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# HIV/AIDS and the Economy in Southern Africa

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by

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# 1 Introduction

HIV/AIDS has eradicated decades of progress in sub-Saharan Africa. With 16 percent of its adult population infected with HIV, Southern Africa is most severely affected. (UNAIDS 2005) I will focus in particular on the six countries with current prevalence rates of over 20 percent: Botswana, Lesotho, Namibia, South Africa, Swaziland and Zimbabwe. Whenever possible, I will compare the experience of those countries to the experience of Uganda, an East African country, where the adult HIV prevalence rate peaked in 1992 at an estimated 18.3 percent (O'Manique 2004) and has since then decreased to 4.1 percent. (UNAIDS 2004c) I will start out with a medical background on HIV/AIDS, which is necessary for an understanding of the socio-economic effects of the disease, and a brief overview of the development of the epidemic in Africa and Southern Africa. I will then turn to an analysis of the socio-economic effects of HIV/AIDS. In my analysis of the demographic impact of HIV/AIDS, I will use seroprevalence rates of the general population whenever those are available, and seroprevalence rates of pregnant women attending antenatal clinics whenever only those are available. Several studies have shown that infection rates among pregnant women provide a reasonable overall estimate of HIV prevalence in the general adult population, although they underestimate the rates among all women while overestimating them among men. (Stanecki 2004) Like Papageorgiou and Stoytcheva (2004), I will then use the Cobb-Douglas production function, extended to include human capital, to analyze the effect of HIV/AIDS on output per worker. Finally, I will describe and qualify the results of

several studies that attempted to estimate the effect of HIV/AIDS has on per worker and per capita output.

## 1.1 Medical Background

After entering the human body, the Human Immunodeficiency Virus (HIV) immediately starts multiplying. It systematically weakens the immune system until the infected person can no longer fight opportunistic diseases, such as pneumonia, and dies. HIV is transmitted through body fluids in one of three ways: through sexual contact, through blood or through the transfer of the virus from an infected mother to her infant before or during birth or during breast feeding. (Du Bruyn 2004a) Once infected, a person experiences three general stages of the disease: During the incubation stage of HIV infection, which last 4 - 6 years, an HIV positive person shows no symptoms. (Du Bruyn 2004a) For the next 4 - 6 years, opportunistic infections occur at an increasing rate. (Du Bruyn 2004a) Finally, HIV develops into AIDS, marking the beginning of a period of various continuous infections and leading to death within the following year. (Du Bruyn 2004a) Because of this ten-year delay between infection and death, today's level of infections will still be visible in death rates ten years from now.

## 1.2 AIDS in Africa

Over the course of the past two decades, Africa has moved from being marginal to the AIDS epidemic to being the "global epicenter." (O'Manique 2004) (see Figure 1) Today, with an estimated 25 million of its people infected with HIV, sub-Saharan Africa accounts for just under two thirds of the world's HIV/AIDS cases, although representing a mere 10% of the world's population. (UNAIDS

2004b).

The disease first erupted in East Africa along the Great Rift Valley from Ethiopia to Central Mozambique, most notably in Uganda, in the late 1980s. (Epstein 2004) From there it spread south- and eastward, reaching Southern Africa in the early 1990s. (see Figure 2) There, the epidemic quickly exploded, leading to rapidly increasing HIV prevalence rates in the mid-1990s. (O'Manique 2004) In Botswana, for example, the prevalence rate among pregnant women has increased from 7 percent in 1991 (Stanecki 2004) to over 40 percent in 2004 (UNAIDS 2004a). In 2003, the average HIV prevalence in Southern Africa was 16 percent compared to much lower rates of 6, 4.5 and less than 0.1 percent in East, West and Central, and North Africa respectively. (UNAIDS 2005) (see Figure 3)

## 1.3 AIDS in Southern Africa

In six Southern African countries – Botswana, Lesotho, Namibia, South Africa, Swaziland and Zimbabwe – at least one in five adults is estimated to be living with HIV. (Epstein 2004) Botswana and Swaziland represent the countries with the highest adult seroprevalence rates, 37.3 and 38.8 percent respectively at the end of 2003, whereas South Africa represents the country with the greatest number of HIV infected people, 5,300,000 at the end of 2003. (UNAIDS 2004d, UNAIDS 2004h, UNAIDS 2004g) In recent years, HIV prevalence has been roughly stable across most of Southern Africa. (UNAIDS 2004b) This stabilization is no sign of relief, however. Instead, it disguises the worst phases of the epidemic, when the large numbers of people newly infected with HIV roughly

equals the large number of people dying from AIDS. (UNAIDS 2004b)

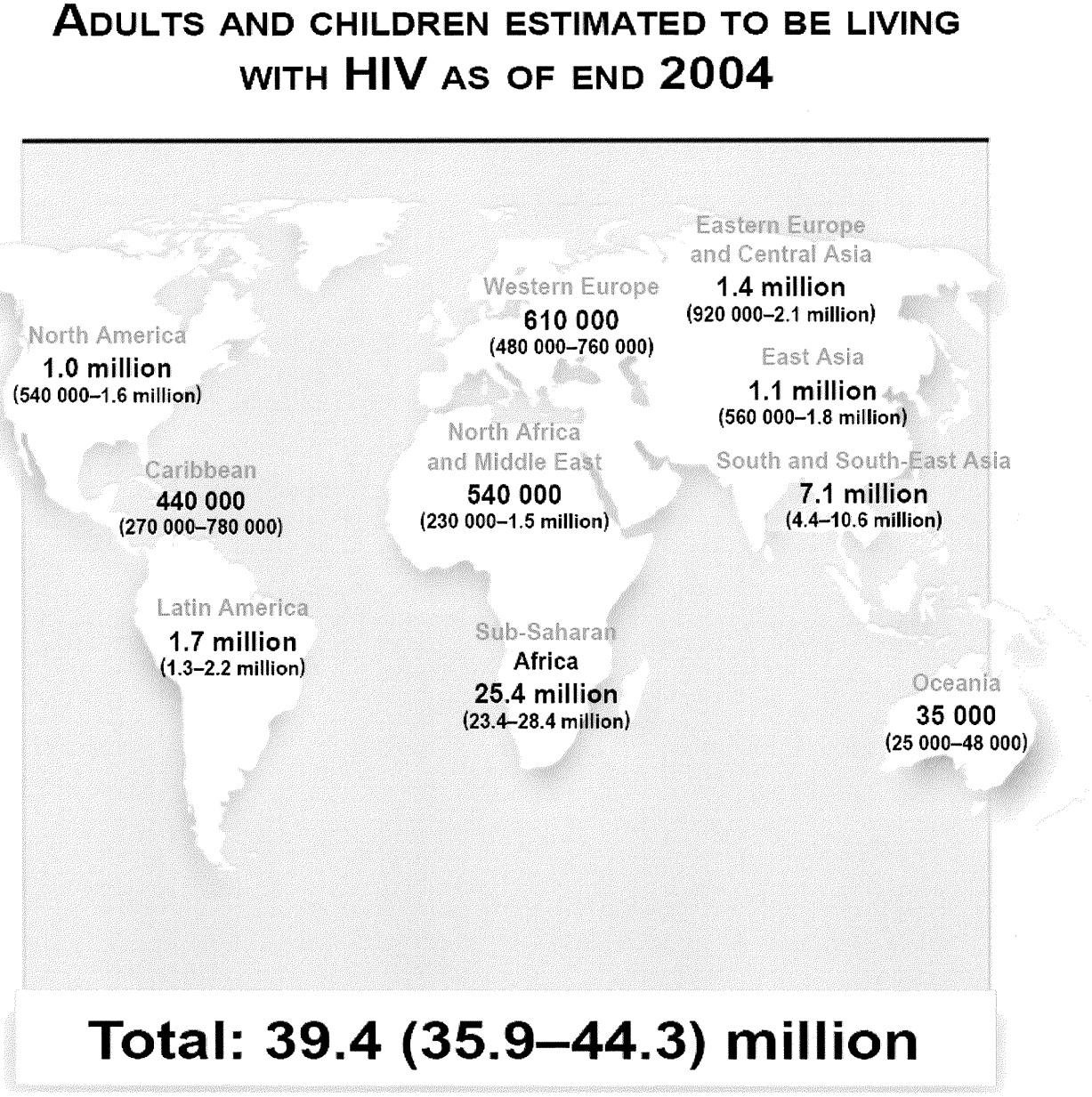
I was unable to find a definite pattern of socio-economic factors that explains the rapid spread of HIV in the six worst affected Southern African countries. UNAIDS (2004a) notes that in the context of widespread impoverishment and high unemployment, sexual relationships gain importance in people's lives because they serve as opportunities for enhancing self-esteem and peer status, and for relieving boredom. Even though this finding could in part explain the high infection rates in low-income countries like Lesotho and Zimbabwe, it is inconsistent with the similarly high or even higher infection rates in middle-income countries like South Africa and Botswana. (UNAIDS 2004d, UNAIDS 2004g, UNAIDS 2004h, UNAIDS 2004i)

Other factors, such as illiteracy rates and the current knowledge of HIV prevention methods, also fluctuate across the six countries. Whereas 33 percent of males and 40 percent of females in Botswana are able to identify two ways of preventing the sexual transmission of HIV and to reject three misconceptions about HIV transmission, only 20 percent of males and 18 percent of females were able to do so in Swaziland. Nevertheless, those two countries have almost identical HIV infection rates. (UNAIDS 2004d, UNAIDS 2004h)

Religious beliefs also fail to give a conclusive reason for the consistently high infection rates across Southern Africa. Whereas more than two thirds of South Africans are Christian, 85 percent of Botswanians hold indigenous beliefs. (UNAIDS 2004d, UNAIDS 2004g) Lesotho, Namibia, Swaziland and Zimbabwe

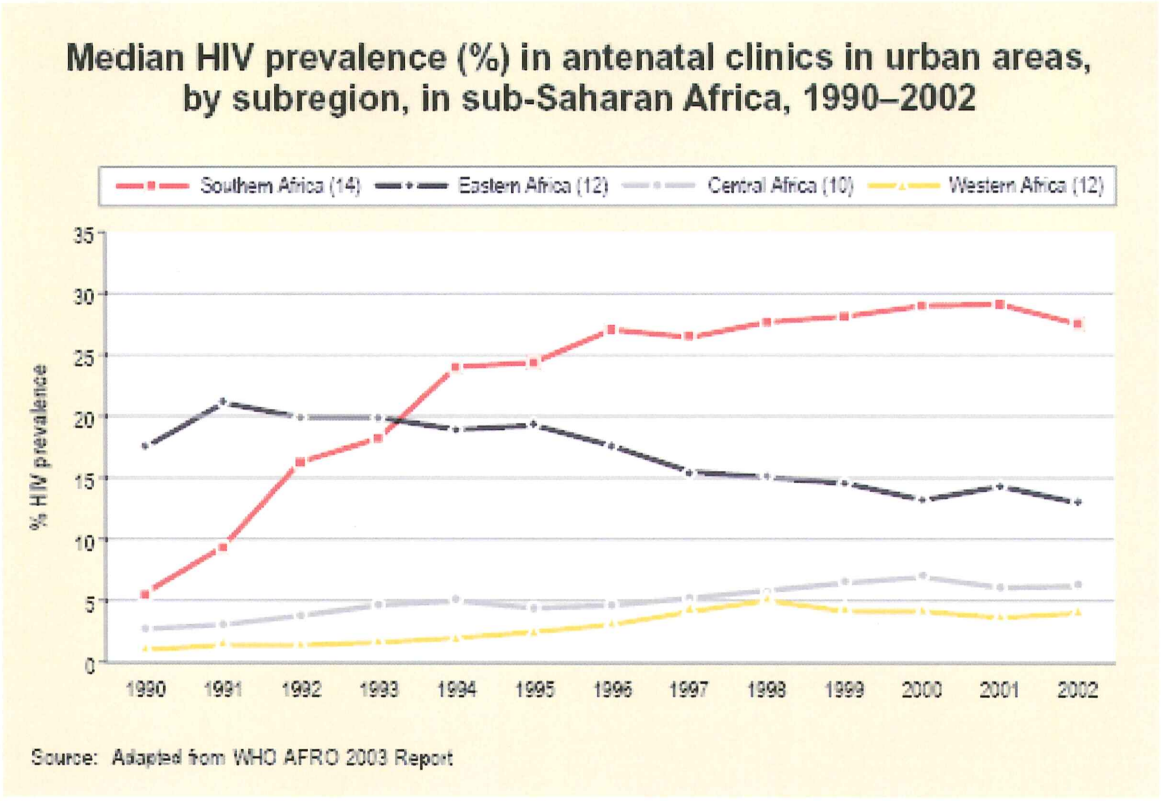
are characterized by a combination of Christian, indigenous and other beliefs. The only consistency across all countries is that none of them has a significant Muslim population. Considering that many northern African countries have a Muslim majority and much lower HIV prevalence rates, this finding supports the conclusion that Islam has a preventive impact on the spread of HIV.

**Figure 1**



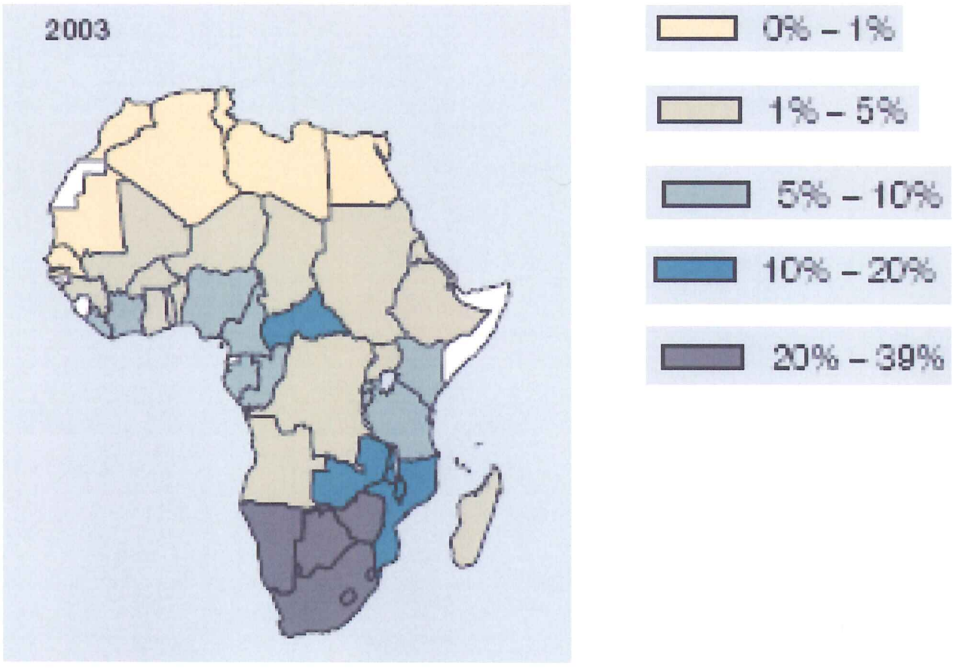

Source: UNAIDS (2004b)

**Figure 2**




Source: UNAIDS (2004b)

**Figure 3**




Source: UNAIDS (2005)

# 2 The Socio-Economic Consequences of HIV/AIDS

## 2.1 Demographic Impact

HIV/AIDS has already changed the demographics of the worst affected countries in Southern Africa. If current trends in HIV seroprevalence continue into the near future and existing relationships between AIDS mortality continue to hold, the AIDS pandemic will dictate the size, growth and age-sex structures of the entire region. (Stanecki 2004)

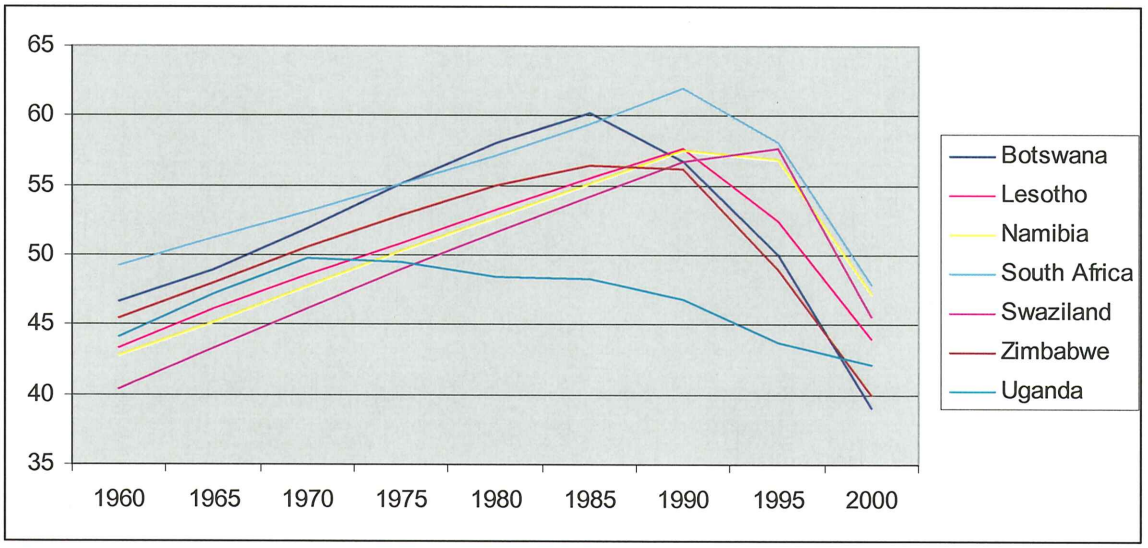
### 2.1.1 Life Expectancy

Following a continuous upward trend, life expectancy has plummeted in all Southern African countries as a result of HIV/AIDS. Average life expectancy across the region decreased from 62 years in the period from 1990 to 1995 to 48 years in the period from 2000 to 2005. (Deen 2005). The fall has been most dramatic in the countries with the highest income per capita and highest original life expectancy – Botswana and South Africa. In Botswana the rate dropped from 61 years in 1987 to 38 years in 2002. In South Africa, it dropped from 63 years in 1992 to 46 years in 2002. (see Figure 4) The U.S. Census Bureau estimates that the 2002 life expectancies for Botswana and South Africa would have been 74 and 66 in the absence of AIDS. (see Table 1)

Over the next decade, life expectancy across the area is projected to fall further to about 43 years (Deen 2005), and to near 30 years in the worst affected countries (Stanecki 2004), before a slow recovery starts. For Botswana and South Africa, the U.S. Census Bureau estimates life expectancy to fall to 27 and

37 years respectively by 2020, compared to 72 and 66 years had AIDS never occurred. (see Table 2) Although the U.S. Census Bureau estimates seem a little extreme – the U.S. Census Bureau estimates current life expectancy in Botswana to be 4 years below the UNAIDS figure, for example – they provide some notion of the tremendous impact AIDS currently has and is going to have in the future. The case of Uganda further supports the prediction that life expectancies in Southern Africa will still decline significantly. Life expectancy in Uganda, where the epidemic peaked in 1992, kept falling until 2000, when it reached 42 years, and has since then risen to 49 years. (UNAIDS 2004c)

**Figure 4**




Source: Word Development Indicators (2002)

## 2.1.2 Crude Death Rates

The dramatic decline in life expectancy is directly related to a steep rise in crude death rates. Crude death rates measure the number of deaths per 1,000 people and represent the most directly felt impact of the AIDS epidemic in the severely affected populations. Even though mortality due to non-AIDS causes will

continue to decline, crude death rates in many sub-Saharan African countries are projected to rise above their current levels because of AIDS. (Stanecki 2004)

The U.S. Census Bureau predicts the net increase in crude death rates due to AIDS to be larger in 2010 than in 2002 for the six worst affected Southern African countries. (see Tables 1 and 2) There are two reasons for this predicted increase. First, in all countries crude death rates are expected to increase because of an increasing number of AIDS deaths. Second, in the absence of AIDS, crude death rates for all countries would have decreased due to better expected health. The net increase in Uganda's crude death rate is expected to stay constant because the number of AIDS deaths will continue to decline and because the crude death rate would have been lower in 2010 than in 2002 in the absence of AIDS.

The consistent increase in mortality across Southern Africa will have a tremendous effect over the upcoming decades. In South Africa, 36 percent of today's 20-year-old males and 54 percent of today's 20-year-old females will fail to see their fortieth birthday. (Bell 2004) At the onset of the AIDS pandemic in 1990, when the infection rate was less than 1 percent (UNAIDS 2004g), those proportions were much lower at 11 and 4 percent. (Bell 2004). As a result, UNAIDS (2004) predicts the populations of the worst affected Southern African countries to be more than one third smaller by 2025 than they would have been in the absence of AIDS. Estimates for South Africa are shown in Figure 5.

**Table 1**

**Demographic Characteristics With and Without AIDS: 2002**

| | Life expectancy at birth | | | Crude death rate | | |
|---|---|---|---|---|---|---|
| | With AIDS | Without AIDS | Net decrease | With AIDS | Without AIDS | Net increase |
| Botswana | 33.9 | 72.4 | 38.5 | 28.6 | 4.8 | 23.8 |
| Lesotho | 37.1 | 64.4 | 27.3 | 24.4 | 8.2 | 16.3 |
| Namibia | 45 | 65.8 | 20.9 | 17.6 | 7 | 10.6 |
| South Africa | 48.8 | 66.3 | 17.5 | 16.6 | 7.3 | 9.3 |
| Swaziland | 41.4 | 72.6 | 31.1 | 19.3 | 4.1 | 15.2 |
| Zimbabwe | 40.2 | 69 | 28.8 | 20.8 | 5.4 | 15.4 |
| Uganda | 44.5 | 56 | 11.5 | 17.3 | 11.6 | 5.7 |

Source: U.S. Census Bureau (2004)

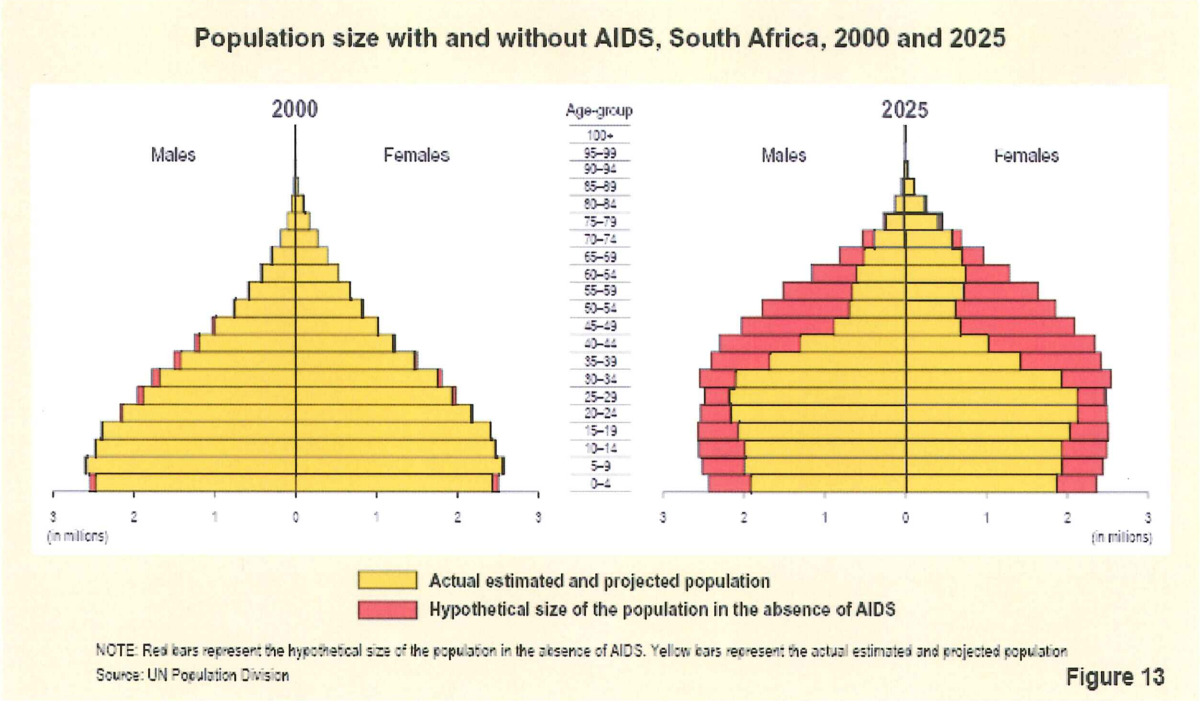
**Table 2**

**Demographic Characteristics With and Without AIDS: 2010 (Forecast)**

| | Life expectancy at birth | | | Crude death rate | | |
|---|---|---|---|---|---|---|
| | With AIDS | Without AIDS | Net decrease | With AIDS | Without AIDS | Net increase |
| Botswana | 26.7 | 74.4 | 47.7 | 42.8 | 4.2 | 38.6 |
| Lesotho | 36.5 | 67.2 | 30.6 | 26 | 7.1 | 18.8 |
| Namibia | 33.8 | 68.5 | 34.8 | 28.1 | 5.7 | 22.2 |
| South Africa | 36.5 | 68.4 | 31.9 | 30.1 | 7.2 | 22.9 |
| Swaziland | 33 | 74.6 | 41.6 | 28.8 | 3.8 | 25.1 |
| Zimbabwe | 34.6 | 71.4 | 36.9 | 27.4 | 4.8 | 22.6 |
| Uganda | 46.8 | 59.2 | 12.3 | 15.2 | 9.5 | 5.7 |

Source: U.S. Census Bureau (2004)

**Figure 5**




Source: UNAIDS (2004b)

## 2.1.3 Age-Sex Structures

Although shocking, decreases in life expectancy and increases in mortality fail to convey the full extent of the disastrous effect HIV/AIDS has on the economic well-being of severely affected countries. HIV is not evenly distributed throughout national populations. By primarily affecting young adults, particularly women, (UNAIDS 2004b) the disease is hitting Southern Africa where it hurts the most. If the current epidemic trends continue, there will be far fewer people in their mid-adult years over the next two decades and possibly even further into the future. (UNAIDS 2004b) Therefore, HIV/AIDS affects the most productive portion of the workforce, which becomes obvious by looking at the distorted population pyramid for South Africa in 2025 in Figure 5.

Unlike most other regions in the world, where HIV/AIDS is concentrated in high risk populations such as sex workers and their clients, homosexuals as well as injecting drug users, sub-Saharan Africa is experiencing generalized epidemics. (UNAIDS 2004) Therefore, Southern-African women are proportionally more affected than women in other regions of the world. Of all Southern-Africans infected with HIV, 57% are female. In the age group 15-24, the proportion is even higher: A striking 76% of young people living with HIV are female. (UNAIDS 2004a) In four countries in sub-Saharan Africa – Kenya, Malawi, Zambia and Zimbabwe – female life expectancy even fell below male life expectancy during the period from 2000 to 2005. (UNAIDS 2004b)

In sub-Saharan Africa heterosexual intercourse is the predominant mode of HIV transmission. (UNAIDS 2004b) During this type of intercourse, women face a higher risk of contracting the virus than men, especially during violent or forced intercourse. Furthermore, women are infected earlier in their lives than men because they tend to have sex with older men, who have already had numerous sexual partners, hence being more likely to have contracted HIV. (UNAIDS 2004b) Marriage does not prevent women from being infected with the virus because vast numbers of men have sex with sex workers in addition to their wives, and married couples are unlikely to use condoms. As a result, married 15-19-year-old females have higher HIV-infection levels than non-married sexually active females of the same age. (UNAIDS 2004b)

## 2.2 Impact on Output

Whereas the effect of HIV/AIDS on total output is apparently negative

because of the reduction in labor alone, its effect on per capita output is less obvious. A reduction in labor supply could lead to an increase in the amount of capital available to each worker, hence increasing output per worker, which should be closely related to output per capita. In the case that labor and capital are complements rather than substitutes, however, a reduction in labor supply would lead to a less efficient use of available capital, hence decreasing output per worker.

In order to explore the effect of HIV/AIDS on output per worker in more detail, I will use an extended version of the Cobb Douglas production function, which includes human capital. Output in the extended Cobb Douglas production function is described by $Y=AK^{\alpha}(hL)^{1-\alpha}$. Output per worker, therefore, is expressed by $y=Ak^{\alpha}h^{1-\alpha}$. I will start my analysis by examining the effect HIV/AIDS has on each component of output per worker: total factor productivity, physical capital per worker and human capital per worker. The constant α, which is about 0.3, is assumed not to be affected by the AIDS pandemic. Then I will use the concept of the dependency ratio to relate output per worker to output per capita. Lastly, I will use the insight I have gained in my analysis to qualify the results of several recent studies on this topic.

### 2.2.1 Human Capital

HIV/AIDS not only erodes the existing abilities and capacities embodied in its victims but also weakens the mechanism through which human capital is formed in the next generation and beyond. Therefore, even if Southern Africa finds a way to control the epidemic, its human capital will take decades to

recover. This long-run effect on human capital levels distinguishes HIV/AIDS from other major epidemics like the Black Death of the 1300s and emphasizes the extent of lasting damage it can afflict on Southern Africa.

The AIDS pandemic may affect Southern Africa's ability to produce education and to effectively use it for economic growth. (Birdsall 2004) Although education alone is not sufficient for faster growth, it contributes to higher productivity on the micro-level, hence giving disadvantaged members of society the opportunity to improve their status. (Birdsall 2004) HIV/AIDS affects both the supply of and the demand for education. Since educators are among the hardest hit professions, the formation of human capital is endangered. (UNAIDS 2004b) For countries like Botswana, Namibia, South Africa and Zimbabwe the required number of new teachers had already increased by between 65 and 119 percent by 2000. (Haacker 2002) In order to make up for the loss of teachers, affected countries must find ways to retain more of their scarce human capital in the education sector, either by increasing salaries and hence the fiscal burden, or by decreasing educational requirements for teachers. (Birdsall 2004) These solutions become even less desirable considering that they both reduce the supply of human capital in the productive sector, which is also experiencing shortage of human capital.

At the same time as the supply of education is shrinking, the demand for education is decreasing. Besides the obvious fact that affected families oftentimes cannot afford to send their children to school, there are other reasons. The dramatic decreases in life expectancy across Southern Africa have

decreased the expected returns to education. Even though there have been no studies on the effect of a decrease in life expectancy on the demand for education, studies on the effect of increases in life expectancy have suggested that a ten-year increase in life expectancy is associated with a 0.3 to 0.6 year increase in schooling completed. (Birdsall 2004) It is therefore quite plausible that shortened time-horizons lead to decreases in human capital.

Education takes place not only in school but also at home. Parents pass on skills and experience to their children. By 2010, only 29 percent of South African children will grow up with both parents, compared to 86 percent if the AIDS pandemic had never occurred. (Bell 2004) Nineteen percent will be completely orphaned; the remaining 52 percent will grow up with only one parent. (Bell 2004) The loss of mothers has an especially detrimental effect. In Manicaland, Zimbabwe, for example, a study showed that the death of a woman lead to the dissolution of the household in two out of three cases. (UNAIDS 2004b) The children of these households are not only less likely to receive formal education in school, but they are also lacking the informal education by their parents. Many of them are forced to provide care to their sick parents and to start working to provide for themselves and younger siblings. (UNAIDS 2004b)

Results on whether skilled or unskilled labor is more affected by the AIDS pandemic vary. Birdsall (2004) finds that HIV was more likely to infect the relatively well educated, at least for the first decade. In South Africa, unskilled labor has higher infection rates than skilled labor. (Haacker 27) Since the country is experiencing a surplus of unskilled labor with an unemployment rate of 26

percent, (UNAIDS 2004g) this seems to relieve economic concerns. Du Bruyn (2004b) notes, however, that the possible transfer of skills and knowledge from skilled to unskilled labor will not take place because of the decreased returns to human capital. The pool of skilled labor, which is already in short supply, will therefore shrink. Bell (2004) estimates that if the current scale of mortality continues, South Africa will be "full of uneducated adults in two generations." As a result, average family income would be about half its 1990 value. Had the AIDS pandemic never occurred, he estimates that it would have quadrupled by 2080. (Bell 2004)

No matter whether skilled or unskilled labor is more affected, however, there is a broad consensus in the literature that the effect of HIV/AIDS on human capital per worker will be severe, long-lasting and negative.

### 2.2.2 Physical Capital

The amount of physical capital available to each worker is determined by the investment rate, the depreciation rate, and the population growth rate. Whereas depreciation remains constant, both investment and population growth in Southern Africa are affected by the high HIV infection rates.

A country's investment rate is assumed to be equal to the country's savings rate. Due to increased costs and lost revenue, both public and private savings have decreased due to HIV/AIDS. In South Africa, for example, an estimated 5 percent of GDP will be used to cover AIDS related expenses by 2010 (Haacker 2002), hence not being available for consumption or investment.

Government expenditures have increased due to increases in personnel

cost and health sector spending. (Haacker 2002) In Swaziland, for example, the cost of sick leave and death-related benefits is projected to make up 14% of the public sector wage bill by 2010. (Haacker 2002) In addition, more than half of all hospital beds in many Southern African countries are occupied by HIV positive patients. (Haacker 2002) Government revenue has declined and will further decline relative to a no-AIDS scenario because of a less rapidly increasing or even shrinking tax base, which includes components such as income, company profits, imports and consumption, and a decline in tax collection rates due to personnel losses. (Haacker 2002)

Companies are also facing increases in costs due to HIV/AIDS: direct costs, which include absenteeism, sick leave and disability pensions, medical care, pensions to surviving dependents, loss of productivity as well as funeral cost and attendance; and indirect costs, most importantly decreases in returns to training. For each percentage point of AIDS cases among employees, a company's direct costs increase by 1 to 2 percent of the company's total wage bill. (Haacker 2002) In South Africa's mining industry, for example, where certain mines are experiencing infection rates as high as 45 percent, (Du Bruyn 2004b) this effect will have a tremendous effect. Gold Fields Limited, South Africa's second largest gold mining company, estimated in 2002 that HIV/AIDS will increase the cost of an ounce of gold by $10. (Du Bruyn 2004b)

Just like shortened time horizons negatively impact investment in human capital, they negatively impact investment in physical capital. As the prospect of retirement becomes less likely, savings rates are likely to fall. (Bloom 2004)

Making matters worse, the expected rate of return on investment is likely to decline due to a fall in productivity, a possible increase in the capital labor ratio and an increase in risk owing to the instability and uncertainty brought to the market by HIV/AIDS. (Haacker 2002, Du Bruyn 2004b) Besides further lowering domestic investment, the fall in expected return deters foreign direct investment. Foreign companies also might decide not to invest in countries with high HIV prevalence rates because of the threat to their own workers, higher labor turnover and the likely loss of trained workers. (Bloom 2004)

Whereas a reduction in the investment rate decreases physical capital per worker in the Solow Model, a fall in the population growth rate increases capital per worker. The population growth rates of the hardest-hit Southern African countries have dropped by between 0.6 and 1.5 percent due to higher death rates and lower fertility as a result of HIV/AIDS. (Haacker 2002) By 2010, the populations of five of the six countries – Botswana, Lesotho, South Africa, Swaziland, and Zimbabwe –are projected to decrease. (Stanecki 2004) Even in South Africa, where the population is expected to grow in spite of the epidemic, HIV/AIDS has a clear negative effect on population growth. (see Figure 5) By increasing mortality and decreasing fertility, the epidemic will lead to populations being more than one-third smaller by 2025 than in the absence of AIDS in the six hardest-hit countries in Southern Africa. (UNADS p. 57)

Since HIV/AIDS reduces both the investment rate, which is positively related to capital per worker, and the population growth rate, which is negatively related to capital per worker, capital per worker might rise or fall. Most

researchers agree that the capital-labor ratio will increase, although they disagree on whether a rise in the capital-labor ratio will lead to an increase in output like in the Cobb-Douglas production function. (Bell 2004, UNAIDS 2004b)

### 2.2.3 Total Factor Productivity

Declines in output per worker that are not explained by decreases in the factors of production, are due to losses in productivity. Productivity, which can be broken down into technology and efficiency, is the effectiveness with which factors of production are converted into output. (Weil 2005) HIV/AIDS will decrease Southern Africa's level of technology as well as efficiency on both the micro and macro level of the economy.

Since Southern Africa represents a developing region of the world, it imports most of the technology it uses from more advanced countries. By decreasing human capital, the AIDS pandemic impedes this transfer of technology now and in the years to come. Just as "education speeds technological diffusion," (Nelson 1966) losses in human capital slow technological diffusion because countries will stop importing new technologies, when they are lacking the skilled personnel required to operate it.

Efficiency on the micro level decreases because firms have to face an increasing number of disruptions to the production process due to absenteeism. They not only have to cope with the loss of HIV positive employees, who become sick and eventually die, but also with the absence of healthy workers, who spend more and more time caring for the sick and attending funerals. (Du Bruyn 2004b)

A study conducted by the South African Bureau for Economic Research in late 2003 indicated that 39 percent of companies noticed a significant increase in absenteeism over the past few years. (Du Bruyn 2004b) The Center for Health and Development of the University of Boston attempted to quantify that effect. In its study, which encompassed six formal sector companies in South Africa and Botswana, it found that HIV/AIDS victims took an additional 15 days of paid sick leave in their second to last year of employment and an additional 35 days in their final year. (Du Bruyn 2004b)

After the death of an employee, his or her position needs to be filled. In addition to the loss of skills and experience and the additional training costs, companies have to endure a period of vacancy, which can be quite long due to the general shortage of skilled workers and management-level staff in Southern Africa. (UNAIDS 2004b) According to the Boston University study, companies require an average of about seven weeks to fill positions that require a skilled worker and about eleven weeks to fill managerial positions. (Du Bruyn 2004) During the period of vacancy, the lack of a skilled worker slows down or interrupts the production process because the duties of the deceased have to be carried out by his or her coworkers. The lack of a supervisor or manager has even graver implications, decreasing morale and productivity across entire sections of unsupervised, uninstructed workers.

Efficiency on the macro level decreases because the AIDS epidemic causes an erosion of public institutions. Just like private sector companies, governments are losing skilled staff. This loss not only hinders the delivery of

vital public services previously provided, it also prevents an effective response to the HIV/AIDS crisis. (UNAIDS 2004b) Market failures, such as the provision of a suboptimal level of schooling, can no longer be corrected. (Bell 2004)

Relative to a no-AIDS scenario, the level of technology in Southern Africa falls due to a slowing of technological diffusion. Efficiency also decreases as a result of absenteeism and periods of job vacancies in the individual firms as well as an erosion of public institutions. Hence, total factor productivity declines due to HIV/AIDS, causing output per worker to fall proportionally.

### 2.2.4 Dependency Ratio

The Cobb-Douglas production function is a model of output per worker, not output per capita. Because of the distortions in age structure caused by the AIDS pandemic, the change in output per capita will not be identical to the change in output per worker. In order to capture more accurately the change in a typical individual's available income, I will translate output per worker into output per person using the concept of dependency ratios. Dependency ratio is conventionally defined as the ratio of the number of individuals below the age of 15 or above the age of 50 to the number of individuals in-between those ages. (Haacker 2002)

Haacker (2002) predicts that dependency ratios will initially increase across Southern Africa because most AIDS victims are part of the working age population. In South Africa, for example, the Department of Labor expects 3 percent of the country's workforce to be in the terminal stages of AIDS by 2010.

(UNAIDS 2004b) Over the course of the epidemic, this effect will add up to a total decrease of up to 35 percent of the workforce by 2020 in South Africa and the other similarly affected countries. (UNAIDS 2004b)

In the later stages of the epidemic, dependency ratios may start to fall again as birth rates decline. (Haacker 2002) Many women will die during their reproductive years, hence not having any or not as many children as they would have had otherwise. In addition, HIV positive women who survive through their child-bearing age will have fewer children because HIV lowers the fertility of its victims. (Haacker 2002) If the fall in birth rates decreases the non-working-age population sufficiently, it might make up for the decline in the working-age population. As a result the dependency ratio would fall.

### 2.2.5 Research Findings

In my analysis, I found that the effect of HIV/AIDS on output per worker depends on whether the decrease in the population growth rate makes up for the decrease in the investment rate as well as the losses in human capital per worker and productivity. If α in the Cobb-Douglas production function is equal to 0.3, as conventionally assumed, output per worker is expressed as $y=Ak^{0.3}h^{0.7}$, meaning that productivity and human capital per worker are given more weight than physical capital per worker. A possible increase in capital per worker is therefore less significant than a decrease in productivity and human capital of the same proportion. Unless the depressing effect of HIV/AIDS on population growth is very large, output per worker will decrease. Output per person will fall even

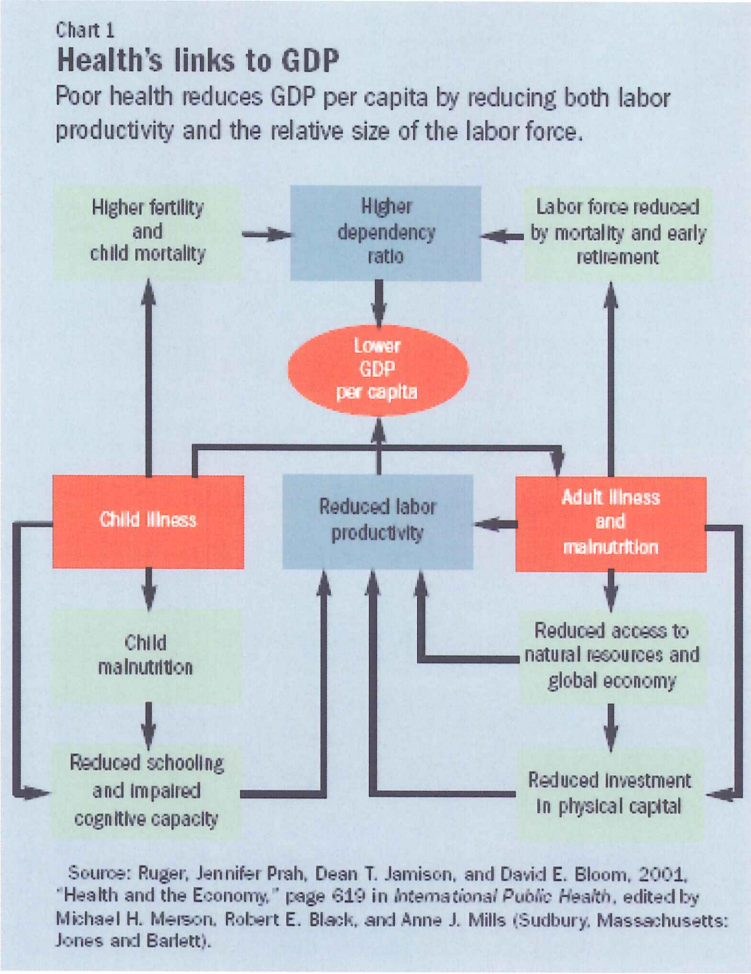
further since dependency ratios are expected to rise, at least in the near future. Do recent studies support the conclusion that HIV/AIDS reduces output per worker?

Papageorgiou and Stoytcheva (2004) find that HIV/AIDS will have a negative effect on output per worker. Using the Solow Model – extended for human capital – they estimate that an increase in AIDS incidence by 1 in 100,000 people is associated with a 0.003 - 0.004 percent decrease in per worker income. For the six Southern African countries with seroprevalence rates between 21.3 percent (Namibia) and 38.8 percent (Swaziland), this estimation would mean a decrease in per worker income by between 0.6 - 0.9 percent to 1.2 - 1.6 percent. Since this estimate considers only people currently infected with HIV, hence excluding AIDS victims who are already deceased and people who will be infected in the future, the total effect on income over the entire lifespan of the epidemic will be considerably larger.

David Bloom, who previously concluded that the AIDS epidemic has had an insignificant effect on the growth rate of income per capita, (Bloom 1997) states in a newer article that "the effect of HIV/AIDS on GDP per capita [in Sub-Saharan Africa] could eventually prove devastating" (Bloom 2004) as a vicious cycle is created, "with health declines setting off impoverishment and further ill health." (Bloom 2004) Figure 25 depicts Bloom's view of how poor health reduces GDP by reducing labor productivity and increasing the dependency ratio through a variety of channels. All his findings are in line with the results of my analysis and support the conclusion that HIV/AIDS has a negative effect on

income per capita across Southern Africa.

**Figure 6**




Source: Bloom (2004)

Haacker (2002) reports the results of four recent studies, two of which support the position that HIV/AIDS negatively impacts per capita incomes. In one of those studies, Arndt and Lewis (2000) construct an economy-wide simulation model for South Africa to compare an AIDS scenario to a hypothetical no-AIDS scenario using demographic estimates for the impact of the epidemic along with assumptions about behavioral and policy responses. Their simulation predicts that GDP per capita in South Africa will fall by 8 percent over the simulation

period from 1997 to 2010 with a decline in total factor productivity accounting for 2.7 percent, a fall in national savings accounting for 3.6 percent and decreases in household and government spending accounting for the remaining 1.7 percent.

Bonnel (2000) hypothesizes that the AIDS epidemic prevents an increasing share of the population from participating in economic growth, hence decreasing physical, human and social capital. Analyzing data from those sub-Saharan African countries for which data is available for the period from 1990 until 1997, he estimates that HIV/AIDS has reduced the growth rate of income per capita in a typical sub-Saharan African country with a prevalence rate of 20 percent by 2.6 percent per year.

The other two studies mentioned by Haacker (2002) find that HIV/AIDS has a positive effect on per capita income. ING Barings (2000) first models demographic changes that are likely to occur over the course of the epidemic, then conducts long-term economic forecasts to predict the impact of HIV/AIDS on macroeconomic variables in South Africa over the period from 2000 to 2015. Focusing heavily on the demand side of the economy by assuming that AIDS-related expenditures stimulate demand, the study predicts that annual GDP growth will be only 0.2 to 0.4 percent lower than it would have been had AIDS never occurred. Since ING Barings estimates population growth rates to be between 0.3 and 1.7 percent lower due to AIDS over the same period, annual GDP per capita growth will be between 0.1 and 1.3 percent higher than in the absence of HIV/AIDS.

The South African Bureau for Economic Research (BER) (2001) takes a similar approach, analyzing the impact of HIV/AIDS on five key macroeconomic channels and then combining the model for aggregated simulation results. The BER estimates that real GDP per capita growth in South Africa will be on average 0.7 to 1.0 percent higher for the years from 2002 to 2015 because GDP growth will decline only modestly by 0.3 to 0.6 percent, while population growth will fall by 1.3 percent. The modest estimate regarding the fall in GDP growth rests on the assumptions that HIV/AIDS leads to an increase in capacity utilization, a shift of about 5 percent of the labor force into the formal sector and the implementation of more productive technologies as firms seek to offset labor losses.

The arguments supporting the conclusion that HIV/AIDS has a positive effect on output per worker are unconvincing. ING Barings' prediction rests on the claim that AIDS-related expenses stimulate demand. In my analysis, I found that, although families have to spend more money on AIDS victims, their budget constraint forces them to save less and to decrease spending in other areas, such as schooling. Therefore, they are simply reallocating their budget. Even in the case that they borrow money to finance AIDS-related expenses, they are hardly stimulating the economy, since those borrowings are not used for productive investments but to cover costs that would have never occurred in the absence of AIDS.

The claim made by the South African Bureau for Economic Research that increased capacity utilization, the movement of some workers from the informal

to the formal sector and the implementation of new technologies will increase output per worker is also unconvincing. Various studies have shown that capital and skilled labor are complements. (Bell 2004, UNAIDS 2004b) Given that capital and unskilled labor are substitutes, HIV will only lead to an increase in the capacity utilization in the unskilled sector, which means a rise in the ratio of capital to unskilled labor. Furthermore, South Africa has a vast supply of unskilled labor, which is demonstrated by the movement of workers from the informal to the formal sector. Hence, the increase in capacity utilization in the unskilled sector cannot be very large. The second argument is also invalid. The movement of workers from the informal to the formal sector might keep output in the formal sector – and hence measured GDP – constant. However, total output from both the formal and the informal sector – and hence actual income – has to decline because the informal sector shrinks and the formal sector remains the same. The third argument can also be dismissed. Since HIV/AIDS hinders technology diffusion, (Nelson 1966) South Africa's level of technology will likely be lower – not higher – than in the absence of AIDS.

## 3 Conclusion

Through my analysis, I have found that HIV/AIDS has a considerable demographic impact on Southern Africa. Vast decreases in life expectancy, increases in crude death rates, especially among the young, working-age population, and distortions in age-sex structures lead to economic problems.

Although not conclusive, my analysis of the effect of the epidemic on income per capita has lead me to the prediction that HIV/AIDS has a negative

impact on income per capita in Southern Africa. Productivity and human capital per worker are expected to decrease significantly, whereas physical capital per worker will likely increase. The Cobb-Douglas production function gives more weight to productivity and human capital per worker than to physical capital per worker, suggesting an overall decrease in output per capita.

While some recent studies support my conclusion, others contradict it. The studies that find that HIV/AIDS has a positive effect on output per worker, however, exhibit serious flaws in their reasoning. Therefore, I dismiss them as unlikely and predict that per capita incomes across Southern Africa will be lower due to HIV/AIDS than they would have been had the epidemic never occurred.

## Bibliography

Arndt, Channing and Jeffrey D. Lewis. (2000). "The Macro Implication of HIV/AIDS in South Africa: A Preliminary Assessment," *South African Journal of Economics, 2000.*

Bell, Clive, Shantayanan Devarajan and Hans Gersbach. (2004). "Thinking About the Long-Run Economic Costs of AIDS." *The Macroeconomics of HIV/AIDS*, Ch. 3, 96-133.

Birdsall, Nancy and Amar Hamoudi. (2004). "AIDS and the Accumulation and Utilization of Human Capital in Africa." *The Macroeconomics of HIV/AIDS*, Ch. 4, 134-166.

Bloom, David E. and Ajay S. Mahal. (1997). "Does the AIDS Epidemic Threaten Economic Growth?," *Journal of Econometrics 77, 105-124.*

Bloom, David E., David Canning and Dean T. Jamison. (2004). *Finance and Development*, March 2004, International Monetary Fund.

Bonnel, Rene. (2000). "HIV/AIDS: Does it Increase or Decrease Growth?," *South African Journal of Econometrics.*

Deen, Thalif. (2005). "Deaths Outnumber Births as AIDS Ravages Southern Africa," *Inter Press Service News Agency*, http://ipsnews.net/interna.asp?idnews=27616.

Du Bruyn, Rudrik. (2004a). "An Introduction to the Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS)," *University of Pretoria Working Paper.*

Du Bruyn, Rudrik. (2004b). "The Impact of HIV/AIDS on the Economy and

Business in South Africa," *University of Pretoria Working Paper.*

Epstein, Brynn G. (2004). "The Demographic Impact of HIV/AIDS," *The Macroeconomics of HIV/AIDS*, Ch. 1, 1-40.

Haacker, Markus. (2002), "The Economic Consequences of HIV/AIDS in Southern Africa," *IMF Working Paper No. 02/38.*

ING Barings, South African Research. (2000). *The Economic Impact of AIDS in South Africa: A Dark Cloud on the Horizon.*

Nelson, Richard R. and Edmund S. Phelps. (1966). "Investment in Humans, Technological Diffusion, and Economic Growth," *American Economic Review, 56(2), 1966.*

O'Manique, Colleen. (2004). *Neoliberalism and AIDS Crisis in Sub-Saharan Africa: Globalization's Pandemic*, Palgrave Macmillan.

Papageorgiou, Chris and Petia Stoytcheve. (2004). "What Do We Know About the Impact of AIDS on Cross-Country Income So Far?" *Louisiana State University Working Paper.*

Stanecki, Karen A. (2004). "The AIDS Pandemic in the 21th Century", *U.S. Census Bureau International Population Reports.*

UNAIDS. (2004a). *AIDS Epidemic Update 2004.*

UNAIDS. (2004b). *Report on the global AIDS epidemic.*

UNAIDS. (2004c). *Epidemiological Fact Sheets: Uganda.*

UNAIDS. (2004d). *Epidemiological Fact Sheets: Botswana.*

UNAIDS. (2004e). *Epidemiological Fact Sheets: Lesotho.*

UNAIDS. (2004f). *Epidemiological Fact Sheets: Namibia.*