumcision can be one explanation to the differences in HIV/AIDS rates between southern and northern Africa since it understandable affects the viral transmission rate. Since many countries in northern Africa have less rates of HIV/AIDS and many of the countries are Islamic which do practise circumcision this explanation is in line with the results.

6.2.2 Concurrency

The variable concurrency is the variable with a lot of missing data. This variable is included in the human interaction equation and in regression equation 2. The human interaction regression showed that there is a very weak negative association, however, not significant. For regression equation 2 the relationship is very weakly positive but neither this is significant. The reason why they are not significant might be explained by the low sample size. Usually when having low sample size the p-values are allowed to be higher and still interpreted to be of significance. Considering concurrency, however, the p-values are too high. Any statistical conclusions can therefore not be assumed, which is why the hypothesis can neither be rejected nor accepted.

6.2.3 Migration

This variable is consistently through the regressions negatively correlated to HIV/AIDS. Neither of the regression equations show significant results.

Considering that none of the results were of significance any predictions about the hypothesis, which assumed a positive correlation, can be made. The hypothesis can neither be rejected nor accepted.

6.2.4 Urbanization

This variable showed in the human interaction regression, a significant, weak positive correlation towards HIV/AIDS. Neither of regression equation 1 nor 2 showed correlations of significance but showed both weak positive associations. The hypothesis can therefore be accepted. By moving from the country-side into the cities where over-crowdedness and e.g. lack of sanitation affects the life conditions might affect the sexual behaviour according to the assumptions based on the theoretical framework. Poor women who leave the country-side hoping for work possibilities in the cities are in risk of being caught in prostitution, which is a highly risky activity concerning HIV/AIDS.

6.3 The demographic variables

The demographic variables include the two independent variables; percent of population younger than 15 years old and percent of the population whom are women. These two variables were both assumed to have a positive correlation to the prevalence of HIV/AIDS.

6.3.1 Young people in the population

The demographic regression equation presented a negative correlation between the variable young people in the population and HIV/AIDS, however, not significant. Regression equations 1 and 2 both showed weak positive correlations, whereas only regression equation 1 was significant. One explanation to this is the lower sample size in regression equation 2 which increases the significance levels. Since the positive correlation was the one significant the hypothesis is assumed to be accepted. As mentioned in the theoretical framework young boys and girls are unaware of the risks of practising unsafe sex and having sex in young ages is not uncommon leading to increased viral transmission rates.

6.3.2 Women in the population

All three regressions showed a positive correlation between HIV/AIDS and percent of women in the population. The human interaction regression showed

that the variable was highly significant and the last two regressions were also of significance. Therefore the hypothesis is accepted. This result is fairly reliable considering the significance levels despite the low sample size. The result can be explained, as written in the theoretical framework, by women being more vulnerable towards being infected and therefore affecting the viral transmission rate. This due to several reasons, both socially as well as biologically. Since differences between countries in percent of females of the population are not considerable this will probably not increase the understanding of the differences between the HIV/AIDS rate between the African countries. However, it implicates that information and protection should to some extent focus on females.

7 CONCLUSION

The aim of the thesis was to explore the determinants of HIV/AIDS in Africa. The chosen independent variables constituted the theoretical framework and were connected to the assumption; that to understand the transmission of HIV/AIDS sexual behaviour and viral transmission rate are essential. The independent variables were studied and examined through multiple regression equations. The conclusion is that a few of the determinants showed significant correlations towards HIV/AIDS based on the African countries in the sample.

The independent variable circumcision was through all regressions highly significant and showed a negative correlation towards HIV/AIDS. Another variable, highly significant, was percentage of women in the population, which showed a positive correlation towards HIV/AIDS. Both of these variables were highly significant despite of the low sample size, which increases the reliability of the result.

This is a very important field of research to highlight. Identifying causes to HIV/AIDS in Africa might be sufficient for the understanding of the variation of the prevalence within African countries. To comprehend the variation is of great importance to explain the path of the epidemic and to recognize the most effective policy interventions.

In sum, this thesis shows how difficult it is to make general conclusions. The result of this study is subject to some restrictions such as limited data and time. For future research it would be preferable to use data based on the same year and for all African countries, to be able to make more trustfully conclusions. An extension of the amount of variables such as condom use, alcohol consumption, the spread of information about HIV/AIDS and other social aspects would be motivating to examine. An expansion of this thesis, including a country-based survey, where examining micro-level aspects to a greater extent, combining qualitative and quantitative research would be preferable. Another limitation of the paper is the unawareness of the direction of the effect between the HIV/AIDS and the independent variables. This thesis can not inform whether it is HIV/AIDS affecting the independent variable or if it is the independent variable that is affecting the HIV/AIDS prevalence. There are ways to proceed in this matter, which also is a possibility for extending the original thesis. Furthermore, important to bear in mind is that HIV/AIDS prevalence presents a delayed picture of the epidemic since it reflects patterns of HIV/AIDS occurrence of several previous years.

Along the process I also came to question if some of the independent variables should be connected to viral transmission rate or sexual behaviour. One example is GNI, which is connected to viral transmission rate, but could also be connected

to sexual behaviour, however, this is something to elaborate and examine for the future. A few of the variables, mostly migration and urbanization were also closely linked in the theoretical framework but are both of importance in the research. A lot of empirical research is based on the southern Africa, which is why much of the theoretical framework is based on studies from this part of Africa. I am also aware of sometimes presenting empirical facts about Africa as one unit, which is something, since the differences between the African countries are huge, I tried to avoid but since this constitute a lot of the empirical research it was inevitable.

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*The quote in the introduction is from Palmberg Mai 1993. *AIDS i Afrika*. Nordiska Afrika institutet. In the book it is expressed in Swedish as: “Det är viktigare att veta vart aids är på väg än att veta varifrån den kommer”

9 APPENDIX 1

The 37 African countries that have constituted the research are: (the countries with missing data information for concurrency are emblazed with *)

Algeria*
Angola
Benin
Botswana*
Burkina Faso
Burundi*
Cameroon
Central African Republic
Chad
Republic of Congo
Côte d'Ivoire
Egypt*
Ethiopia
Gabon
Ghana
Guinea-Bissau*
Lesotho
Madagascar
Malawi
Mali
Mauritania*
Mauritius*
Morocco
Mozambique
Namibia
Niger
Nigeria
Rwanda
Senegal
Sierra Leone
South Africa
Sudan*
Swaziland*
Togo
Tunisia*
Uganda
Tanzania

10 APPENDIX 2

Map of Africa

Source: UN 2001