The Economic Impact of HIV/AIDS in Botswana

Final Report

Presented by

to

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Table of Contents

List of Tables

List of Figures

Abbreviations

ACHAP	African Comprehensive HIV/AIDS Partnership
ART	Anti-Retroviral Therapy
BAIS	Botswana AIDS Impact Survey
BER	Bureau for Economic Research
BHP	Botswana Harvard Partnership
BHRIMS	Botswana HIV/AIDS Response Information Management System
BIDPA	Botswana Institute for Development Policy Analysis
BNPC	Botswana National Productivity Centre
CDC	Centres for Disease Control
CGE	Computable General Equilibrium
HBC	Home-Based Care
HIES	Household Income and Expenditure Survey
IEC	Information Education and Communication
IFPRI	International Food Policy Research Institute
NAC	National AIDS Council
NACA	National AIDS Co-ordinating Agency
NSF	National Strategic Framework
OAP	Old Age Pension
OVC	Orphans and Vulnerable Children
PMTCT	Prevention of Mother to Child Transmission
SAM	Social Accounting Matrix
STDs	Sexually Transmitted Diseases
TFP	Total Factor Productivity

UNDP	United Nations Development Programme
UNICEF	United Nations Childrens' Fund
VCT	Voluntary Counselling and Testing

Acknowledgements

This report was prepared by a core team comprising Keith Jefferis (team leader, Econsult Botswana), Happy Siphambe (University of Botswana) and Anthony Kinghorn (HDA, Health & Development Africa). Significant inputs were also provided by James Thurlow (IFPRI) on the CGE modelling.

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1. Introduction

Over the past few years, dealing with HIV/AIDS and its effects has become one of the major public policy issues in most Southern African countries. While it is fundamentally a health issue, the impact of HIV/AIDS goes far beyond health because of its widespread human, social and economic effects. Southern Africa has the highest HIV prevalence rates in the world; several countries in the region have HIV prevalence rates over 20 percent of the adult population, with the highest reported adult HIV prevalence rates of over 30 percent (see Table 1). As a result, it is estimated that nearly two-thirds of all HIV positive people in the world live in sub-Saharan Africa, while South Africa, along with India, has the highest number of HIV positive people of any country in the world.

Until very recently HIV prevalence seems to have been following a steady upward trend, although there is now some evidence of stabilisation – and even reversal - of prevalence rates. Prevalence rates amongst specific sub-groups of the adult population are higher, with sentinel surveys of pregnant women in Botswana showing rates of 40-50 percent in some age cohorts.

Table 1-1: Country-specific HIV and AIDS Estimates, Southern Africa, end 2005

	Estimated number of people living with HIV				AIDS Deaths	Orphans due to AIDS
Country	**HIV+ Adults and children 2005**	**HIV+ Adults (15+) 2005**	**Adult (15–49) HIV rate (%) 2005**	**Adult (15-49) HIV rate (%) 2003**	**Deaths in adults and children 2005**	**Orphans (0–17) currently living 2005**
Sub-Saharan Africa	**24 500 000**	**22 400 000**	**6.1**	**6.2**	**2 000 000**	**12 000 000**
Angola	320 000	280 000	3.7	3.7	30 000	160 000
Botswana	*270 000*	*260 000*	*24.1*	*24.0*	*18 000*	*120 000*
Congo DR	1 000 000	890 000	3.2	3.2	90 000	680 000
Lesotho	270 000	250 000	23.2	23.7	23 000	97 000
Madagascar	49 000	47 000	0.5	0.5	2 900	13 000
Malawi	940 000	850 000	14.1	14.2	78 000	550 000
Mauritius	4100	4100	0.6	0.2	<100	…
Mozambique	1 800 000	1 600 000	16.1	16.0	140 000	510 000
Namibia	230 000	210 000	19.6	19.5	17 000	85 000
South Africa	5 500 000	5 300 000	18.8	18.6	320 000	1 200 000
Swaziland	220 000	210 000	33.4	32.4	16 000	63 000
Tanzania	1 400 000	1 300 000	6.5	6.6	140 000	1 100 000
Zambia	1 100 000	1 000 000	17.0	16.9	98 000	710 000
Zimbabwe	1 700 000	1 500 000	20.1	22.1	180 000	1 100 000
Global	**38 600 000**	**36 300 000**	**1.0**	**1.0**	**2 800 000**	**15 200 000**

Source: UNAIDS/WHO (2006)

The impact of such high HIV prevalence rates is widespread. For many of those infected, HIV infection results in death within a few years, although the gradual roll-out of medical treatment for the disease has enabled it to be transformed into a manageable chronic condition. Demographically, a sharp rise in mortality has caused life expectancy to fall, in some cases quite

drastically, and a reduction in the population growth rate, although earlier forecasts of negative population growth rates as a result of HIV/AIDS do not appear to be borne out.

Health systems, both public and private, have become dominated by the needs of AIDS patients, and there has been a consequent squeeze on resources for treating other illnesses. Socially, the impact is devastating, given the human cost of so much illness and so many deaths, while the rise in the number of orphans and breakdown of family structures poses challenges for both state and social support systems. There will almost certainly be an increase in poverty, as households with AIDS patients face a reduction in income (as breadwinners become sick and die) and an increase in expenditure on medical and related costs.

A considerable macroeconomic impact is also to be expected, with HIV/AIDS affecting the size of the labour force, the availability of skills and productivity. Outside of its effects on the labour force, HIV/AIDS causes resources to be diverted that would otherwise be used to finance investment. Hence the impact of HIV/AIDS on macroeconomic variables such as economic growth, per capita incomes, savings, investment and employment is likely to be significant. For governments, HIV/AIDS has an adverse fiscal impact, as expenditures rise with higher spending on health care and social support, and revenues are affected by slower economic growth.

Responses to HIV/AIDS have become more effective over time, although there remain considerable variations in both the nature of those responses and their effectiveness across countries. Broadly speaking, responses are two pronged. The first component focuses on preventing infection and reducing HIV incidence and prevalence, through information dissemination, education, awareness raising and promoting behavioural change. The second focuses on providing treatment for those already infected. In some countries this has largely been restricted to the treatment of opportunistic infections, while in others treatment has included the provision of Anti-Retroviral Therapy (ART). ART remains expensive, and in Southern Africa, only the richer countries – Botswana, South Africa and Namibia – can provide ART on a widespread basis through the public health service on the basis of domestic financing. In other countries, ART provision is largely limited to private medical facilities, charities and NGOs, and sporadic provision through the public health system, but financing is almost entirely dependent upon donor support.

This report has been prepared for the National AIDS Co-ordinating Agency (NACA), which falls under the Office of the President of the Government of Botswana, as one of a set of studies examining the impact of HIV/AIDS which have been financed by the United Nations Development Programme (UNDP). It focuses on the economic impacts of AIDS at both macro- and micro-levels, and includes an assessment of the likely impact on the key macroeconomic variables mentioned above, as well as the fiscal impact, and the impact on households and firms. One of the key objectives of the study is to update a previous exercise, undertaken in 1999-2000, which examined the likely macroeconomic impact of HIV/AIDS (BIDPA 2000). The updating is necessary for a variety of reasons, including addressing any possible shortcomings in the previous study; taking advantage of recent methodological developments in evaluating the economic impact of HIV/AIDS; making use of new data and demographic projections; and incorporating the impact of ART provision.

The report is structured as follows: chapter 2 explores the developments related to HIV/AIDS in Botswana since 2000, including HIV prevalence data; chapter 3 reviews the channels through

which HIV/AIDS can impact on the economy and presents the results of updated demographic projections prepared for this study; chapter 4 evaluates the BIDPA (2000) study results; and reviews the results of other relevant studies on the economic impact of HIV/AIDS. Chapter 5 presents the results of an updated version of the macroeconomic projection model used in BIDPA (2000), while chapter 6 contains macroeconomic projections from a Computable General Equilibrium (CGE) model of the Botswana economy. Chapter 7 presents the results of the survey of firms carried out for this study, chapter 8 considers the effects on household level incomes, while chapter 8 reviews the impact on government spending. Chapter 9 assesses the impact on government spending, while Chapter 10 contains conclusions and policy recommendations.

2. Recent Development with respect to HIV/AIDS in Botswana

a. Policy and Institutional Developments

i. Key institutional developments:

Botswana's institutional response to HIV/AIDS has been one of the more progressive and active amongst Southern African countries. The need for a multisectoral response was recognised early on, given the cross-cutting nature of HIV/AIDS and its widespread impact on society and the economy, besides the obvious health issues. This resulted in the establishment of the National AIDS Council (NAC), chaired by His Excellency the President, with representatives from across government, the private sector and civil society. The National AIDS Co-ordinating Agency (NACA), which provides the Secretariat to the NAC, was established under Office of the President to co-ordinate the multi-sectoral approach. This high level at which HIV/AIDS is being dealt with reflects the importance ascribed to the issue in Botswana. NACA has also led the formulation of the National Strategic Framework (NSF) for HIV/AIDS, which details the anticipated response to the epidemic over 2003-2009 (NACA, 2003a).

Outside of government, considerable donor input has been received in the form of finance, technical, logistical and research support, as well as free or reduced price medication. Key collaborative initiatives include the African Comprehensive HIV/AIDS Partnership (ACHAP), with the Bill & Melinda Gates Foundation and the Merck Company; the BOTUSA project, with the Centers for Disease Control and Prevention (CDC) of the U.S. Department of Health and Human Services; and the Botswana-Harvard project, with the Harvard School of Public Health AIDS Initiative for HIV Research and Education. ACHAP works with government to decrease HIV incidence and increase the rate of diagnosis and the treatment of the disease, through advancing prevention programmes, healthcare access, patient management and treatment of HIV/AIDS. The Bill & Melinda Gates Foundation and The Merck Company Foundation have each dedicated US$50 million over five years towards the project, which currently runs until 2009. Merck is also donating two anti-retroviral medicines for appropriate treatment programmes developed by the Government for the duration of the initiative. The BOTUSA Project provides technical assistance, consultation and funding, implements programs, and conducts research with the Botswana government and other local and international partners for prevention, care and support, and surveillance of HIV/AIDS, tuberculosis, and sexually transmitted diseases (STDs), while the Botswana-Harvard Project (BHP) focuses on research and training. Finally, various organisations under the United Nations – including UNDP, UNAIDS and UNICEF – also have significant programmes dealing with HIV/AIDS-related issues.

ii. Key Policy Developments

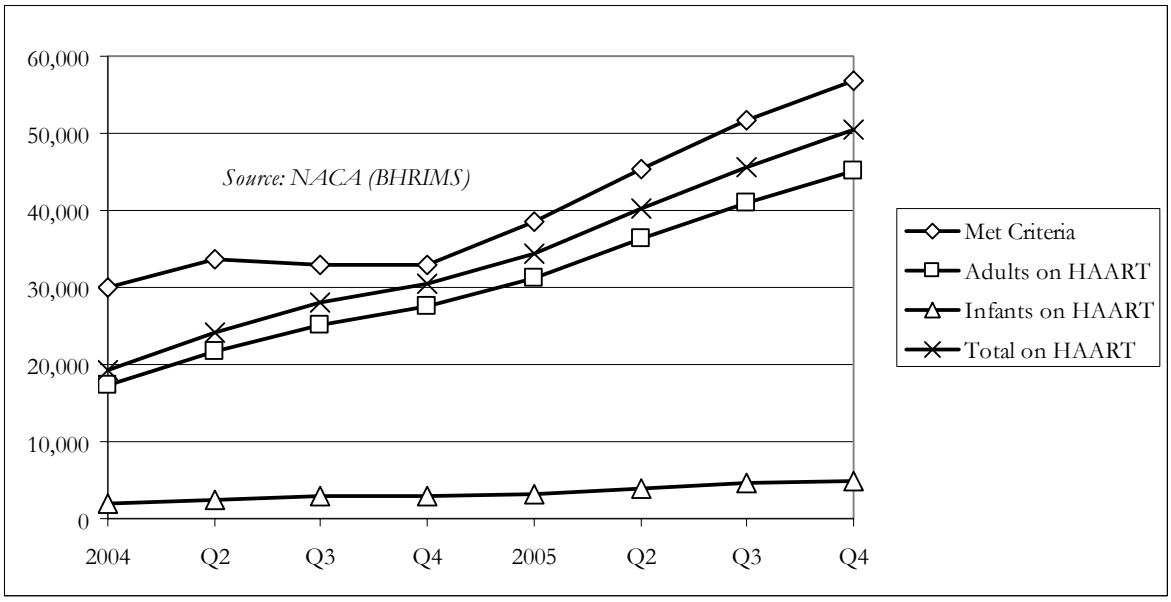
In view of Botswana's very high HIV prevalence rates, a decision was taken in 2002 to, in principle, provide ART medication free of charge through the public health service (ART had been available through private medical aid schemes prior to this time), subject to detailed examination of the key parameters relevant to making the project a success. These included

ascertaining the likely clinical need; ascertaining the resource requirements (financial, staffing, infrastructure etc.) as well as resource gaps; determining a realistic roll-out schedule and establishing the modalities of delivery; establishing eligibility criteria that balanced resource availability with clinically justified treatment on an equitable basis (using principles such as "treat the sickest first" and "secure the family"). The initial feasibility study was carried by consultants from McKinsey (2001), following which a detailed strategy was formulated, covering:

- Policy, planning, and project management
- Information, Education, and Communication (IEC), and community mobilization
- Training of healthcare professionals
- Staff recruitment and retention
- Drug logistics
- Laboratory and testing logistics
- Information technology for nationwide tracking and monitoring of patients, laboratory samples, and medication utilization
- Procurement and upgrading of space
- Monitoring, evaluation, and operational research

A phased approach was adopted for the MASA programme, as the ART treatment programme is known, with an initial 19,000 patients covered in four treatment centres. This was later rolled out to 32 treatment centres, and by 2005, 45,000 adults were covered (see Figure 2-1). When combined with private sector provision under medical aid and company schemes, the total number in receipt of ART was reported at 58 800 in December 2005 (NACA/BHRIMS 2006).

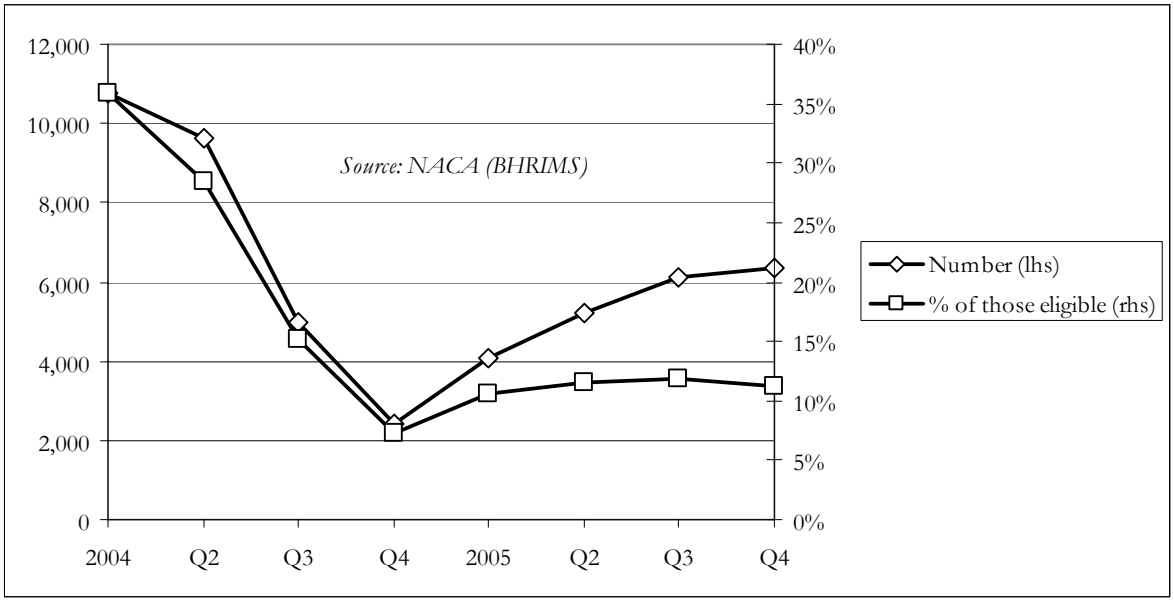
Figure 2-1: ART Eligibility and Uptake (Public Sector)



The intention is to continue the rollout until 110 sites are covered, by 2009. At the same time as the number of patients enrolled in MASA has risen, the treatment deficit has been slowly reduced, from 10,700 (36 percent of those eligible) in 2004 Q1 to 6,400 (11 percent of those

eligible) in 2005 Q4 (eligible refers to those tested and meeting established clinical and other criteria) (see Figure 2-2).

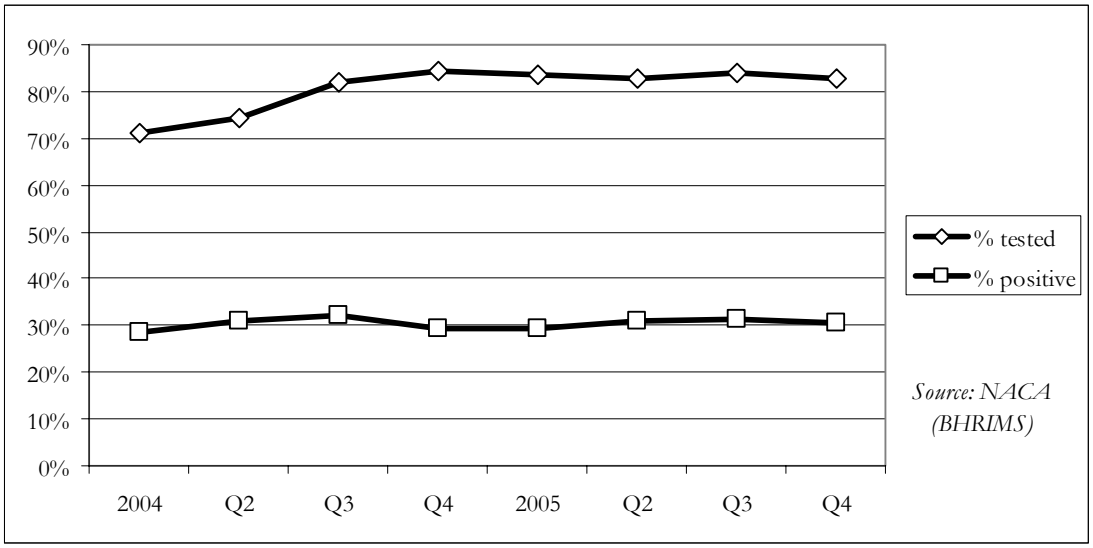
Figure 2-2: ART deficit



It is more difficult to relate the extent of MASA rollout to potential demand; the McKinsey (2001) study concluded that there would be an initial maximum potential demand of 110,000 in 2001, rising to 260,000 in 2005, assuming rollout from late 2001. The demographic projections used in the current study suggest lower figures, rising from 29 300 in 2001 to 59 200 in 2005 and around 120 000 in 2016, based on WHO classifications.

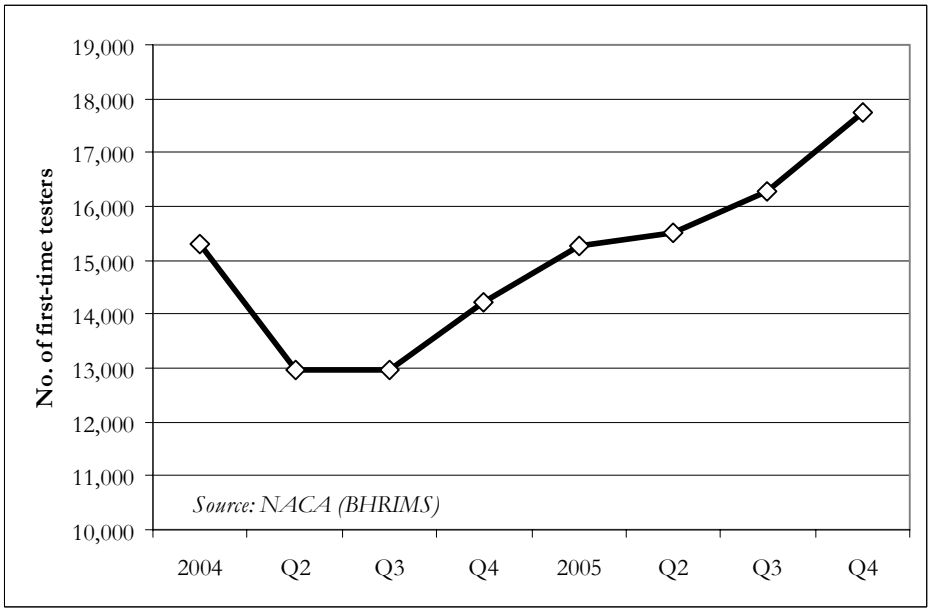
An associated policy initiative is the Prevention of Mother-to-Child Transmission Programme (PTMCT), which focuses on minimising the transmission of HIV from HIV positive mothers to their babies, whether directly or through breast milk. Enrolment in the PMTCT programme was initially low, but has increased significantly since ART has been made available through the MASA programme. The proportion of women presenting for ANC treatment who agree to testing has risen from 71 percent in early 2004 to 83 percent by mid-2005, while the proportion testing HIV+ positive has been steady at around 30 percent (see Figure 2-3).

Figure 2-3: PMTCT uptake and testing



There has also been considerable emphasis on testing of HIV status. A nationwide network of Voluntary Counselling and Testing (VCT) centres has been established through the Tebelopele initiative (see figure 2-4). Routine HIV testing (RHT) is now practised in public health facilities, where patients presenting for medical treatment are tested for HIV unless they opt otherwise. In 2005, 142 500 people agreed to RHT (representing 89 percent of those who were offered RHT). When combined with those receiving testing through Tebelopele, over 207 000 people received an HIV test in 2005 (this excludes those tested through other programmes, such as those offered by NGOs, and those using private medical facilities). This figure represents around 20 percent of the adult population.

Figure 2-4: VCT First-time testers

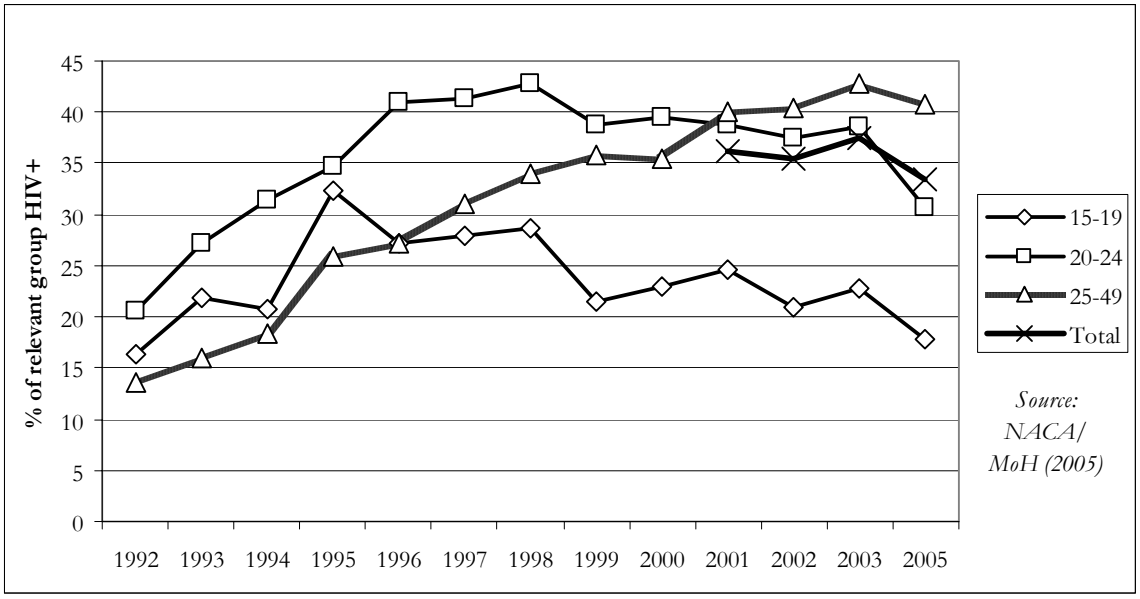


b. HIV Prevalence Trends

i. Sentinel Survey Results

Sentinel survey data from anonymous testing of pregnant women presenting at ANC facilities has been carried out since 1992, although prior to 2001 the testing did not cover all of the health facilities in the country. As Figure 2-5 shows, prevalence rates followed a generally rising trend until 2003, when the (age-adjusted) overall prevalence rate reached 37.4 percent of pregnant women. Among specific age cohorts, prevalence among 15-19 year olds has been generally declining since 1995, while that among 20-24 year olds has been declining since 1998. Among 25-49 year olds, prevalence rose steadily through to 2003, before dropping slightly in 2005 (there was no sentinel survey carried out in 2004 as the nationwide Botswana AIDS Impact Survey (BAIS) was conducted in that year). The overall prevalence rate fell from 37.4 percent in 2003 to 33.4 percent in 2005, which was a statistically significant decline.

Figure 2-5: HIV Prevalence Trends, 1992-2005



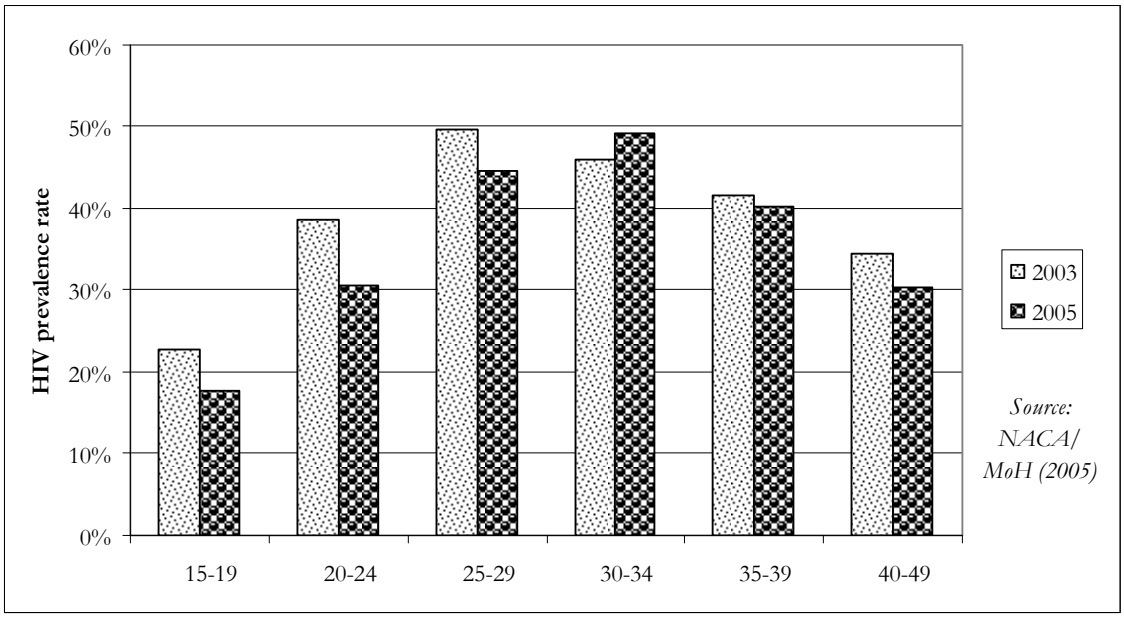
The relatively early peaking of prevalence rates in the younger age cohorts suggests that among younger people at least, the extensive IEC has had the intended effects and that behavioural change is taking place as intended.

Sentinel survey results also provide information regarding HIV prevalence according to various sub-groups of the female population.

HIV Prevalence by Age Cohort

HIV prevalence varies considerably by age cohort, with the highest prevalence rates of almost 50 percent recorded in the 25-29 (2003) and 30-34 (2005) age cohorts (see Figure 2-6).

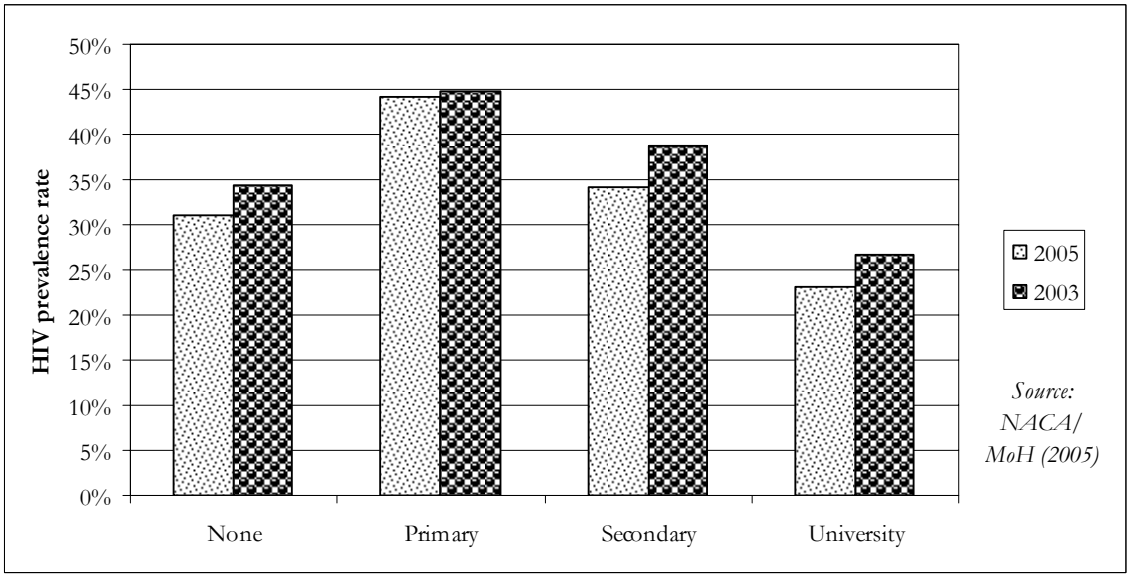
Figure 2-6: HIV Prevalence by Age Cohort, 2003-5



HIV Prevalence by Education

HIV prevalence also varies by level of education, with the highest prevalence rate for those with primary education only, and declining prevalence rate as the level of education rises (Figure 2-7). Prevalence is also lower for those with no education.

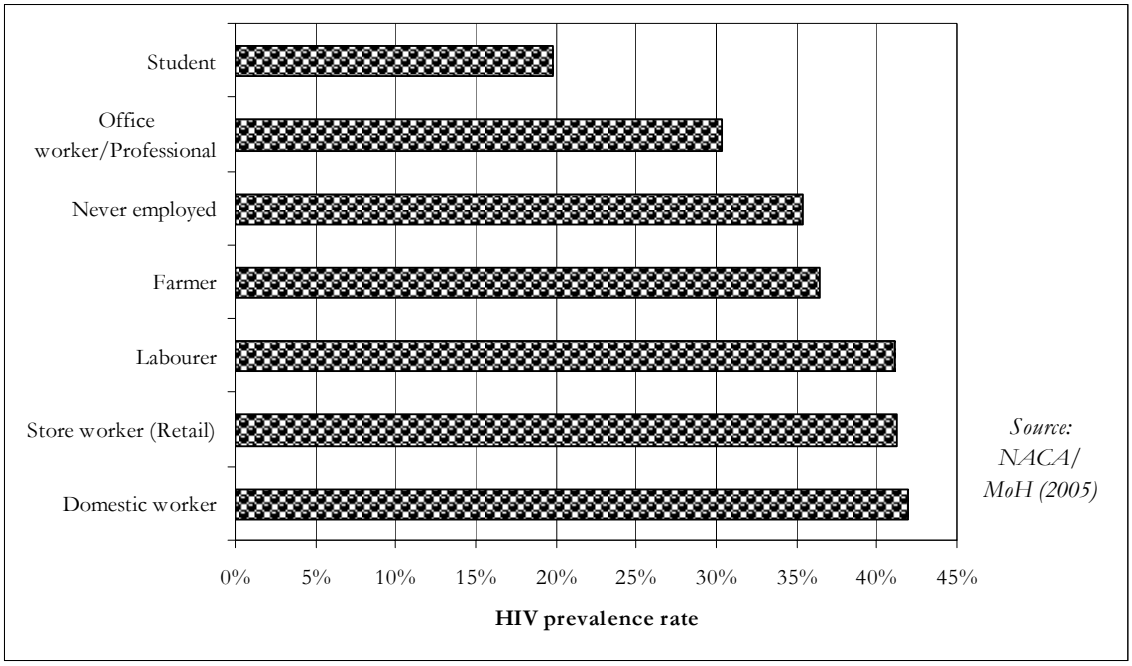
Figure 2-7: HIV Prevalence by Education, 2003-5



HIV Prevalence by Occupation

The sentinel survey data also provides information on HIV prevalence by occupation, which is particularly important for the purposes of evaluating the economic impact of HIV/AIDS. The data indicates that students and more highly skilled workers (office/professional) workers have a lower prevalence rate than less skilled workers (domestic workers, labourers, store workers and farmers) (see Figure 2-8).

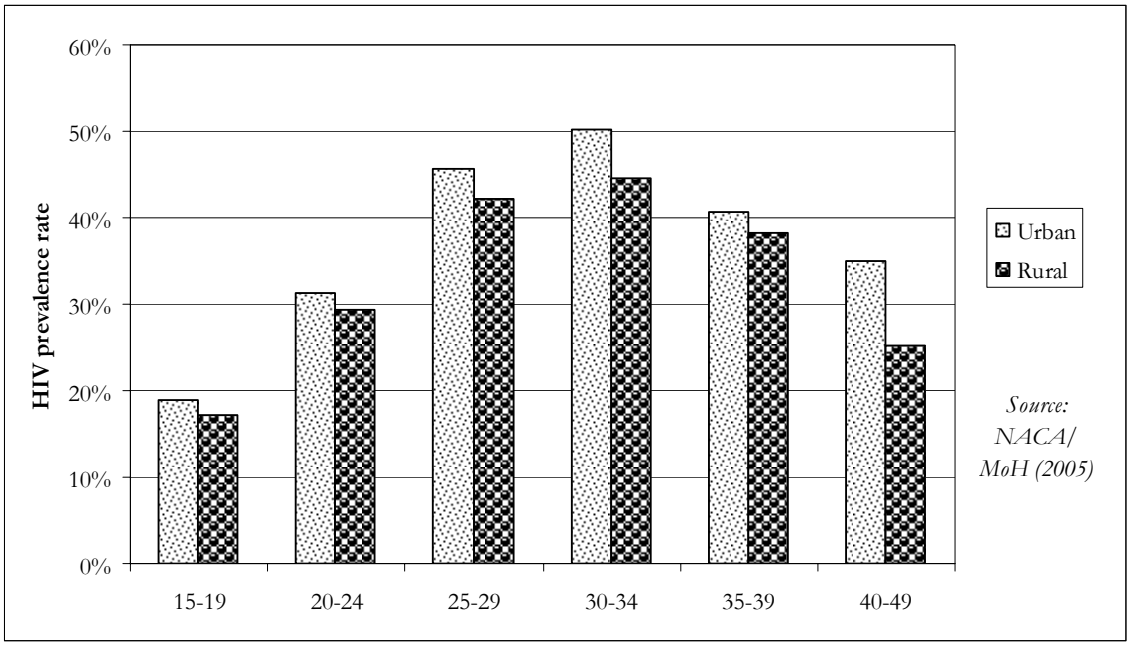
Figure 2-8: HIV Prevalence by Ocupation, 2005



HIV prevalence by rural-urban location

Being a nationwide exercise, the sentinel survey includes information on prevalence rates in urban and rural areas. As figure 2-9 shows, rural prevalence rates are marginally lower than urban prevalence rates, although the difference is not statistically significant.

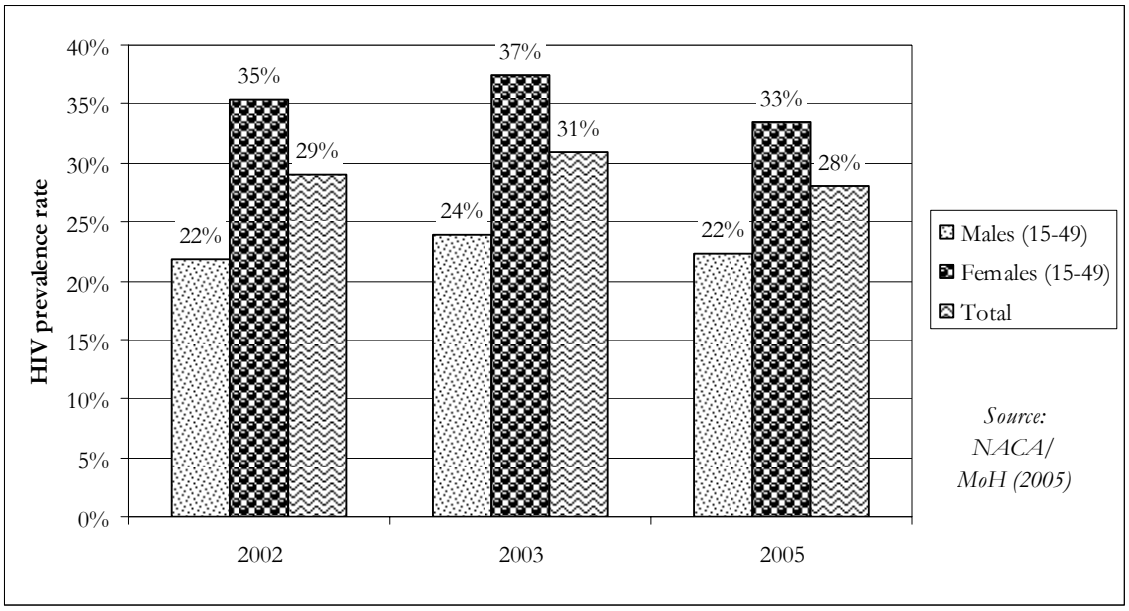
Figure 2-9: Rural and Urban HIV prevalence rates



HIV prevalence by gender

Although the sentinel survey covers only pregnant women, the resulting data is used to derive HIV prevalence rates for males, utilising the relative male/female prevalence rates derived from VCT testing centres and the BAIS survey. These estimates show a considerably lower HIV prevalence rate for males than for females (see figure 2-10). Combining the male and female prevalence rates, overall adult (15-49) HIV prevalence rates can be obtained; these are estimated at 29 percent in 2002, 31 percent in 2003 and 28 percent in 2005. It is important to note that the overall prevalence rates derived from the sentinel surveys are considerably lower than the female-only prevalence rates which are often quoted as the basis for Botswana's HIV prevalence rate.

Figure 2-10: HIV Prevalence by Gender, 2002-5



ii. BAIS II Results

In 2004 the second large scale nationwide AIDS Impact Survey (BAIS II) was conducted. The survey used a two-stage probability sampling design to select 8,380 households, of which 7,600 with 24,672 eligible household members participated. It was designed to measure knowledge and attitudes, identify certain factors that are associated with the HIV prevention, transmission, and impact mitigation among the general population aged 10-64 years. It also included a voluntary HIV test. Of the 24,672 eligible household members, 14,587 (59.1 percent) agreed to an HIV test[1].

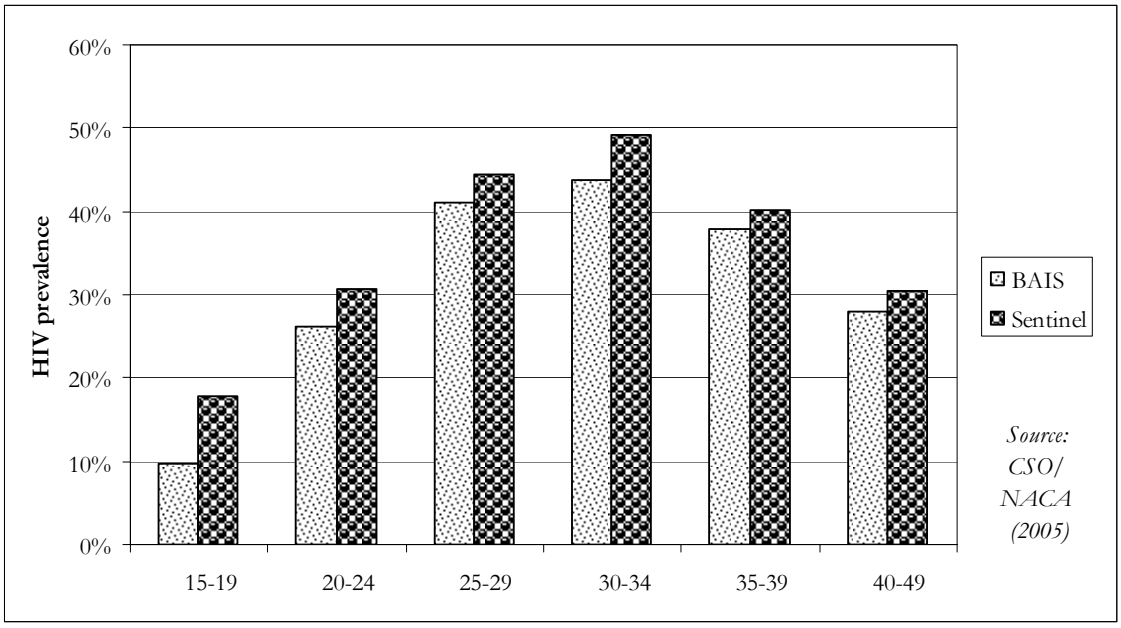
The overall HIV prevalence rate from the BAIS II survey was 17.2 percent among the population aged over 18 months. Among adults aged 15-49, the prevalence rate was 25.3 percent.

The prevalence rates recorded in the BAIS II survey were generally lower than those recorded in the sentinel surveys. The overall female prevalence rate amongst women aged 15-49 in the BAIS II survey was 29.4 percent, compared with 37.4 percent in the 2003 sentinel survey and 33.4 percent in the 2005 Survey. As figure 2-11 shows, the main difference between the two surveys was in the very young (15-19 year) age cohort.

In order to improve comparability between the two surveys, the HIV prevalence rate has been calculated for women who were pregnant at the time of the BAIS II survey in 2004 or who had given birth during 2000-04. The HIV prevalence rate for this group of women is 32.4 percent, which is much closer to the sentinel survey prevalence rate.

[1] Analysis of the characteristics of those who agreed to be tested and those who declined indicates that the high level of declines did not introduce any substantial bias into the overall survey estimates of HIV prevalence (CSO, 2005, p.38)

Figure 2-11: HIV Prevalence – Comparison of BAIS & Sentinel Survey Data



The BAIS II survey data have also been used to determine predictors of HIV prevalence, using logit regressions (CSO, 2005b). In general the predictive results were poor, indicating that HIV prevalence is widespread and generalised across the population. To the extent that there were some statistically significant predictors of HIV prevalence, these were consistent with other results, including gender (male, negative), level of education (positive for primary only, negative for secondary or higher) and age. As in the sentinel survey results, there was no statistically significant difference between urban and rural prevalence rates.

3. The Potential Macroeconomic and Demographic Impacts of HIV/AIDS.

a. The Potential Macroeconomic Impact of AIDS

In this study four different aspects of the macroeconomic impact of AIDS are considered:

(i) the impact on key macroeconomic variables (GDP, average incomes, savings and investment, employment and wages);

(ii) the household level impact, focusing on household incomes (rather than average incomes), poverty, and income distribution;

(iii) the impact on firms, focusing on output, productivity, investment and measures taken to counter HIV/AIDS;

(iv) the fiscal impact on government revenues, spending (and specifically spending related to HIV/AIDS) and the budget balance.

Below we consider the potential channels through which each of these economic impacts may operate. Detailed analysis of these impacts is provided in later chapters.

i. Impact on GDP and Average Incomes

The potential macroeconomic impact of AIDS operates through various different channels. These effects can helpfully be divided into those that arise from rising morbidity (greater sickness) and those that arise from rising mortality (higher death rates).

Rising morbidity may have the following impacts:

- **reduced productivity** due to workers' time off for sick leave or to look after sick family members, lower productivity while at work due to illness or worry;
- **increased expenditure** on:

  health care (by individuals, firms and government);

  training (by firms and government, to replace sick workers);

  sick pay (by firms and government);
- **reduced savings**, as at least part of the additional expenditure will be taken from income that would otherwise be saved;
- **reduced investment** (both public and private), due to:

  lower expected profits, or increased economic uncertainty;

  diminished ability to finance investment due to lower savings;

Rising mortality has a demographic impact, through:

- smaller population and labour force;

- changed age structure of population and labour force (which affects the experience and productivity of the labour force);
- availability of skills;
- labour force participation rates.

HIV/AIDS can therefore affect output (GDP) relative to the level that would have prevailed without AIDS, by affecting the size, skill structure and productivity of the labour force, and by reducing the rate of investment (gross fixed capital formation) and hence the available capital stock. Because all of the key inputs to production are likely to be negatively affected (labour, capital and productivity growth), it is highly likely that the rate of GDP growth will be reduced.

It is important to emphasise that this does not necessarily mean that the economy will become smaller in absolute terms as a result of HIV/AIDS; this would only happen if the GDP growth rate became negative. What is more likely that the GDP growth rate is likely to be reduced (but still be positive). This simply means that the economy will be smaller as a result of HIV/AIDS, compared to the size that it would have been without AIDS, but will be larger than its present size – in other words it will continue to grow.

A second important point to note is that a lower rate of GDP growth does not necessarily mean that average incomes (GDP per capita) will be affected in the same way. While the GDP growth rate is likely to fall, the population growth rate will also be reduced. If the population growth rate falls by more than the GDP growth rate as a result of AIDS, then AIDS would actually increase the growth rate of average incomes. In order to make a projection of the likely impact on the growth of average incomes, it is therefore necessary to obtain or produce comparative figures on the projected growth rates of both GDP and the population.

Lower economic growth will also affect consumption demand, which suggests that the market for firms depending on local consumers will grow more slowly due to AIDS. Furthermore the widespread impacts on the labour market (via labour supplies, productivity, and labour demand) are likely to affect wages and employment, both of which could either rise or fall depending on how the other variables interact.

ii. Household Impacts

The above discussion refers to broad macroeconomic impacts at a high level of aggregation. However, this does not necessarily tell us much about the effects at a disaggregated level, that of individual households (or groups of households). This is important, as there are likely to be quite different effects across households; not all households will be affected by AIDS in the same way, most obviously depending on whether or not a household has a member who is HIV positive. The impact on household consumption spending (which determines living standards) might be quite different to the impact on average national incomes (GDP). Working at a household level, we can consider the potential impact of HIV/AIDS on poverty and income distribution.

Households may be affected by HIV/AIDS in the following ways:

- loss of income, if a breadwinner stops work due to sickness or death (this is a permanent impact);

- loss of income, if a breadwinner has to stop work to look after a sick family member (this is a temporary or transient impact);
- increased dependency ratios (the number of non-working members supported by income-earning household members);
- additional expenditure, on health care and, eventually, funeral costs (again, a transient impact).

The above effects apply to households with a member who is HIV positive. All of them tend to decrease income and increase spending, so that the disposable income of the households will be reduced. Some of these households will find that their disposable income is no longer sufficient to keep them above the poverty line, or households in poverty may find that the depth of their poverty has worsened. Overall, the direct effect of HIV/AIDS will be to worsen poverty, although it should be noted that the short term impact on poverty is likely to be worse than the long-term impact (because of the impact of the transient factors noted above).

However, there are also a number of indirect effects that stem from the macroeconomic impacts described above, which will affect all households, not just those with an AIDS patient. It is likely that the levels of employment and wages will be affected. Whether these effects will be positive or negative cannot be determined *a priori*, but households will find that their incomes will be affected by increased or reduced chances of finding work, and, for those in work, increased or reduced wages. This will also have an effect on poverty (which may be positive or negative).

Distributional effects could also be important, given that some households will become poorer, while others (depending on the degree and direction of change of wages and employment) may become better off. Again, *a priori*, it is not possible to predict the direction or magnitude of the distributional impact of AIDS.

iii. Firm-level impact

HIV/AIDS has extensive effects on firms, through the impacts on the workforce, investment and markets.

The workforce is affected in several ways. As workers become sick, their productivity falls, due to time taken off for sick leave and reduced ability to perform while at work. Absenteeism is increased, making it more difficult to plan maintain production levels. If the disease is not treated, the eventual death of workers or retirement on medical grounds results in the loss of experience and investment in skills. Extra expenditure is required, whether on sick pay, medical insurance, supplementing the cost of the medication that is required to mitigate the impact of the disease, and additional training and/or recruitment is required to maintain desired skill levels and workforce complement.

Investment is affected in a number of ways. First, the higher costs of doing business reduce profitability, as well as the availability of funds, both of which are likely to reduce overall investment levels. Second, the additional uncertainty that results – for instance, over the future availability of skilled labour – will also tend to reduce investment.

Firms in certain industries will also find their business growing more slowly, especially those that are dependent upon consumer spending, which will feel the effects of slower population growth and the diversion of consumer spending to HIV/AIDS-related needs.

iv. Fiscal Impact

AIDS is a development of such proportions that it will inevitably have an impact on government revenues and spending, and therefore on the budget balance and government saving or borrowing. AIDS will have direct effects on some key areas of government spending, most obviously the health budget, but there will also be a range of indirect effects as the ability to raise tax revenues is affected. The main impacts can be identified as follows:

Expenditure:

Health spending: will rise due to the additional clinical costs of AIDS treatment and care, as well as the costs of awareness campaigns and other HIV/AIDS prevention measures (although not all of the latter will necessarily fall under the health budget). The degree of impact on the health budget depends on four key factors:

(i) decisions taken about making drug therapies generally available, and the nature of the treatment protocols utilised;

(ii) the (unknown) future availability of new treatments;

(iii) the degree to which care for AIDS patients is split between hospital-based and home-based care;

(iv) the ability of the public health service to manage its functions and spend the budgets that are provided.

Although the impact of AIDS will inevitably to increase health spending, it should be noted that in most countries health expenditure makes up a relatively small proportion of the overall government budget (in Botswana, it has historically been around 5 percent).

Education spending: will be affected by AIDS, but the direction of this impact will be difficult to predict. The increased death rate means that more people will have to be educated/trained to meet targets for the provision of skilled workers. However, the reduction in the rate of population growth means that the population will be smaller as a result of AIDS, and hence the demand for general education (particularly primary and junior secondary) will be reduced, and this will tend to have a negative effect on the education budget.

Social Welfare spending: larger expenditure of support for orphans is occurring. Some reduction in spending on old age pensions is also expected to result from earlier deaths among adults.

Other types of spending: lower population will also lead to reduced needs for other types of government spending, such as on urban and village infrastructure, water supplies etc. Depending on the outcome for the government budget balance, it may also be necessary to cut back on certain areas of spending that are not directly affected by AIDS or lower population growth.

Revenues

The impact of AIDS on government revenues will not be as direct as on expenditures. The main source of revenues – the minerals sector – is unlikely to be affected (assuming that the diamond mines can source sufficient skilled labour, either locally or from abroad). The second largest revenue source, earnings from the Southern African Customs Union, may be affected (indirectly) by changes in the economy as a result of AIDS.

The sources that will be more directly affected by lower population growth – tax revenues from income taxes and sales taxes – at present account for a relatively small proportion of total revenues.

b. The Potential Demographic Impact of AIDS

A detailed analysis of the potential demographic impact of HIV/AIDS is being carried out in a parallel study (CARE, 2006). Results from this demographic impact study were used as inputs to the analysis of the macroeconomic impact, which is crucially dependent upon labour force developments. The same demographic projections were used for the analysis of the fiscal impact of HIV/AIDS. The demographic projections were prepared using the Actuarial Society of South Africa (ASSA) model, calibrated to Botswana data including the sentinel surveys, the BAIS II, and national population and household censuses. The model forecasts population annually by age cohort, and in the "with AIDS" scenarios models the spread of HIV prevalence and AIDS through the population. The model permits the following interventions:

- improved treatment for sexually transmitted diseases (STDs);
- information and education campaigns (IEC) and social marketing;
- voluntary counselling and testing (VCT);
- mother-to-child transmission prevention (MTCTP); and
- anti-retroviral treatment (ART).

The key assumption, regarding the use of ART, is that from around 2008, 90 percent of eligible people (newly AIDS-sick – see below) will make use of ART.

The model produces the following outputs:

- numbers of people in each sex/risk group/HIV classification and in total;
- number of deaths in each year due to AIDS or other reasons;
- HIV prevalence rates for different groups;
- fertility and birth rates;
- male and female mortality rates by age;
- crude extra mortality i.e. additional mortality resulting from AIDS;
- numbers of people accessing prevention and treatment programmes; and
- numbers of adults and children in different stages of HIV disease.

The model uses the WHO Clinical Staging System for the four stages through which adults are expected to progress before dying of AIDS (in the absence of ART). The effects of anti-retroviral treatment (ART) are modelled by introducing a further two stages, which represent people receiving treatment and people who have started treatment but subsequently discontinued treatment. Descriptions of these six disease states are given in the table below. The first two

stages are largely asymptomatic. Symptoms occur more frequently in stage 3, while people in stage 4 experience a range of more severe conditions that are referred to collectively as AIDS.

HIV stage	Description
1	WHO stage 1: Acute HIV infection
2	WHO stage 2: Early disease
3	WHO stage 3: Late disease
4	WHO stage 4: AIDS
5	Receiving anti-retroviral treatment
6	Discontinued anti-retroviral treatment

Three core scenarios are modelled: (1) no AIDS; (2) AIDS, no ART; (3) AIDS with ART. The following charts are included below:

- Total population, with and without AIDS and ART;
- Adult and population HIV prevalence, with and without ART;
- No. of ART recipients;
- Numbers of HIV positive adults by HIV stages, with ART;
- AIDS-related Death rates with and without interventions.

As figures 3-1 and 3-2 show, the impact on the total population is considerable. HIV/AIDS reduces the population significantly below what it would have been without the disease; by 2021, the population is estimated to be some 18-23 percent smaller than it would have been, and over the 20 years to 2021, the population growth rate will fall from an estimated 1.9 percent p.a. without AIDS to between 0.8 and 1.1 percent with AIDS (depending on the impact of ART).

Figure 3-1: Total Population

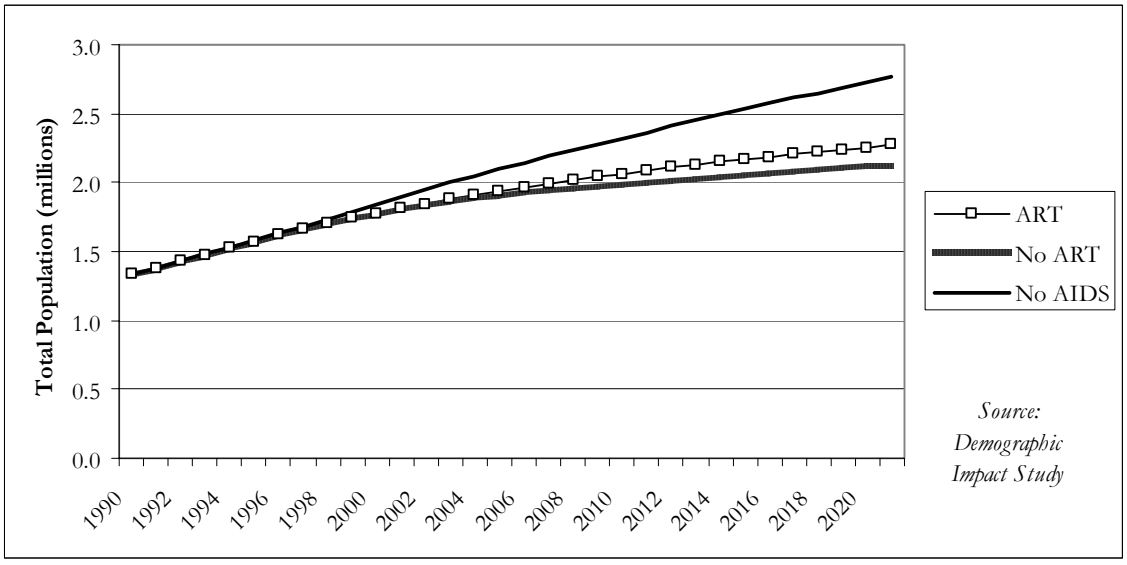
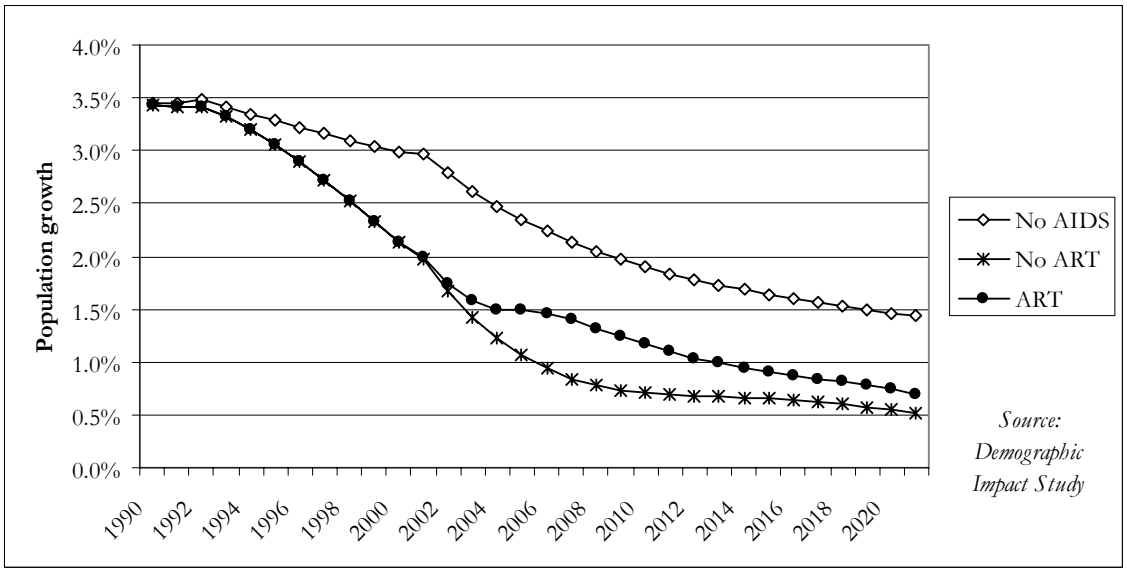


Figure 3-2: Population Growth Projections



Adult HIV prevalence rates are shown (in figure 3-3) to have peaked in 2000, at around 25 percent. It should be noted, however, that HIV prevalence rates will be higher (and will decline more slowly) if ART is widely used, because of the longer life expectancy of HIV+ individuals on ART. In situations of extensive ART usage, HIV prevalence therefore becomes a misleading indicator of the success of HIV prevention and alleviation strategies. Of more relevance is the impact of ART on death rates; as figure 3-4 shows, the death rate from AIDS-related factors should decline significantly, although it will remain high, even with ART.

Figure 3-3: Adult and Population HIV Prevalence

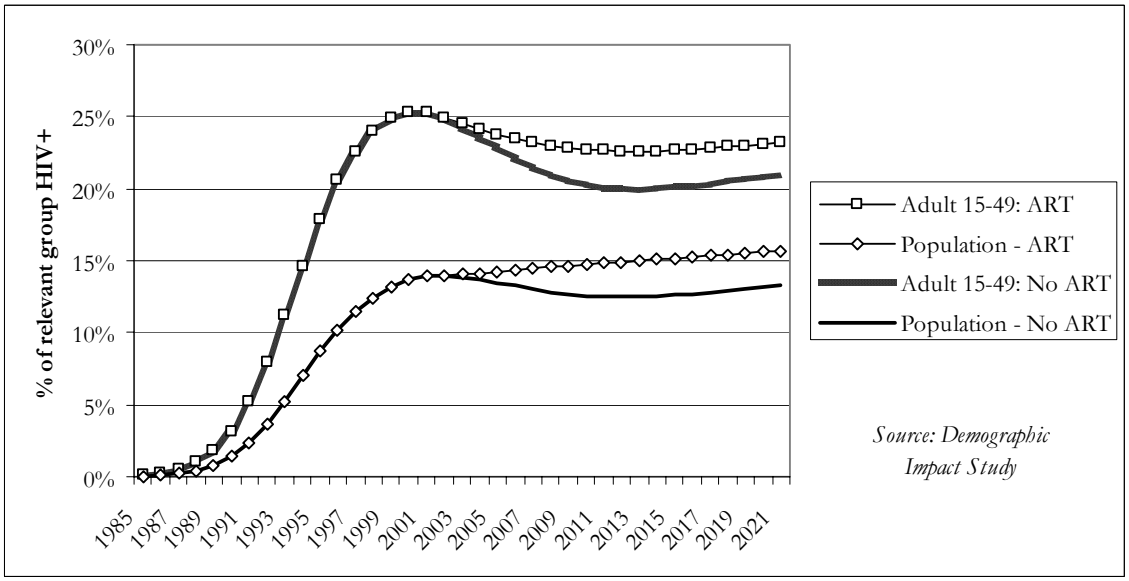
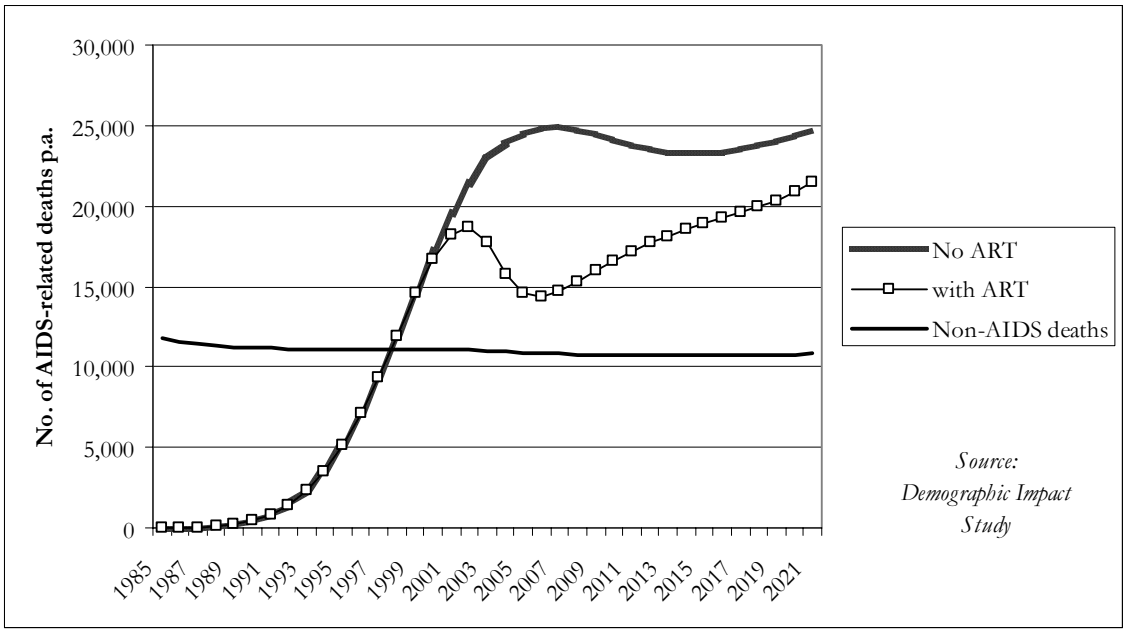


Figure 3-4: AIDS-related deaths



The number of projected ART recipients is shown in figure 3-5. Even with successful ART rollout, the projected numbers of ART recipients are significantly lower than the projections contained in the McKinsey report. Figure 3-6 shows the total number of HIV+ individuals under with-ART and no-ART scenarios. It shows that with a successful ART rollout, the number of HIV+ individuals would rise from around 250 000 at present to 350 000 by 2020. At the same time, the number of individuals with AIDS would be sharply lower under the with-ART scenario (figure 3-6).

Figure 3-5: Number of ART Recipients

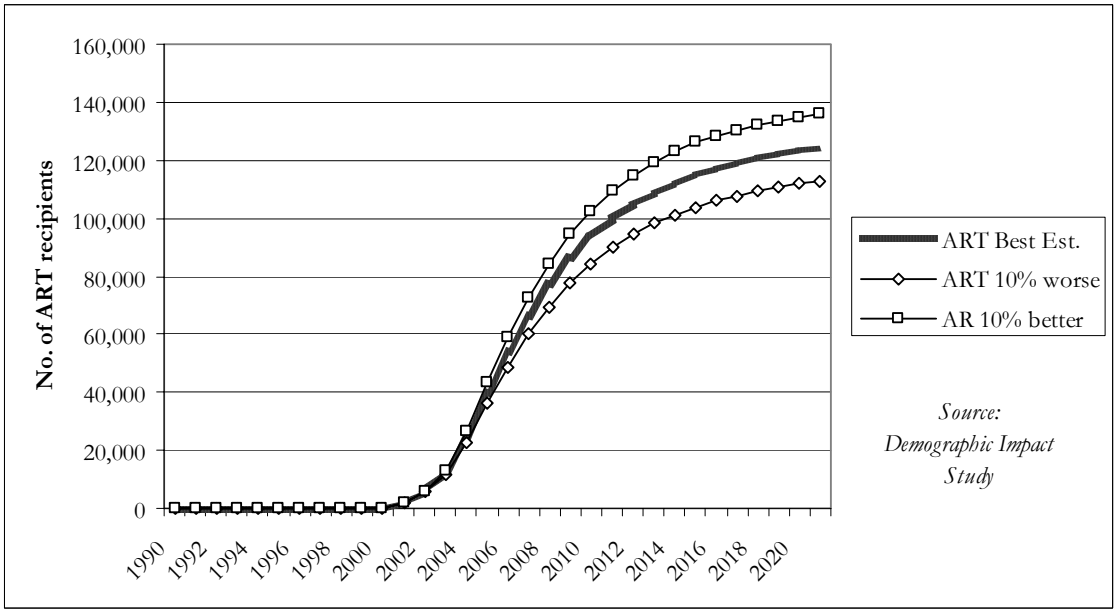


Figure 3-6: Total HIV Infections

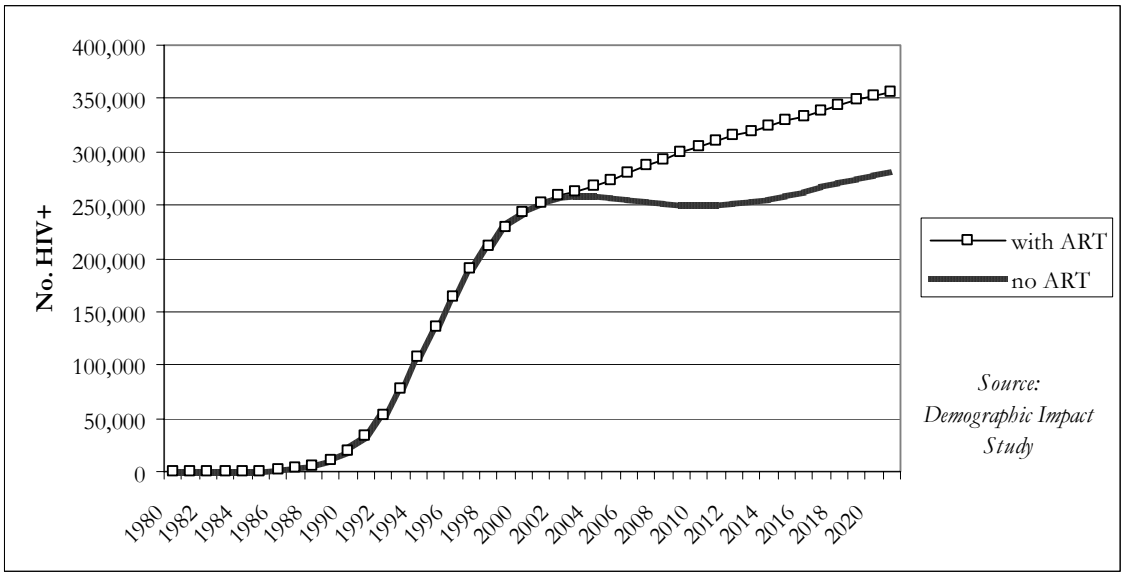
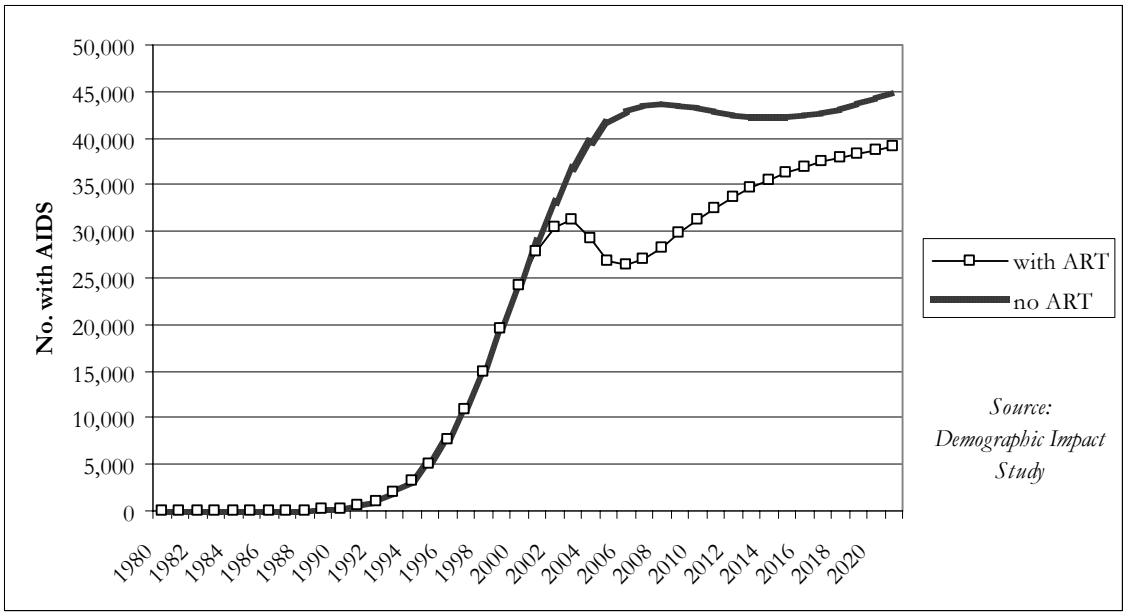


Figure 3-7: No. of individuals with AIDS

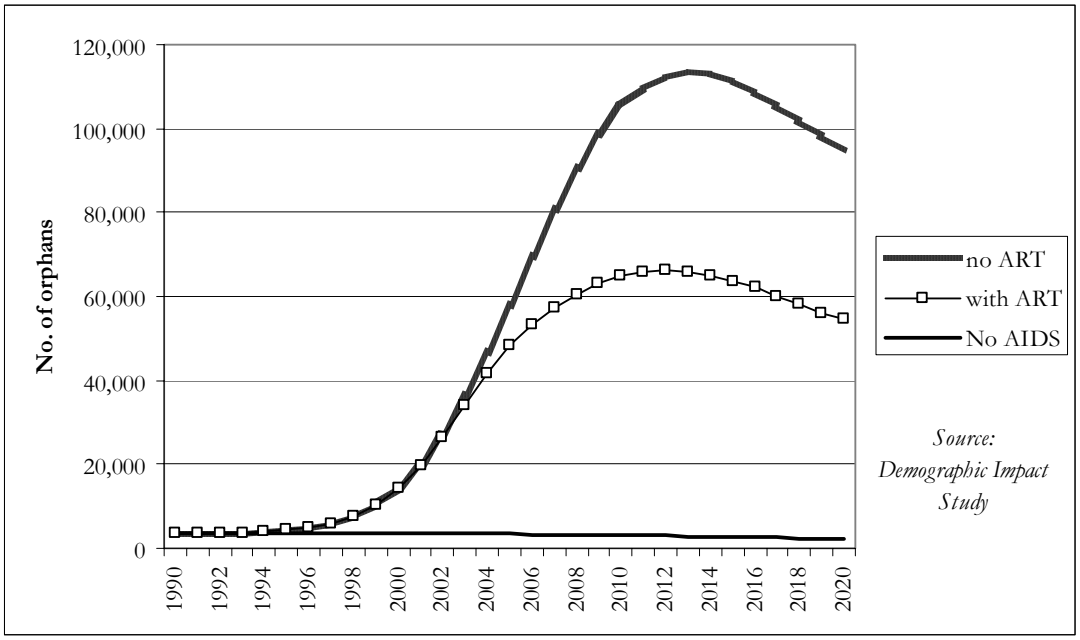


Furthermore, beyond its immediate impact on mortality, the pandemic also increases the number of orphans, who already number 50 000 (see figure 3-8)[2]. The resulting increase in the average dependency ratio will exacerbate the high burden placed on remaining households and the government.

[2] Orphans are here defined as children who have lost both parents (i.e., 'double orphans'). The demographic study estimates that an additional 325 000 children will be *either* maternal or paternal 'AIDS orphans' by 2021.

Figure 3-8: Number of Orphans

(children who have lost both parents)



4. Recent Work on the Macroeconomic Impact of HIV/AIDS in Botswana and Southern Africa

A major objective of the current study is to review the study carried out by BIDPA on the same topic in 1999-2000. The first part of this chapter reviews the macroeconomic projections contained in BIDPA (2000), and assesses them in terms of actual economic performance to date. To the extent possible, reasons for any divergence between projected and actual performance are identified. The second part of the chapter reviews the structure of the BIDPA macroeconomic model, along with other relevant modelling exercises carried out in recent years on Botswana and Southern Africa.

a. Assessment of BIDPA Macroeconomic Forecasts

The BIDPA study projected a range of macroeconomic variables at 5-yearly intervals over the period from 1996 (the base year) to 2021. Predictions were made of the following variables (in terms of levels and/or real growth rates):

- real GDP (economic growth)
- real GDP (income) per capita
- average wages
- skilled labour wages
- un(der)employment

A number of scenarios were modelled, depending on key parameters relating to investment and productivity. The key result was a projection that GDP growth would be reduced by 0.5-1.5 percent a year through to 2021 as a result of HIV/AIDS[3].

Obviously only a small portion of the projection interval has passed, with most GDP and other data available up to 2004/05. However, we can make comparisons of the actual outturn with projections in the BIDPA and other studies. It is important to note, however, that it is not possible to carry out a direct assessment or evaluation of the BIDPA projections, as they involved a comparison of the economic impact of HIV/AIDS with a "No AIDS" counterfactual, and the course of this "No AIDS" scenario is unknown. The comparison that can be done, of the actual outcome with the projected outcome, is different, but nonetheless useful. In addition, some of the assumptions and parameters used in the BIDPA study can be compared with the actual outcomes.

It should also be noted that the BIDPA projections covered 5 year intervals from 1996-2001 and 2001-2006 (and through to 2021). The latest available Botswana macroeconomic (GDP) data is for 2004/05, so the relevant data for 2001 to 2005 will be compared with the BIDPA projections and assumptions for 2001-2006 (generally measured in terms of annual average growth rates).

[3] Note that other studies (discussed in more detail below) have suggested that the negative impact might be larger. For instance, IMF studies on Botswana projected a 3-4% a year reduction in GDP growth, while Arndt & Lewis's CGE modelling exercise for South Africa estimated that HIV/AIDS would have a negative impact of 2.6% a year on GDP growth.

Table 4-1: Actual Outturn vs BIDPA (2000) Projections & Assumptions

(period averages)

	1995/6 - 2000/01	2000/01 - 2004/05	2000/01 - 2005/06
Economic Growth			
BIDPA	3.1%		2.9%
Actual (non-mining)	5.9%	4.6%	
Actual (non-mining private sector)	5.4%	3.3%	
GDP per capita (growth)			
BIDPA	1.3%		1.1%
Actual (non-mining private sector)	2.8%	1.6%	
Population Growth			
BIDPA	2.5%		0.8%
Actual (CSO)	2.4%	0.9%	0.9%
Actual (CARE)	2.5%	1.7%	1.7%
Labour Force Participation Rate			
BIDPA	51%		51%
Actual	58%	57%	
Investment (% GDP)			
BIDPA	25%		25%
Actual	30%	27%	
Productivity (TFP) Growth (%)			
BIDPA	0.25%		0.25%
Actual		1.3%	
HIV prevalence (15-64 yrs, %)			
BIDPA	31%		30%
Actual		24%	

Note: *BIDPA (2000) projections taken from Scenario J ("most likely")*
GDP measured at factor cost
TFP growth: non-farm business sector, average over 1996/7 – 2003/4

Sources: *Population Projections 2005 (CSO)*
National Population and Housing Census 2001 (CSO)
Annual Economic Report 2005 (MFDP)
BAIS II 2004 (CSO/NACA)
BNPC Productivity Statistics 2005
Centre for Actuarial Research (CARE), University of Cape Town

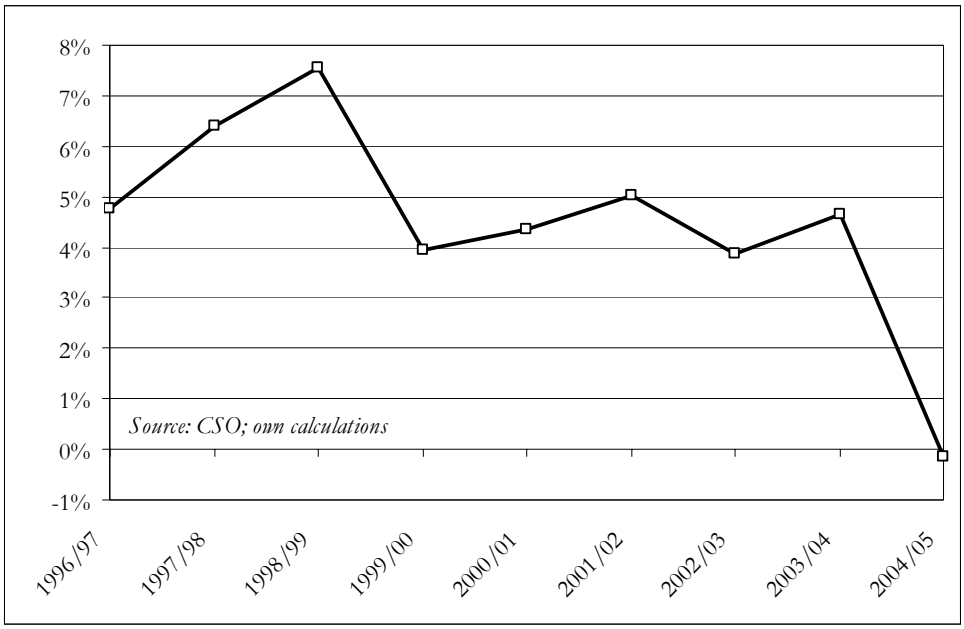
The results are summarised in table 4-1. The most important of these are that (non-mining) GDP growth was higher than projected, both from 1996-2001 and from 2001-2005[4]. However, from 2000/01 to 2004/05, population growth was also higher than projected, and thus GDP per capita growth was only slightly higher than projected (1.6 percent p.a. compared to a projected 1.3 percent). GDP growth is determined by a wide range of causal factors, and it is not possible to state whether the higher-than-projected growth is due to the impact of HIV/AIDS being less than projected, especially as it is not known what GDP growth would have been in the absence of HIV/AIDS. Nevertheless, this does suggest that the worst scenario of the projected economic

[4] The BIDPA study projections were of GDP growth excluding mineral rents. This is not directly observable, but the closest equivalent is the growth of GDP excluding mining.

impact of HIV/AIDS has not (yet?) been realised. However, it should be noted that these growth rates refer to period averages; in the most recent year for which data is available, that is 2004/05, non-mining GDP growth was only 0.9 percent, which is a sharp reduction from the growth rates of earlier years, and HIV/AIDS may have been a causal factor in this sharp reduction in growth.

Although GDP growth has been higher than that projected in the BIDPA study, the direction of change has been as predicted, i.e., the BIDPA study projected that GDP growth would decline, and that has indeed been the case. As Figure 16 shows, the growth of GDP in the non-mining private sector has been steadily declining over the past decade.

Figure 4-1: Growth of GDP in non-mining private sector



While the factors that determine GDP growth cannot all be identified, it is possible to compare the factors that were specifically included in the BIDPA economic projection model as determinants of growth with their actual outcomes; this includes model inputs and assumptions, such as population projections, HIV prevalence rates and investment rates.

With regard to **population growth**, the actual outturn according to projections in the CARE (2006) study was more than double the rate assumed in the BIDPA projections; hence, higher population growth can explain part of higher than projected economic growth rates. There is also some evidence that the **Labour Force Participation Rate** (LFPR) may have increased. The 2001 census results show a higher LFPR (58 percent of 15-64 year olds) than that used in the BIDPA projections (51 percent). The 2004 BAIS II results also show a higher LFPR (57 percent), which suggests that the higher economic growth could be due to faster labour force as well as faster population growth.

With regard to **investment rates**, the actual outturn as recorded in the national accounts data was somewhat higher than the BIDPA projections, although declining through to 2005. This may be a partial explanation of higher economic growth rates.

With regard to **HIV prevalence**, the actual outturn was somewhat lower than that used in the BIDPA projection model, and this may also be a partial explanation for the higher economic growth rates.

One of the most important input assumptions in the BIDPA model relates to **productivity trends.** Although data on productivity is sketchy, some estimates have been made by the Botswana National Productivity Centre (BNPC, 2005). These data indicate that average TFP growth in the non-farm business sector averaged 1.3 percent a year over 1996/7 – 2003/4, which is considerably higher than the assumption in the BIDPA model of 0.25 percent a year growth (which was itself based on TFP growth estimates made in the mid-1990s). This suggests that higher-than-anticipated productivity growth could be an important explanation of economic growth being higher than projected.

Finally, the BIDPA study was carried out at a time when Anti-Retroviral Therapy (ART) was expensive and not widely available (essentially restricted to members of private medical aid schemes). Since that time the cost of ART has fallen substantially and the treatment is widely available through the public health service. This may also be contributing to a reduced impact of HIV on the economy, through improved health/productivity of the workforce, although at the same time the high overall cost of ART provision and related health expenditures may be reducing government investment in the economy.

b. Assessment of BIDPA and Other Macroeconomic Models

The BIDPA model projected the macroeconomic impact of HIV/AIDS using a modified Solow-type growth model, following earlier modelling of other African economies using a similar approach. The model contained two economic sectors (the formal and informal sectors) and three factors of production (skilled labour, unskilled labour, and capital).

Labour force projections used demographic data from the CSO (for projections without HIV/AIDS) and from the ASSA model (for projections with HIV/AIDS), supplemented by an estimated impact of HIV/AIDS on productivity and labour availability. The labour force was broken down according to skill level (skilled/unskilled; unskilled into formal/informal). The model was calibrated to a 1996 base year using 1995/96 Labour Force Survey data and National Accounts data. No specific allowance was made for ART provision or its impact on HIV/AIDS or the population. Capital stock projections were produced using the long-term investment rate (as a percentage of GDP), with no binding savings constraint.

A number of scenarios were generated for the economic impact of HIV/AIDS by varying the following parameters in the model:

- skilled workers HIV+ rate (compared to overall HIV+ rate);
- skilled workforce growth rate (compared to overall labour force growth rate);
- productivity loss for HIV+ workers;
- HIV impact on investment rate;
- formal sector productivity growth.

The emphasis on the impact on skilled workers and on productivity and investment reflected general concerns about the channels through which the economic impact of HIV/AIDS

operates, and Botswana's specific concerns with the constraints already imposed on development through the shortage of skilled labour.

i. Subsequent work on the economic impact of HIV in Botswana

The BIDPA study has set a benchmark that has been followed by other studies on the impact of HIV/AIDS in Botswana. A paper published by the IMF in 2001 "draws upon, updates and extends the BIDPA results, using a similar framework" (MacFarlan & Sgherri, 2001). It focuses on the same channels for the economic impact of HIV/AIDS, i.e., the demographic/labour supply impact; productivity changes; the impact on human capital/skilled labour; and the impact on investment & savings. It does, however, note that the BIDPA study may have under-estimated "intangibles", i.e. the impact on economic growth through confidence and the investment climate. It also expressed concerns that the BIDPA study may have under-estimated the impact on health care spending, and hence on savings and investment.

The IMF analysis uses basically same model as BIDPA but varies it by incorporating different scenarios, specifically lower capital inflows from abroad; lower capital accumulation (investment); reduced productivity growth (TFP); and a greater negative labour productivity impact (via lost working time) of HIV/AIDS[5]. The analysis predicts GDP growth to fall by 3-4 percent a year over a decade. The higher impact is due partly to updated demographic projections implying a higher HIV prevalence, but also because the analysis incorporates the feedback effect of lower capital accumulation. It concludes that the "prospects of moving towards a more diversified economic structure would appear to be particularly threatened by HIV/AIDS", because of intensifying skills shortages, a deteriorating investment climate and a weakening of the social fabric.

A subsequent IMF study (Masha, 2004) notes that "a major gap in most of the existing studies is the lack of analysis of how social and economic adjustments are likely to mitigate the future course of the epidemic, and subsequently the macroeconomic impact". In other words, economic modelling relies on demographic projections that incorporate minimal intervention to counter HIV. The study therefore models an "AIDS with intervention" scenario in addition to "no AIDS" and "with AIDS" scenarios; the "AIDS with intervention" scenario is based on the plans outlined in NACA's National Strategic Framework (NACA, 2003a).

The study uses a simpler model than that used in the BIDPA study and the earlier IMF study, in that the economy has a single sector and two factors of production, i.e. it doesn't model the different responses of the formal and informal sectors, nor does it distinguish skilled and unskilled labour. Nevertheless, the study provides some interesting results. First, it notes that while a large scale treatment/intervention programme is in progress, economic growth is reduced because of the impact of high HIV/AIDS treatment costs on savings and investment, hence capital accumulation is lower. In the medium term, however, economic growth rises because of the positive impact of intervention on labour force size and productivity. It addition, however, it notes that the beneficial medium term economic impact is highly dependent upon degree to

[5] TFP is Total Factor Productivity, which refers to the overall productivity with which inputs to production are combined, rather than the productivity gains that result from additional labour or capital inputs. TFP growth is the main determinant of long-term economic growth.

which programme is financed by external donors. The analysis assumes that donors meet 50 percent of the programme costs, and notes that without this, the cost of the intervention programme would cause economic growth to fall to a much greater extent due to reduced availability of investment funds, despite the positive impact on the labour force and productivity. It also concludes that under the AIDS-with-intervention (NSF) scenario, the "indirect fiscal effects of a comprehensive prevention and treatment programme [from higher tax revenues due to higher economic growth] can significantly contribute to the financing of such a programme".

ii. Other relevant studies

Besides the BIDPA study and the two IMF papers mentioned above, there have been no other studies on the economic impact of HIV/AIDS in Botswana.

As noted, the two IMF papers used the same fundamental approach (model type and structure) as the BIDPA study, although addressing some of the shortcomings in that study. In particular, they incorporated a channel reflecting the impact of HIV on savings and investment, which was not explicitly done in the BIDPA study[6]. The later study incorporates the effect of possible adjustments in response to the epidemic, specifically the impact of ART, reflecting the more widespread availability and reduced cost of ART.

The BIDPA study was criticised in some quarters for concentrating on the non-mining sector of the economy. In fact the BIDPA study did not omit the non-mining sector; what it did was to exclude *mining rents*, i.e. the portion of mineral revenues (and hence of GDP) that results from the monopoly status inherent in mineral deposits. The reason for doing so was that the mineral rent portion of GDP is not directly attributable to capital or labour; hence including it would have made it more difficult to identify the economic impact of HIV/AIDS. The IMF (2001) paper followed the same approach, for the same reasons.

However, there is no doubt that a richer analysis of the impact of HIV/AIDS on an economy can be obtained from a modelling approach that incorporates different sectors. This is in contrast to the approach used by BIDPA and the IMF, which works at the aggregate economic level and includes only limited distinction between economic activities, through the model's division into formal and informal sector economic activities and skilled and unskilled labour. In practice of course, the economic impact of HIV/AIDS will vary across sectors, depending on a number of factors such as the degree of labour/capital intensity in the production structure of each sector, and its use of skilled and unskilled labour. Given that HIV/AIDS has its impact through various different channels, including investment, labour availability and productivity, and public spending, the sectoral impacts may well vary.

Such a disaggregated approach can be modelled using a computable general equilibrium model (CGE). A CGE-based analysis of the economic impact of HIV/AIDS has been carried out for South Africa (Arndt & Lewis, 2000, 2001). The authors note that:

"CGE models have a number of features that make them suitable for examining "cross-cutting" issues such as the impact of HIV/AIDS.

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[6] The reason for this was that with an average savings rate of 40% of GDP and an average investment rate of 25%, there was considerable scope for savings to fall as a result of HIV/AIDS-related expenditure both public and private, without GFCF being adversely affected.

- They simulate the functioning of a market economy, including markets for labour, capital and commodities, and provide a useful perspective on how changes in economic conditions will likely be mediated through prices and markets.
- Unlike many other partial equilibrium or aggregate macro approaches, they are based on a consistent and balanced set of economy-wide accounts (called a Social Accounting Matrix, or SAM), which requires (among other things) that key behavioural and accounting constraints (such as budget constraints and balance of payments equilibrium) are maintained, which in turn serves as an important check on the "reasonability" of the outcomes.
- Because they can be fairly disaggregated, CGE models can provide an economic "simulation laboratory" with which we can examine how different factors and channels of impact will affect the performance and structure of the economy, how they will interact, and which are (quantitatively) the most important" (Arndt & Lewis 2000, p.4)

CGE models therefore permit a disaggregation of the economy into various different productive sectors (14 in South Africa), each using a range of factors of production (e.g. skilled and unskilled labour, and capital), and incorporating different household types by income level and various government spending categories; they can also incorporate different HIV prevalence rates across skill categories. CGE modelling enables the consideration of distributional impacts, the impact on overall economic growth and sectoral growth, the impact on employment and wages in different segments of the labour market, as well as the impact on relative prices.

Arndt & Lewis (2000) pay particular attention to the impact of HIV/AIDS on productivity (TFP) growth in the CGE modelling exercise for South Africa. They conclude that HIV/AIDS will reduce growth by 2.6 percent a year (vis a vis the "no AIDS" scenario), with lower GDP per capita (reduced by 8 percent after 10 years). The contribution of various factors to lower GDP growth include lower productivity growth (34 percent of the total impact); lower government savings (leading to lower investment, to the extent that it is not replaced by FDI) (45 percent); reduced labour supply (13 percent) and reduced factor-specific productivity (8 percent).

In a second paper using the same approach, Arndt & Lewis (2001) looked at sectoral impacts, and found that while all sectors of the SA economy were adversely affected, the greatest negative impacts were in the construction and equipment sectors, while the least affected were medical services and government. The explanation for these effects was that the construction and equipment sectors were strongly affected by the reduction in investment (as investment demand accounts for the majority of output in those sectors), while government and medical services were the least affected due to the direct impact of HIV/AIDS in increasing demand for the output of those sectors.

The CGE approach has also been used to model the impact of HIV/AIDS in Zambia (Lofgren, Thurlow & Robinson, 2004). This assessment concluded that over the period 2001-2015, HIV/AIDS would reduce average economic growth from 5 percent (without AIDS) to 4.1 percent, a reduction of almost one percent a year. It also analyses the impact of a publicly-funded treatment programme for HIV/AIDS, providing ART to half of those who would clinically benefit from such treatment. The costs of such a programme are very high, leading to a 50 percent increase in government spending. The negative impact of HIV on economic growth is

reduced by half in this scenario, with growth averaging 4.6 percent. However, the additional taxes or government borrowing required to pay for this treatment imposes a burden on households, so that private consumption growth is lower, and poverty higher, than under the AIDS-without-treatment scenario. GDP per capita growth is marginally higher under the two with-AIDS scenario (with and without treatment) than under the no-AIDS scenario.

iii. Macro-econometric models

A third approach is to derive simulations from a large scale econometrically-estimated macroeconomic model, which are available in some countries for the purposes of macroeconomic forecasting. Use of such this approach for forecasting the impact of HIV/AIDS is feasible if such a model has been previously estimated and can be readily adapted to incorporate the channels through which HIV/AIDS affects the economy. This approach has been used in South Africa, particularly in the analyses carried out by the Bureau for Economic Research (BER) at the University of Stellenbosch. Like a CGE, such a model can simulate the impact of HIV/AIDS across economic sectors. BER's 2001 exercise (Laubscher et al 2001) projected that economic growth in South Africa would be reduced by 1.4 percent a year over 2001-2015, although GDP per capita growth would rise by 0.9 percent p.a..

BER's more recent exercise, carried out for USAID (BER 2006) focuses on the impact of alternative intervention scenarios, including the provision of ART. The methodology is similar, in that it uses the BER's existing medium-term macro-econometric forecasting model of the South African economy, with assumptions regarding the channels through which HIV/AIDS has a macroeconomic impact, and associated parameter values, added to the model. The main channels modelled are the lower demographic growth rates of the population and labour force; lower productivity; additional government spending on health care and welfare payments; additional direct and indirect costs to firms; and the impact on household savings and consumption expenditure.

Although the methodology is different to the other studies discussed above, the results are similar. The impact of HIV/AIDS on growth is -0.5 percent a year on average between 2000 and 2020 without ART, and -0.4 percent a year with ART (the model assumes a 50 percent take up of ART by the relevant HIV+ cohorts). However, GDP per capita rises, growing on average by 0.4 percent a year faster with AIDS, because the slowdown in population growth is larger than the slowdown in economic growth. Also, the decline in population and labour force growth results in a sharp reduction in unemployment; in 2020, unemployment is projected to decline from 27 percent in 2004 to 21 percent in 2020 in the no-AIDS scenario, but to decline to 9 percent in the with-AIDS scenarios. Savings and investment are both adversely affected, with the latter declining by around 3 percent of GDP.

iv. Impact on Poverty and Inequality

The BIDPA (2000) study simulated the impact of HIV/AIDS on household income levels, and hence on poverty and income distribution. This was done by taking the actual results of the 1993/94 Botswana Household Income and Expenditure Survey (HIES) and distributing HIV/AIDS across individuals (and hence households), with the probabilities of HIV infection being determined in line with the prevalence rates for different age and residence groups derived

from Sentinel Surveys. The impact of HIV infection and eventual illness and death on household incomes was then simulated, and the resultant changes in poverty and inequality calculated. The results (which were subsequently published in Greener, Jefferis & Siphambe (2000) and Greener (2004)) indicated that HIV/AIDS would tend to raise poverty levels by between 4 and 6 percent compared to what they would be otherwise (given that poverty has been declining in Botswana, HIV/AIDS would cause a slowdown in poverty reduction of this amount). The same methodology was subsequently used in Salinas & Haacker (2006), and is accepted as a useful way of analysing the impact of HIV/AIDS on poverty and inequality.

v. Implications for this study

This review has several implications for the methodology to be employed in the current study to assess the macroeconomic impact of HIV/AIDS. First, the aggregate growth function approach used by BIDPA (2000) is an accepted one in the literature, and has been used on several occasions since that study was finalised (see summary of economic impact studies in table 4.2). However, the approach can be improved in several ways. One necessary improvement is to refine the incorporation of savings-investment linkages, and in particular to pay more attention to the public and private costs of HIV/AIDS treatment, the impact of these costs on savings, and the impact of reduced savings on investment, and hence on growth. A further essential refinement is to broaden the range of scenarios to include widespread ART provision and its impact on population growth, the labour force, productivity and costs. Finally, greater attention needs to be paid to productivity (TFP) growth under the various scenarios (with/without HIV/AIDS; with/without ART).

A second implication is that, if CGE modelling is feasible, it can provide a broader and richer range of outputs, in that it can more thoroughly trace the impact of HIV/AIDS and ART provision through the economy, and permit a more detailed analysis of the impact on different production, labour market and household sectors. It should be noted that the CGE approach is not fundamentally different to the growth function approach – in that a similar production function is central to the CGE model – it is just much more disaggregated in terms of economic sectors and markets, and labour and household categories. However, the data requirements of CGE modelling are much more demanding than that of an aggregated growth function approach; besides requiring a (recent) Social Accounting Matrix (SAM), it requires suitably disaggregated data on national accounts, the labour market, and the government budget, as well as information on HIV prevalence across labour market categories. The most recent SAM and Labour Force Survey for Botswana are both from 1996, and CGE modelling requires that the SAM to be updated, at least to 2001.

Finally, while the macro-econometric modelling approach has been used successfully in South Africa, this is dependent upon the use of an existing model. There is no such model currently existence for Botswana (at least none that is readily available), and the task of producing one is beyond the scope of this study. Hence this approach will not be pursued, but both the aggregate growth model and the CGE approaches will be used (i.e., updating/refining the BIDPA approach, and building a suitable CGE). The outputs of both will be used for the final economic impact projections.

With regard to the impact of HIV/AIDS on poverty and inequality, the same approach will be used as in the BIDPA study, i.e. simulating the poverty impact based on the 2002/03 HIES. The CGE model will also provide estimates of the distributional impact.

Table 4-2: Summary of Results – Economic Impact of HIV/AIDS

Authors	Country	Method	Period Covered	Impact on Growth Rates	
				GDP	GDP per cap.
Over (1992)	30 sub-Saharan African countries	Econometric estimation & simulation	1990-2025	-0.56% to -1.08%	0.17% to -0.35%
	10 most advanced epidemics			-0.73% to -1.47%	0.13% to -0.60%
Kambou, Devarajan & Over (1992)	Cameroun	CGE	1987-91	-1.9%	n/a
Bloom & Mahal (1995)	51 countries	Econometric estimation	1980-92	-ve but small	
Cuddington (1993a,b)	Tanzania	Aggregate growth model	1985-2010	-0.6% to -1.1%	0.0% to -0.5%
Cuddington & Hancock (1994a,b)	Malawi	Aggregate growth model	1985-2010	-0.1% to -1.5%	-0.1% to -0.3%
BIDPA (2000)	Botswana	Aggregate growth model	1996-2021	-0.8% to -1.9%	+0.4% to -0.5%
Quatteck/Ing Barings (2000)	South Africa	Macro-econometric model	2001-2015	-0.3%	+ve
Arndt & Lewis (2000)	South Africa	CGE	2001-2010	-1.6%	– 0.8%
MacFarlan & Sgherri (2001)	Botswana	Aggregate growth model	1999-2010	-3.5% to -4.5%	0% to -1%
Laubscher et al/BER (2001)	South Africa	Macro-econometric model	2001-2015	-0.33% to -0.63%	+0.7% to +1.0%
Bell, Devarajan & Gersbach (2004)	South Africa	Overlapping-generations model	1990-2080	n/a	-0.2% to -2.5% (†)
Lofgren, Thurlow & Robinson (2004)	Zambia	CGE	2001-2015	-0.4% to -0.9%	+0.2%
Masha, I (2004)	Botswana	Aggregate growth model	1991 – 2016	-0.8% to 2%	n/a
BER (2006)	South Africa	Macro-econometric model	2000-2020	-0.4% to -0.6%	+0.3% to +0.4%

Source: updated from Table 4 in BER (2006)

Notes: † real income per family, derived from figures in paper

5. Macroeconomic Impact of HIV/AIDS: Updated Aggregate Growth Model

a. Introduction

The aim of this chapter is to develop updated projections for the macroeconomic impact of AIDS in Botswana, focusing in particular on GDP growth and per capita real incomes. It simulates the growth path of the economy over a 20-year period (2001-2021) under three scenarios: "no-AIDS"; "AIDS-with-ART" and "AIDS-without-ART", and makes projections for key economic variables under each scenario, enabling comparisons between them. It also permits the variation of key parameters in the with-AIDS scenarios, which enables the projections to identify areas where policy interventions might best help to minimise the impact of AIDS on the economy. The modelling approach adopted essentially replicates that followed in the BIDPA (2000) study, and the description of the model is largely as in that study. As noted in previous reports, the same methodological approach was followed by the IMF (2001) and (2004) studies, with some amendments. We have also introduced some changes in this model, as described below.

The results show that while HIV/AIDS is likely to have a significant negative impact on GDP growth, reducing the economic growth rate as compared to the no-AIDS scenario, as well as a negative impact on per capita incomes. Unemployment (and underemployment) is, however, likely to be lower under both of the with-AIDS scenarios than in the no-AIDS scenario. The results are of course sensitive to the assumptions made about various key parameters, especially about the rate of investment in the AIDS-with-ART and AIDS-without-ART scenarios.

b. The Macroeconomic Simulation Model

i. Model Structure

At the centre of the model is a production function, which enables output (GDP) to be calculated as a function of inputs (labour and capital) and productivity changes. If the inputs of the different factors of production can be projected (projections which will differ under the AIDS and no-AIDS scenarios), then GDP can also be projected.

The model goes beyond a simple, single production function by introducing the following innovations:

- the economy is divided into formal and informal sectors, with each modelled separately;
- labour is divided into skilled and unskilled categories

The model therefore has three labour markets: skilled formal sector, unskilled formal sector, and unskilled informal (it is assumed that all skilled workers are employed in the formal sector[7]). These labour markets behave differently.

[7] While there may be a few skilled workers employed in the formal sector, the numbers are considered small enough (in terms of the classification of skilled and unskilled workers used here) not to make any significant impact on the results, and hence they are not included in the model.

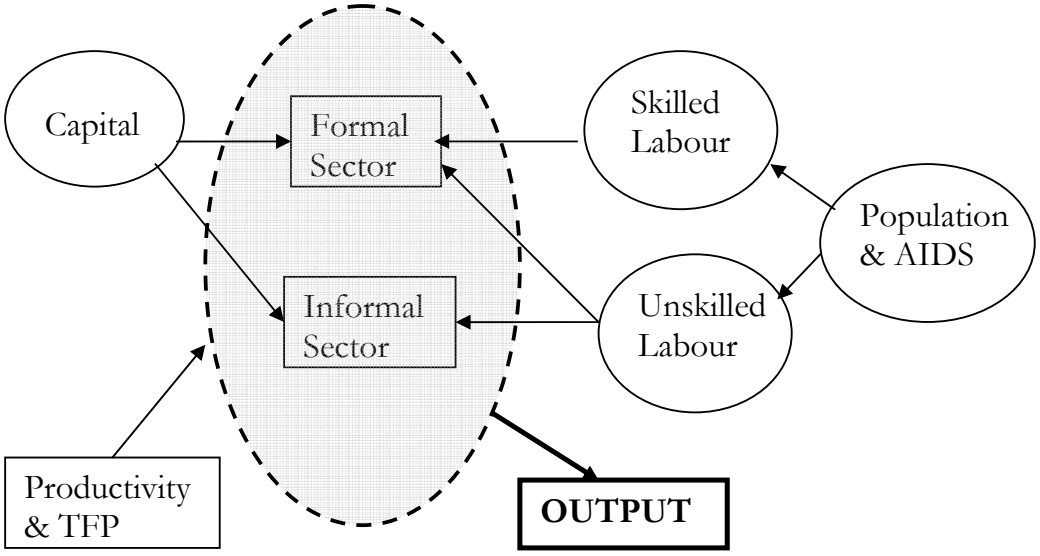
- in the skilled, formal sector, it is assumed that market forces work, and that wages adjust to equate demand and supply;
- in the unskilled, formal sector, it is assumed that there is a minimum wage, which does not adjust in response to demand and supply; instead, it is assumed that the minimum wage continues to increase at its average rate over the past decade, which is around 1 percent a year in real terms. As a result, the formal sector market for unskilled labour does not clear, and there is (formal sector) unemployment;
- unskilled workers who are unemployed in the formal sector make up the supply of labour in the informal sector, where wages adjust to clear the market and equate demand and supply.

The model therefore incorporates skilled and unskilled labour separately, along with unemployment and dual labour markets. Furthermore, labour is modelled in terms of effective (productivity-adjusted) labour supply, rather than simply numbers of workers.

The advantages of this approach, and the reasons for choosing it are as follows:

- the production function approach allows forecasts of output to be made according to the factor inputs (capital and labour) available, and hence forecasts of economic growth rates with different amounts of inputs;
- it permits modelling of labour markets and consequently determination of the quantity of labour employed, and its wage rate;
- the division into formal and informal sectors reflects the structure of sub-Saharan African economies in general, and the Botswana economy in particular;
- labour and capital inputs can be changed to reflect the impact of AIDS, as can various other parameters;
- the incorporation of a sticky wage for unskilled labour in the formal sector, and market determination of wages in the informal sector, reflects the institutional structure of wage determination; and
- the use of effective labour supply incorporates the productivity gains that come from workers' experience, as well as the impact of AIDS through the changing age structure of the workforce and the lower productivity of AIDS-infected workers;
- the model is appropriate to the particular economic structure of Botswana (in particular the persistent shortage of skilled labour).

The model is shown diagrammatically below.



The production function takes the Cobb-Douglas form (this relates to the manner in which inputs are combined to produce output). In the formal sector, this is as follows:

$$Yf_t = \alpha f . \gamma f^t Efs_t^{\beta_s} Efu_t^{\beta_u} Kf^{(1-\rho f)} \qquad [1.]$$

where *Efs* and *Efu* represent effective labour supplies of skilled and unskilled labour respectively (measured in efficiency units), and *Kf* is the capital stock. The shares of output attributable to each factor are β_s, β_f, and ρf=1-β_s-β_u. γf represents an exogenous technological trend, while the constant αf is a scale factor, which is used to calibrate the model in the base year (2000/01), so that it fits the actual data from that year.

The definition of output (GDP) used in the model is slightly different to the conventional definition in the national accounts, in that mineral rents – which comprise a significant proportion of GDP – are excluded. These rents are not directly attributable to capital or labour, but result from the monopoly status inherent in mineral deposits. The inclusion of the value of mineral rents in output would obscure the impact of HIV/AIDS on the economy, hence the exclusion. The value of mineral rents is proxied by government's income from mineral revenues[8]. It should be noted that all projections are in real terms (in constant 2000/01 prices).

ii. Assumptions in the model

Like all models, this one makes certain assumptions regarding the behaviour of the economy. The assumptions that are explicitly or implicitly made here are as follows:

- markets will clear (prices adjust to equate supply and demand) (except for the formal sector market for unskilled labour);

[8] The argument for excluding mineral rents from output, and the method of calculation, is taken from Bank of Botswana, 1993.

- the economy responds to changes in factor prices, by substituting cheaper factors of production for more expensive ones, e.g., if a shortage of skilled labour causes skilled wages to rise relative to cost of unskilled labour and capital, the economy will substitute unskilled labour and capital for skilled labour;
- the rate of factor substitution is fixed and determined by the production function;
- there are constant returns to scale and the price of capital is fixed.

The assumption that factor substitution takes place in response to changes in relative prices is probably reasonable one over a long period of time on an economy wide basis. It assumes that firms behave rationally and that natural selection will help the firm sector as a whole to adjust the relative price changes. What is less satisfactory is that the value of the rate of substitution is fixed – and on the basis of our present knowledge of the economy, we have no way of knowing whether that fixed value is correct.

This raises a more general point that the model depends upon a variety of parameter values, many of which are unknown and cannot be determined from empirical data. Where possible, the projections deal with this through sensitivity analysis - varying these parameters and determining the impact of this variation on the results.

In order to apply the model, it is necessary to calibrate it so that its projections match the actual (known) values of relevant economic variables in some base period. In this case, 2000/01 is chosen as the base year, as it is the most recent year in which detailed national accounts and population data are available.

iii. Investment and Capital Stock

The production function requires information regarding the capital stock (K) in order that output can be calculated; hence capital stock projections have to be made for the simulation period. This is a difficult task, although it can be achieved by projecting investment rates and making an assumption about depreciation. However, it is not accuracy about the exact level of the capital stock that is essential, but modelling the impact of AIDS on the likely path of the capital stock (i.e., it is the AIDS impact on investment that is important, rather than the absolute level of investment).

There are two main channels through which AIDS can impact on investment: availability of finance (savings), and investment intentions. Assessments of the economic impact of HIV/AIDS in other countries focus mainly on the first impact, i.e., reduced availability of savings. Botswana's case is somewhat unusual, however, as the savings rate is very high (around 40 percent of GDP), while the investment rate is around 25 percent of GDP. There is, therefore, considerable scope for savings to be reduced before the savings constraint starts to be binding on investment. At a macroeconomic level, there should be sufficient savings to finance desired investment, even if the costs of dealing with HIV/AIDS reduce savings somewhat. This was the approach followed in the BIDPA (2000) model, where it was assumed that investment would not be reduced because of lower savings, given the very high initial level of savings in Botswana.

However, the true picture may be more complex than this. Most of the costs of HIV/AIDS in the with-ART scenario fall on government, and with a binding fiscal constraint (the government's commitment to a balanced budget), increased expenditure on HIV/AIDS will lead to reduced

expenditure in other areas. With total HIV/AIDS costs potentially reaching 3.5 percent of GDP, public sector investment could be reduced by this amount. This should, however, be seen as a maximum. HIV/AIDS costs may be financed, in part, by cutting back on recurrent expenditure, or by cutting back on low-productivity investment, or by cutting back on wasteful components of government spending more generally. Indeed, there is some anecdotal evidence that the need to find resources to finance HIV/AIDS-related spending has stimulated a useful prioritisation exercise in terms of the allocation of public spending between competing needs. Also, in reality, government may not meet all of the needs for HIV and AIDS services (including e.g. large scale increases in hospital capacity). This may be through implicit or explicit policy decisions, or simply because of capacity constraints on large scale implementation.

In this study, therefore, we model the impact of different assumptions regarding the negative impact of HIV/AIDS on investment. This contrasts with the approach taken in BIDPA (2000), and reflects comments made subsequently about the way in which investment and savings were incorporated into the model. The approach followed here is more akin to the approach followed in the modelling of HIV/AIDS in other countries, where the impact of HIV/AIDS costs on savings causes investment to fall.

The negative impact of HIV/AIDS on investment will depend on the expenditure associated with dealing with HIV/AIDS, and this will be greater in the "with ART" scenario. Nevertheless, investment may also be reduced for other reasons, as the uncertainty associated with HIV/AIDS (for instance, affecting the availability of skilled labour), may also negatively affect investment intentions. This negative impact is likely to be more severe in the "without-ART" scenario, as a far greater burden of dealing with HIV/AIDS then falls on the private sector.

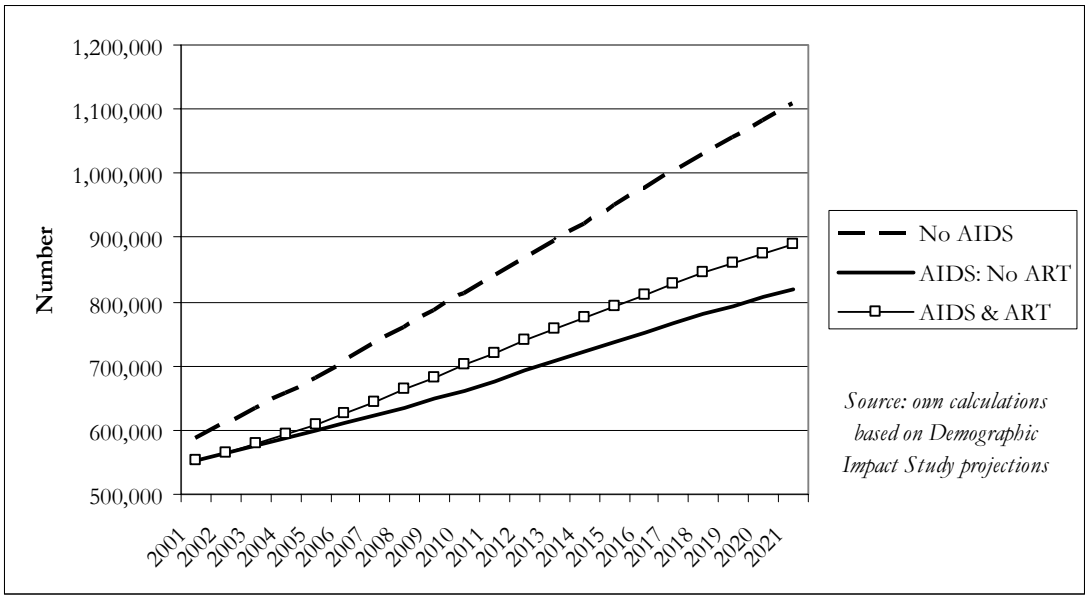
c. Impact of HIV/AIDS on the Labour Force

i. Size of the Labour Force

It is important to incorporate the impact of HIV/AIDS on the labour force, as this is one of the main channels through which the economic impact of HIV/AIDS occurs.

The demographic projections have been used to project the growth of the total labour force over the period to 2021. If we assume (for simplicity) that the labour force participation rate remains unchanged, then the growth of the labour force will be as shown in Figure 5-1. This shows that under both of the "with AIDS" scenarios, the labour force will be significantly smaller in 20 years with AIDS than it would have been without AIDS. In the no-AIDS scenario the labour force in 2021 would total 1,109,622 (an increase of 89 percent over the 2001 level), whereas in the "AIDS-with-ART" scenario it would only total 888,838 (an increase of 61 percent) and in the "AIDS-without-ART" scenario it would only increase by 48 percent.

Figure 5-1: Labour Force Projections



There is also a slight change in the age structure of the labour force. Without AIDS, the average age of the labour force increases from 33 years in 2001 to 35 in 2021; with AIDS it remains at 33 years. Hence AIDS has the effect of shifting the labour force to a slightly younger age structure.

ii. Labour Efficiency Units

As in the BIDPA (2000) study, our approach models the labour force in terms of "labour efficiency units", which incorporates the impact of work experience on productivity and efficiency. Because work experience is more important to skilled than unskilled labour, the shifting of the labour force to a younger age structure has a more dramatic effect on skilled workers.

The effective labour supply is measured in terms of labour efficiency units as follows:

$$E_t = \sum_{i=15}^{64} (1 - z a_{it}) \rho_{it} L_{it} \qquad [2.]$$

Where L_{it} is the number of workers of age i at time t, and z is the fraction of the work-year lost per HIV-infected worker as a result of absence from work or reduced productivity due to sickness. This parameter can also take account of the impact of HIV and AIDS on the labour contribution of others, for instance if an uninfected spouse also has to stop working to provide care for an infected partner. a_{it} denotes the proportion of the labour force of age i that is HIV positive at time t. Finally, the parameter ρ_i denotes the work experience of workers of age i. This captures the productivity gains that come with experience on the job.

This formulation in terms of labour efficiency units captures the impact of AIDS on labour supply in two ways. First, AIDS has a demographic impact and alters the age composition of the population and the labour force. These changes in the numbers of workers of different ages are captured in the L_{it} term. A change in the age composition of the labour force alters the productivity of the labour force because of its impact on accumulated work experience, and this

is captured in the ρ_i term. AIDS will affect effective labour supply both by reducing the absolute number of workers and by shifting the age structure in favour of younger, less experienced workers.

As the productivity gains from work experience cannot be measured directly, an indirect approach has to be used. Cuddington (1993a, b) notes that various studies suggest a positive, non-linear relationship between earnings (and, by inference, productivity) and experience, and hence measures the labour efficiency ρ_i of a worker of age i as follows:

$$\rho_i = \delta_1 + \delta_2(i-15) + \delta_3(i-15)^2 \qquad [3.]$$

Where the parameters δ_1, δ_2 and δ_3 are estimated from a Mincerian earnings function from 1995/96 Labour Force Survey data separately for skilled and unskilled labour. Although this data is now somewhat out of date, there is no more recent LFS data (a LFS was being carried out at the time of this study), and hence we have continued to use the parameters estimated for the BIDPA (2000) study.

iii. Labour Force Skill Classification

For the purposes of the model, the labour force is divided into skilled and unskilled categories. This is done in terms of occupational classifications, as below. The BIDPA study made use of labour force data from the 1996 Labour Force Survey (LFS). In the absence of new LFS data, and other data sources were used, including the 2001 Household Census, and the 1993/94 and 2002/03 HIES, to obtain information on the structure of the labour force and changes therein.

Table 5-1: Classification of Workers into Skilled and Unskilled, by Occupation

Skilled		**Unskilled**	
1.	Legislators, administrators and managers	4.	Clerks
2.	Professionals	5.	Service workers & shop and market sales workers
3.	Technicians and associate professionals	6.	Agricultural and related workers
7	Craft and related trades workers	83.	Drivers
81 & 82.	Plant and machine operators and assemblers	9.	Elementary occupations

The disadvantage of using non-LFS data is that these do not provide a breakdown of occupational data into sub-categories; hence category 8 (plant and machine operators/assemblers/drivers), which is "mixed", had to be omitted from the skilled/unskilled classification. The only consistent data over time came from the two HIES, which gave the results shown in table 5.2. One of the important results for this study is that the skilled labour force grew by approximately 0.75 percent a year faster than the unskilled labour force.

Table 5-2: Labour Force Composition - HIES 1993/94 & 2002/03

	1993/94	2002/03	Avg. growth
Skilled	107,582	139,688	2.94%
Unskilled	241,085	293,232	2.20%
Mixed/unspecified	27,203	29,576	0.93%
Total	375,870	462,496	2.33%

d. Model Assumptions

i. Model Parameters

The model can now be used to derive equilibrium solutions for various time periods for the three scenarios (i.e. No-AIDS, AIDS-with-ART and AIDS-without-ART). The model is solved using the labour force and capital stock projections for five-year time intervals from 2001 to 2021 under the three scenarios. This provides outcomes for wages and employment in each of the three labour markets, and real output (GDP less mineral rents) in the formal and informal sectors. Key results are presented in the accompanying graphs and tables.

The model allows key parameters to be varied. In many cases the true values of these parameters are not known, and hence a sensitivity analysis can be carried out to see which variables the model results are most sensitive to.

The following parameters can be changed:

Labour force participation rate (LFPR): this denotes the proportion of the working age population (aged 16-64) actually in the labour force, whether employed or unemployed and seeking work. In the 2001 Census the LFPR was 58 percent. However, it may rise or fall as a result of HIV/AIDS: sick adults, or those caring for them, may withdraw from the labour force, thereby reducing the LFPR; alternatively, a labour shortage caused by AIDS may draw more of working age population into labour force.

Labour force HIV/AIDS prevalence rate (as percent of overall prevalence rate). This can be varied if there is reason to believe that the labour force has a higher or lower HIV prevalence rate than the general population in the same age cohorts.

Skilled labour force HIV/AIDS prevalence rate (as percent of overall LF prevalence rate): this can be varied if there is reason to believe that there is a higher or lower HIV prevalence rate amongst skilled workers than amongst the labour force as a whole.

Growth rate of skilled and unskilled labour forces (relative to overall growth rate of labour force) this reflects the results of education and training and the evolution of the labour force; as noted above, recent data indicates that the skilled labour force grew by 0.75 percent a year faster than the unskilled labour force between 1994 and 2003.

Productivity loss of workers with AIDS (percent of worker-equivalent per year): workers with HIV an AIDS may be less productive than other workers, although the degree of reduced productivity will depend on many factors, including the stage of the disease, the type of treatment undertaken and its effectiveness.

Investment rate (Gross Fixed Capital Formation (GFCF), as percent of GDP, with AIDS and without AIDS, for total economy and for informal sector). This is likely to vary between the no-AIDS and with-AIDS scenarios, as discussed further below.

Annual growth rate in total factor productivity (TFP), with and without AIDS. This is one of the most important potential impacts of HIV/AIDS. TFP refers to efficiency changes that are not attributable directly to either the capital or labour inputs to production, but to the manner in which they are combined in production. Arndt & Lewis (2000) identify four reasons why TFP growth rates are likely to decline as a result of HIV/AIDS: (i) the resources directed towards various aspects of the epidemic, which have an opportunity cost; (ii) the disruption to production from worker illness and absenteeism, resulting in some idling of capital equipment; (iii) higher transactions costs in enforcing contracts (for instance, HIV positive borrowers may have less incentive to repay debts); and (iv) the greater likelihood of illness and death amongst the workforce is likely to reduce the incentive to develop and implement process improvements. To these reasons may be added the negative impact of raised crime levels, and the resources devoted to associated counter-measures, that are likely in a society with a high level of HIV/AIDS and the alienation of some people from society as a whole.

ii. Parameter Value Assumptions

Assumptions need to be made as to the numerical values of the above parameters in order to generate projections. The initial results are reported for a Base Case with "neutral" parameter assumptions that do not vary significantly across the three scenarios, in order to initially identify the economic impact of HIV/AIDS through the changes in the size and composition of the labour force. The Base Case is not the most likely scenario, but rather a starting point for more complex simulations.

Productivity loss of workers with AIDS (percent of worker-equivalent per year): there are only a few empirical estimates of the negative labour productivity impact of AIDS, and most analyses try to make reasonable assumptions regarding this important parameter. Arndt & Lewis (2000, p.10) assume that "AIDS-afflicted workers are half a productive as remaining workers" (i.e. the fall in productivity is 50 percent), while BER (2006, p.50) assumes "a 40 percent reduction in the productivity of both skilled and unskilled workers who are sick with AIDS". In both cases this refers to productivity in the case of the untreated disease, and only to workers who have reached the later stages of the disease (i.e. in WHO stages 4-6) and not those who are HIV positive but asymptomatic. In this study, we take the lower estimate (40 percent). Where ART is available, workers taking ART will be much healthier, but some will experience illness due to treatment lapses or adverse reaction to treatment, and time will also be lost due to the need to collect medication (at present this is done on a monthly basis, on according to some reports can take a whole day). Furthermore, even in the AIDS-with-ART scenario, an estimated 10 percent of eligible adults are projected not to enrol in the ART programme. In line with other authors, we assume that the productivity impact of being on ART is equal to 25 percent of that associated with untreated HIV/AIDS. These factors combined make the average productivity loss in the AIDS-with-ART scenario equal to 15 percent.

Productivity estimates were based on data provided by the Botswana National Productivity Centre (BNPC, 2005). Estimates of Total Factor Productivity (TFP) growth are somewhat

volatile depending on the period chosen, and hence measuring productivity growth over a relatively long period is preferred. Taking the 20 years from 1984/85 to 2003/04, the average TFP growth rate is 1.1 percent a year[9]. We take continued productivity growth at this rate as the base case across the three scenarios (this will be varied in the alternative case below).

Gross fixed investment was set at 25 percent of GDP in the formal sector, which is approximately equal to the average actual investment (GFCF) rate in Botswana over the past ten years. Investment in the informal sector is set at 10 percent of income, which achieves an approximately constant capital-output ratio in the informal sector in the No-AIDS scenario.

Skilled labour force growth: continued investment in education and training is likely to result in faster growth of the skilled labour cohort of the labour force, and a rising proportion of skilled workers in the labour force. Hence it is assumed that the skilled cohort continues to grow on average 0.75 percent a year faster than the unskilled component, in line with historical trends; over 20 years, this would result in the skilled proportion of the labour force rising from the current level of 30 percent to around 34 percent.

The parameter values used in the Base Case scenarios are summarised in the table below:

Parameter	**No AIDS**	**AIDS – with ART**	**AIDS – No ART**
Labour force participation rate (LFPR)	58%	58%	58%
Labour force HIV/AIDS prevalence rate (as % of overall prevalence rate)		100%	100%
Skilled labour force HIV/AIDS prevalence rate (as % of overall LF prevalence rate).		100%	100%
Growth rate of skilled labour force (relative to overall growth rate of unskilled labour force).	0.75%	0.75%	0.75%
Productivity loss of workers with AIDS (% of worker-equivalent per year).		15%	40%
Investment rate formal sector (% of GDP)	25%	25%	25%
Investment rate – informal sector (% of income)	10%	10%	10%
Annual growth rate in total factor productivity (TFP), with and without AIDS.	1.1%	1.1%	1.1%

The results under the Base Case scenario are as follows (see Figures 2-2 to 2-5):

[9] This refers to the TFP growth rate for the "Non-Farm Business Sector" (BNPC 2005, p.17). The agricultural sector is not included in the BNPC estimates. Productivity estimates for mining are adjusted for mineral rents, as in this study. Average growth rates are calculated by OLS.

e. Model Results

i. Base Case

No AIDS

Output: GDP (excluding mineral rents) grows at an average annual rate of 4.5 percent between 2001 and 2021. With population growth averaging 1.9 percent a year, however, GDP per capita grows more slowly than GDP, at 2.6 percent a year. Economic growth in the formal sector (4.6 percent p.a.) is faster than in the informal sector, which grows on average by 2.6 percent a year.

Labour Market: relatively fast economic growth and increasing demand for labour in the formal sector pushes up real skilled wages slightly (0.4 percent a year). Increased availability of skilled labour causes overall employment in the formal sector to increase faster (3.8 percent a year) than the growth of the labour force (3.2 percent a year), and hence employment in the informal sector declines as a proportion of the labour force (indicating falling un-/under-employment). Average wages rise by 1.1 percent a year.

Figure 5-2: Base Case - Real GDP

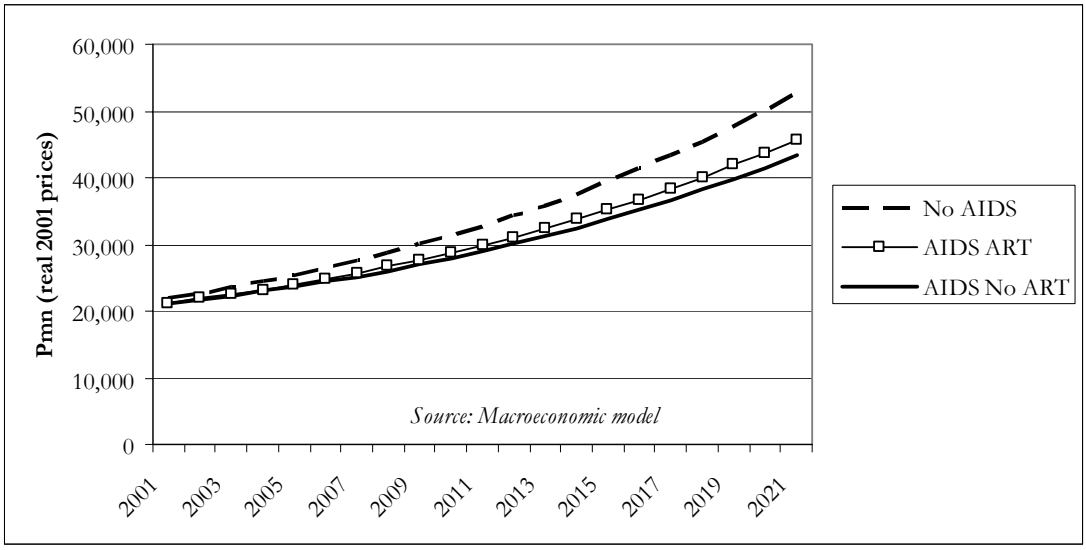
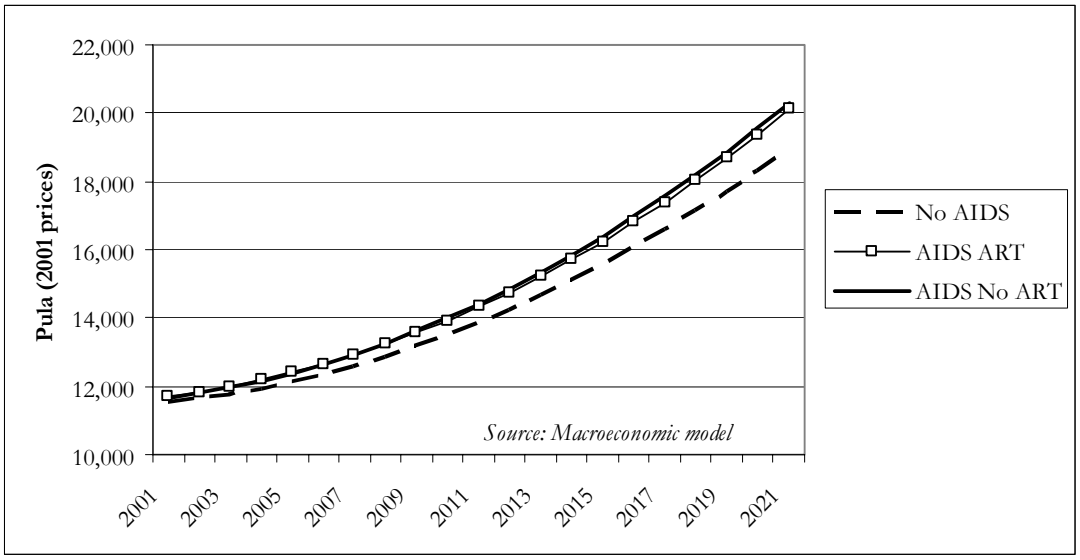


Figure 5-3: Base Case - Real GDP per Capita



AIDS-without-ART

Output: average GDP growth is lower with AIDS, at 3.7 percent - this is entirely to be expected, given the lower growth rate of the labour force. Average GDP per capita growth is slightly higher, at 2.8 percent a year. The lower rate of GDP growth means that in 2021, GDP is 17.7 percent smaller with AIDS than it would have been without AIDS, while the population is 23.0 percent smaller, and as a result GDP per capita is 7.0 percent higher.

Figure 5-4: Base Case - Real GDP Growth

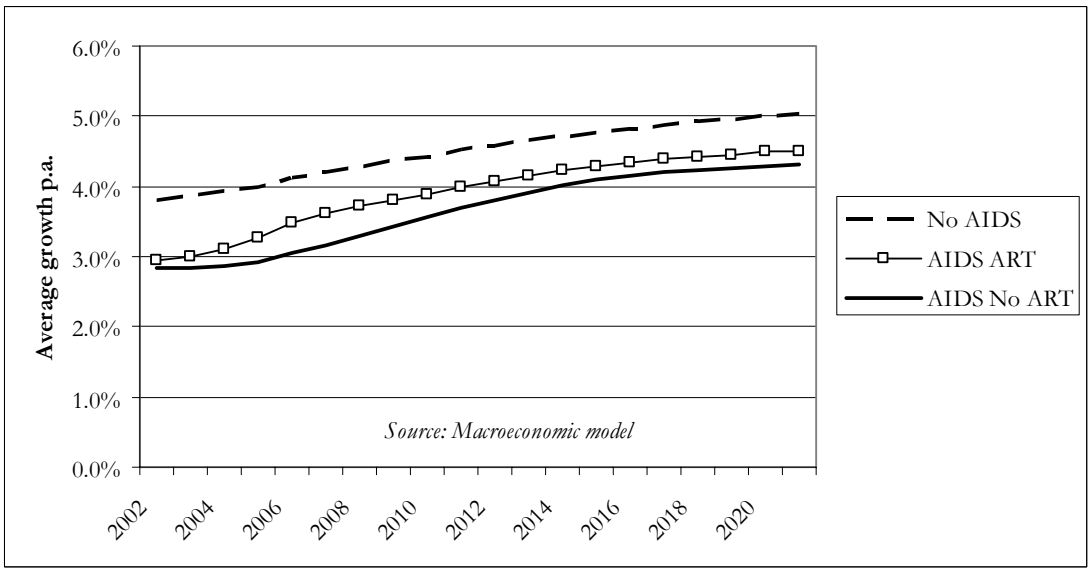
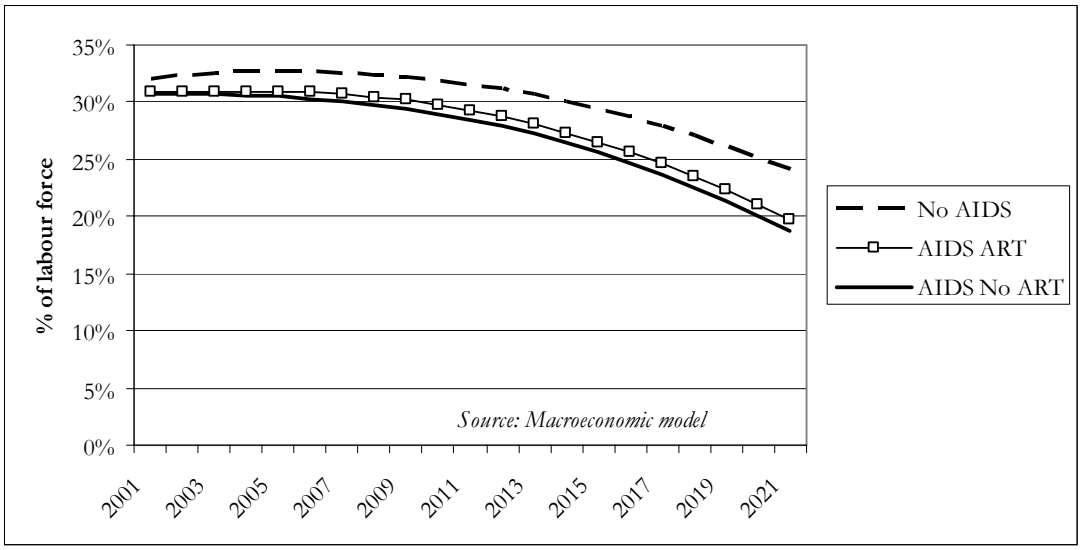


Figure 5-5: Base Case - Underemployment



Labour Market: given the lower rate of labour force growth with AIDS, formal sector employment only grows at 2.8 percent a year. This is, however, faster than labour force growth, and hence the informal sector declines in size, and un-/under-employment also declines. The impact of HIV/AIDS on population growth and the labour force intensifies pressure in the labour market, causing unemployment to fall and wages to rise slightly, relative to the No-AIDS scenario. The relative shortage of skilled labour pushes skilled wages up even faster.

AIDS-with-ART

Output: average GDP growth is lower than in the "without-AIDS" scenario, at 3.9 percent, but higher than in the "AIDS-without-ART" scenario. This largely reflects the positive impact the size of the labour force of providing ART. Although GDP growth is higher, population growth is also higher, and hence GDP per capita is marginally lower under the "with-ART" scenario than under the "without-ART" scenario. The lower rate of GDP growth means that in 2021, GDP is 13.2 percent smaller with AIDS and ART than it would have been without AIDS, while the population is 18.0 percent smaller, and as a result GDP per capita is 5.9 percent higher.

Labour Market: employment trends are similar to those under the "without ART" scenario; formal sector employment grows faster than the labour force, and hence the size of the informal sector declines. Real wages grow by 1.3 percent a year, and are higher than under the "No-AIDS" scenario (reflecting the relative shortage of labour), although not as high as under the "without-ART" scenario (where the labour shortage is even more severe).

Capital-Labour Ratios: the economy is more capital-intensive in the two with-AIDS scenarios, reflecting the relative labour shortage and resultant rise in real wages, which stimulates relative substitution of capital for labour.

The Base Case scenarios indicate that HIV/AIDS, through its impact on population and the labour force, will reduce economic growth, but would lead to slightly higher per capita incomes; furthermore, real wages would be higher, and unemployment lower, with AIDS. ART raises the economic growth rate somewhat compared to the no-ART scenario, but not significantly.

ii. Alternative Case

As noted above, the Base Case identifies the fundamental impact of HIV/AIDS on the economy through changes in the size and composition of the labour force. However, it does not include a number of likely effects that will change, and perhaps exacerbate, the negative economic impact of HIV/AIDS. These are considered in the Alternative Case scenario below, reflecting the following effects.

Labour Force Participation Rate (LFPR): as the results do not indicate a significant fall in un/under-employment in this case, we assume that the LFPR remains unchanged.

Variations in HIV/AIDS prevalence across skill categories: sentinel survey results suggest that HIV prevalence rates vary across skill categories, with lower prevalence for skilled workers. Based on these results, it is assumed that skilled workers have a prevalence rate that is two-thirds of the rate of unskilled workers.

Investment rates: the Base Case assumes that gross investment rates are unaffected by HIV/AIDS; as discussed earlier, however, this is unlikely. The costs associated with HIV/AIDS are, however, likely to reduce investment by causing diversion of expenditure. This is most obvious in the case of ART provision. The majority of these costs in Botswana's case are met by government, and given fiscal budget constraints the consequence of financing an extensive ART programme is likely to reduce spending elsewhere. It is assumed that the eventual costs of ART and other expenditure associated with HIV/AIDS (such as orphan welfare payments) could amount to 3.5 percent of GDP at its peak, falling to just under 3 percent by 2021. Initially, however, some of the costs are being met by donors, and hence the fiscal impact is reduced. The additional spending on HIV/AIDS can be met by reduced investment spending, reduced consumption spending, or through a budget deficit. It is assumed that the government will attempt to maintain fiscal discipline, and that there will not be significant deficit budgeting, and therefore that HIV/AIDS costs are met by reducing expenditure in other areas. Under the with-ART scenario, it is assumed that the impact on investment climbs gradually to 2 percent of GDP (by 2021), as donor support drops off.

The impact on private sector investment is likely to be greater in the "without-ART" scenario, as here the burden of HIV/AIDS-related costs falls on private firms, through greater health care costs, re-training costs, etc., as a larger proportion of the workforce is negatively affected by HIV/AIDS. In addition, the greater uncertainties resulting from the "without-ART" scenario, and reduced profitability, are likely to negatively affect investment. If ART is widely available, these uncertainties are reduced, and hence private sector investment is likely to be higher under the with-ART scenario. The impact on the public sector will be slightly less, as costs in the no-ART scenario are lower, although as discussed in chapter 8, the bulk of HIV/AIDS-related expenditure will be required whether or not ART is provided. Hence the fiscal impact, measured by HIV/AIDS spending as a percentage of GDP, is similar in the two scenarios. In the no-ART scenario, therefore, there is both a significant fiscal impact as well as a larger negative impact on the private sector. It is assumed that in the without-ART scenario, the reduction in investment is greater, and that formal sector investment falls to 22 percent of GDP by 2021. In the informal sector, it is assumed that investment will fall from 10 to 9 percent of income with ART, and to 8 percent without ART.

Impact on productivity (TFP) growth: as noted earlier, various studies suggest that overall productivity growth is likely to be negatively affected by HIV/AIDS, although much more in the case of no-ART than in the with-ART case. Arndt & Lewis (2000) assume that South African TFP growth will be halved in the with-AIDS (and without ART) scenario relative to the no-AIDS scenario. BER (2006) assume that TFP growth is reduced by a slightly smaller amount, by 37 percent in the AIDS-without-ART scenario and 31 percent in the AIDS-with-ART scenario. In this study, we combine these assumptions and use a 50 percent reduction in TFP growth in the AIDS-without-ART scenario (the higher figure is more appropriate, given that HIV prevalence is higher in Botswana than in South Africa), and a 20 percent reduction in TFP growth in the AIDS-with-ART scenario (a lower figure is appropriate given that ART provision and uptake in Botswana is likely to be higher than in South Africa).

Impact on Skilled Labour Force Growth: the impact of HIV/AIDS on skilled labour is difficult to predict; certainly the existing shortage of skilled labour will be intensified, and public sector resources available for investment in education and training may be constrained, especially under the with-ART scenario. In the private sector, reduced life expectancy and higher absenteeism will reduce the returns to training and hence discourage firm-specific investment in human capital. However, the lower HIV prevalence rate for skilled labour will tend to support a higher growth rate of skilled labour. On balance, we assume lower growth rates of the skilled labour force in the two with-AIDS scenarios, at 0.5 percent with-ART and 0.25 percent without-ART, compared to 0.75 percent in the Base Case.

The combination of these changes to key parameters is summarised in the table below:

Parameter	**No AIDS**	**AIDS – with ART**	**AIDS – No ART**
Labour force participation rate (LFPR), with AIDS, as percent of LFPR without AIDS	58%	58%	58%
Labour force HIV/AIDS prevalence rate (as % of overall prevalence rate)		100%	100%
Skilled labour force HIV/AIDS prevalence rate (as percent of overall LF prevalence rate).		66%	66%
Growth rate of skilled and unskilled labour forces (relative to overall growth rate of labour force).	0.75%	0.5%	0.25%
Productivity loss of workers with AIDS (percent of worker-equivalent per year).		15%	40%
Investment rate formal sector (percent of GDP)	25%	⇨23%	⇨22%
Investment rate – informal sector (percent of income)	10%	9%	8%
Annual growth rate in total factor productivity (TFP).	1.1%	0.9%	0.7%

The results of this scenario are as follows (see figures 5-6 to 5-9):

No AIDS

Output and Labour Market: the results are the same as in the Base Case, above.

AIDS-without-ART

Output: average GDP growth is significantly lower with AIDS, at 2.5 percent. This is due to the lower growth rate of the labour force, reduced investment, and reduced productivity growth. Average GDP per capita growth is also lower, at 1.7 percent a year. The lower rate of GDP growth means that in 2021, GDP is 34 percent smaller with AIDS and without ART than it would have been without AIDS, while the population is 23 percent smaller, and as a result GDP per capita is 15 percent lower.

Labour Market: given the lower rate of labour force growth with AIDS, formal sector employment only grows at 1.9 percent a year. This is, however, marginally slower than labour force growth, and hence the informal sector grows in size (in relative terms), indicating rising un-/under-employment. Reduced investment and productivity growth causes wage growth to slow.

Figure 5-6: Alternative Case - Real GDP

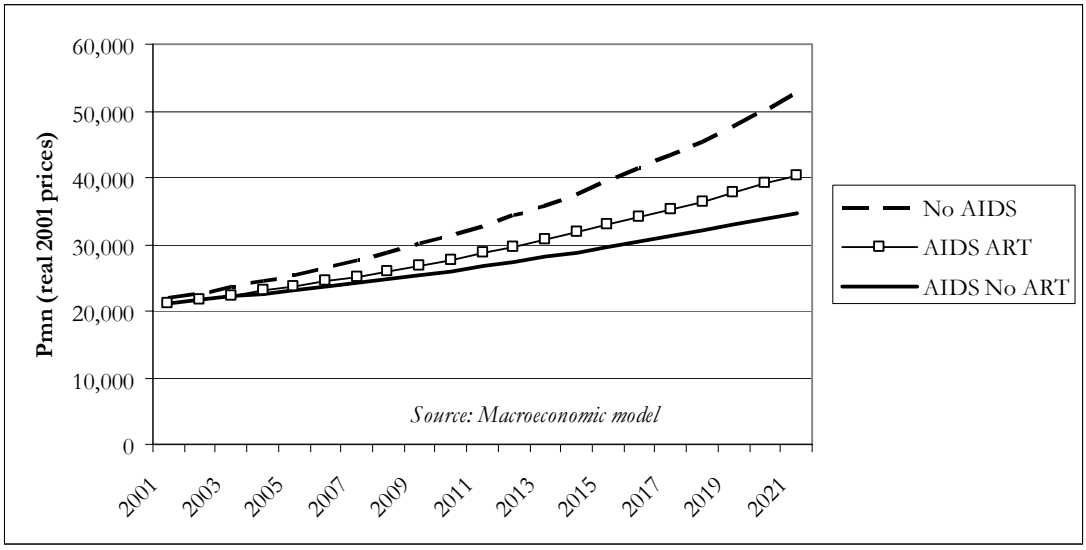


Figure 5-7: Alternative Case - Real GDP per capita

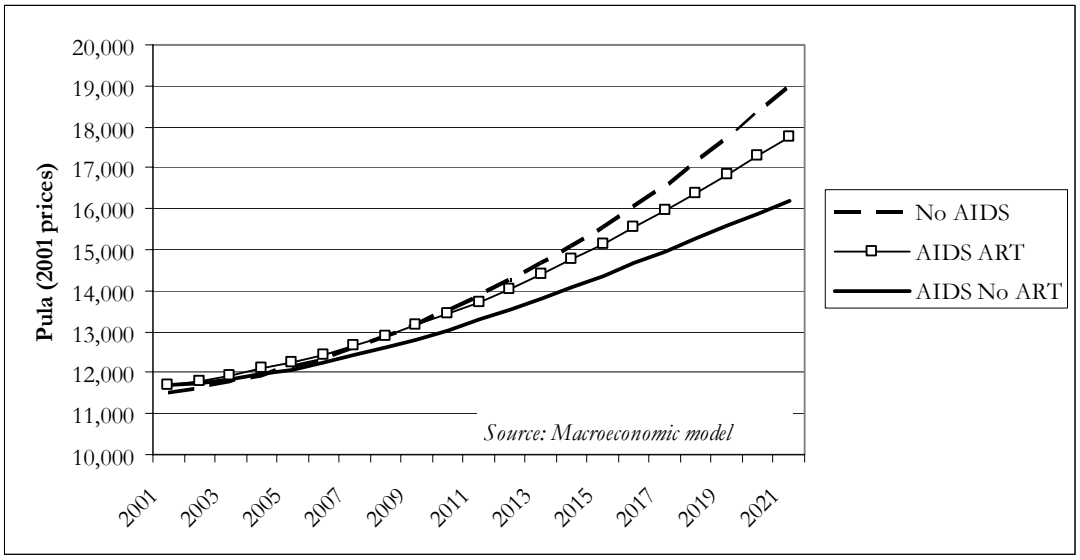


Figure 5-8: Alternative Case - Real GDP Growth

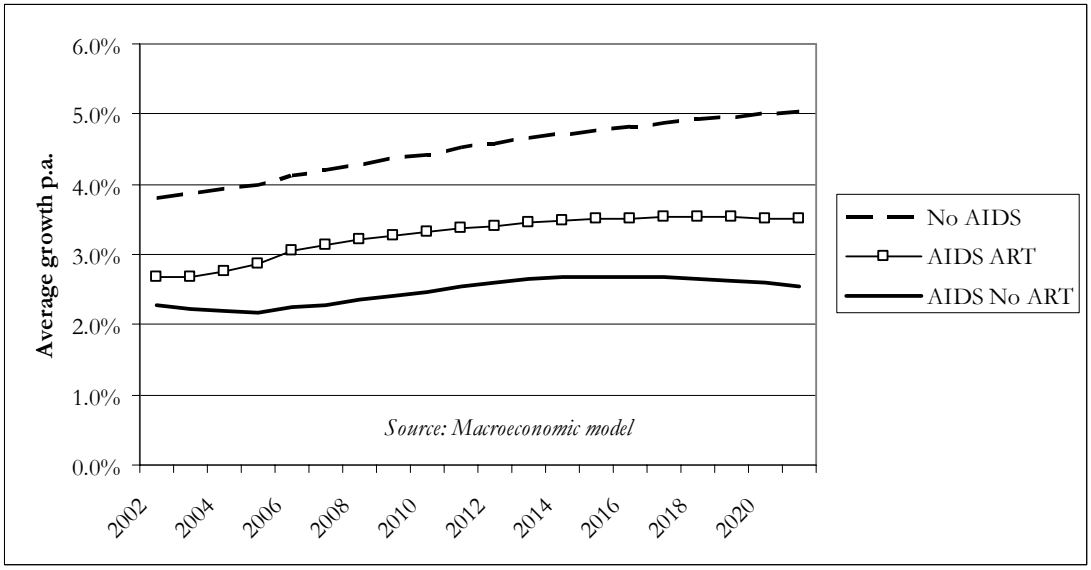
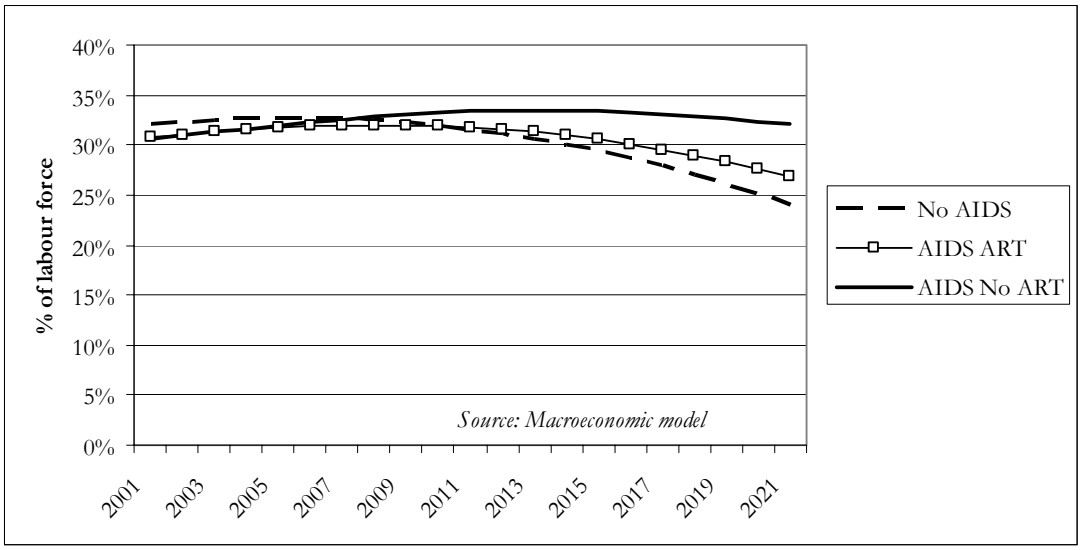


Figure 5-9: Alternative Case - Underemployment



AIDS-with-ART

Output: average GDP growth is lower than in the "without-AIDS" scenario, at 3.3 percent, but higher than in the "AIDS-without-ART" scenario. This largely reflects the positive impact on the size of the labour force of providing ART. Although GDP growth is higher, population growth is also higher; nevertheless, GDP per capita is higher under the "with-ART" scenario than under the "without-ART" scenario. The lower rate of GDP growth means that in 2021, GDP is 23 percent smaller with AIDS and ART than it would have been without AIDS, while the population is 18 percent smaller, and as a result GDP per capita is 6 percent lower.

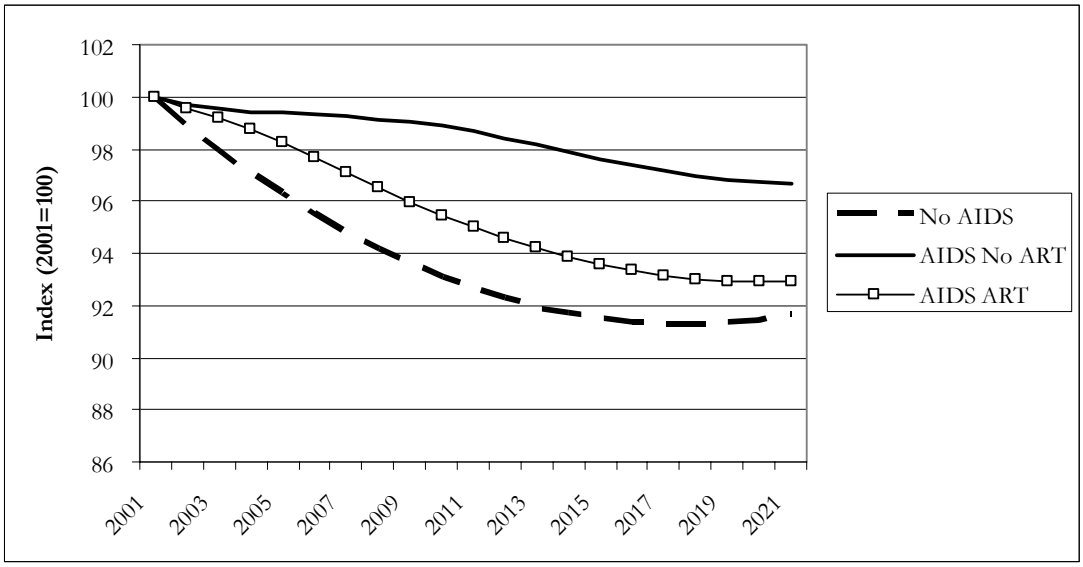
Labour Market: employment trends are more favourable than those under the "without ART" scenario; however, formal sector employment still grows more slowly than the labour force, and the size of the informal sector increases marginally. Real wages grow by 0.7 percent a year, but are lower than under the "No-AIDS" scenario (reflecting reduced investment and productivity growth); however, they are higher than under the "without-ART" scenario, despite the more severe shortage of skilled labour under that scenario.

Capital-Labour Ratios: there are different trends in the capital-intensity of the economy in the no-AIDS and the two with-AIDS scenarios. In the former, capital stock grows at a similar rate to the labour force and hence the capital labour ratio (combined across formal and informal sectors) is largely unchanged over the period as a whole. In the two with-AIDS scenarios, however, capital stock rises more slowly than the labour force, because of lower investment rates, and hence the economy becomes more labour intensive. This illustrates one of the core economic problems arising from HIV/AIDS: due to slower labour force growth, overall economic growth rates can only be maintained if investment rises (hence more capital and a higher K/L ratio would compensate for fewer workers); but if investment falls, as appears likely, the lower growth arising from slower labour force growth is compounded by reduced investment (as well as reduced productivity growth).

This scenario indicates that HIV/AIDS, through its impact on investment and productivity, as well as on population and the labour force, will reduce economic growth significantly, and will also reduce per capita incomes relative to the no-AIDS scenario. Both real wages and employment would be lower, with AIDS. ART raises the economic growth rate and per capita incomes somewhat compared to the no-ART scenario.

These results can also be used to estimate the impact of HIV and AIDS on competitiveness. Using the projections for productivity and average , the unit labour costs (i.e., productivity adjusted real wages) can be calculated for each of the scenarios. The results are shown in Figure 5-10).

Figure 5-10: Unit Labour Costs



These results show that HIV and AIDS do have an adverse impact on competitiveness, in that unit labour costs are higher under the two with-AIDS scenarios than under the No-AIDS scenario. However, of the two with-AIDS scenarios, competitiveness is higher under the with-ART scenario. This is largely due to the smaller adverse productivity impact when ART is provided.

iii. Summary of Macroeconomic Results

We can summarise these results as follows:

- AIDS will have a negative impact on the rate of economic growth in Botswana; if investment is strongly negatively affected, the rate of GDP growth will fall from a projected 4.5 percent a year without AIDS to an estimated 3.3 percent under the "AIDS-with-ART" scenario, and after 20 years the economy will be 23 percent smaller than it would have been without AIDS;
- the impact on the growth of average real incomes (per capita GDP) is also negative, if investment is strongly affected, averaging 2.2 percent a year under the "AIDS-with-ART" scenario, compared to 2.6 percent a year without AIDS, and would be 6 percent lower after 20 years (this contrasts with the results of some other studies, which found that GDP per

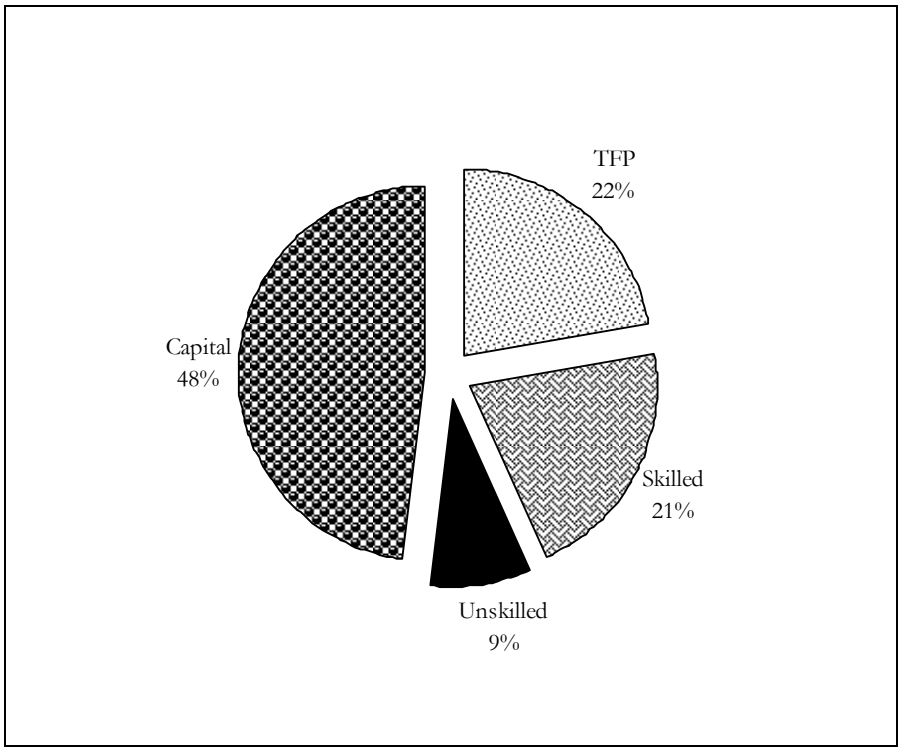
capita could plausibly rise as a result of HIV/AIDS, on the basis that the reduction in GDP growth could be smaller than the reduction in population growth;

- due to the sharp drop in investment (and hence weak demand for labour), wage growth is slower;
- without AIDS, underemployment falls from 32 to 24 percent of the labour force; with AIDS the trend is much less favourable, and underemployment falls more slowly to 27 percent in the with-ART scenario and rises to 32 percent without ART, as the slower growth of the labour force is offset by the effect of lower investment and slower economic growth;

It is important to note that although both GDP and average income growth rates may fall as a result of AIDS, *they both remain positive*. In other words, in the scenarios chosen here, neither GDP nor average incomes will be lower in 20 years than they are now - they may simply be lower than they would have been without AIDS.

The reduction in growth as a result of HIV/AIDS can be decomposed into its various components, as in figure 5-10 (which shows the with-ART case). The greatest impact is from reduced capital stock, which contributes 48 percent of the fall in growth, with reduced productivity (TFP) growth contributing 22 percent, reduced supply of skilled labour 21 percent, and reduced supply of unskilled labour 9 percent.

Figure 5-11: Contributions to GDP Growth (No AIDS vs. AIDS with ART)



In general, the results are highly sensitive to all three key parameters: the investment rate (reflecting the relatively high share that capital has in the production function); the rate of productivity growth (reflecting this as the key determinant of long-term economic growth rates);

and the growth rate of the skilled labour force (reflecting this key binding constraint in the Botswana economy). Reductions in the investment rate and the productivity growth rate are likely; in the simulation they account for 70 percent of the reduction in economic growth, and more generally it is here that the greatest danger of a very adverse economic impact from HIV/AIDS lies.

Table 5-3: Macroeconomic Model Results Summary

	No AIDS		AIDS Baseline [1]		AIDS Full Impact [2]		AIDS with ART [3]	
	2021	Avg. growth 2001-2021	2021	Avg. growth 2001-2021	2021	Avg. growth 2001-2021	2021	Avg. growth 2001-2021
Economy								
GDP (factor cost, Pmn) [4]	52,600	4.5%	43,314	3.7%	34,569	2.5%	40,384	3.3%
GDP/cap (Pmn)	18,989	2.6%	20,318	2.8%	16,215	1.7%	17,771	2.2%
Population (mn)	2.77	1.9%	2.13	0.8%	2.13	0.8%	2.27	1.1%
Av. Wage (P/yr)	19,971	1.1%	22,036	1.5%	18,083	0.5%	19,230	0.7%
Formal sector								
GDP (factor cost, Pmn)	51,041	4.6%	42,411	3.8%	33,168	2.5%	39,055	3.3%
Skilled emp	389,559	4.2%	283,263	2.9%	256,435	2.4%	297,198	3.3%
Skilled wage (P/yr)	34,199	0.4%	39,080	0.8%	33,760	0.1%	34,300	0.1%
Unskilled emp	452,804	3.6%	381,480	2.7%	299,082	1.5%	352,406	2.4%
Unskilled wage (P/yr)	16,076	1.0%	15,855	1.0%	15,816	1.0%	15,805	0.9%
Total employment	842,363	3.8%	664,743	2.8%	555,517	1.9%	649,604	2.8%
Average wage (P/yr)	24,457	0.7%	22,036	1.5%	18,083	0.5%	19,230	0.7%
Informal sector								
GDP (factor cost, Pmn)	1,558	2.6%	903	0.3%	1,401	2.6%	1,329	2.3%
Employment	267,260	1.9%	153,087	-0.5%	262,313	2.2%	239,234	1.9%
Income (P/yr)	5,831	0.7%	5,900	0.8%	5,341	0.3%	5,066	0.0%
% GDP	3.0%		2.1%		4.1%		3.3%	
% labour force	24.1%		18.7%		32.1%		26.9%	

Notes: [1] Base scenario (demographic and labour productivity effects included; investment and total factor productivity effects excluded. No ART).

[2] Alternative scenario (demographic, labour productivity, investment and TFP effects included). No ART.

[3] Alternative scenario, ART provided.

[4] excludes mineral rents

6. Firm-level Impact of HIV/AIDS

Literature has shown that the impact and response to HIV/AIDS differs between small and big firms and by industry. In order to investigate this further in Botswana, a standard questionnaire was drawn up exploring various aspects of HIV/AIDS, its impact on firms and their response. A sample of 25 firms was selected, across a range of industries. The questionnaire is included at Appendix 1[10]. It should be emphasised that the survey was not intended to provide a rigorous, statistically representative sample of firms nationwide (which would have required several hundred interviews, and was beyond the scope of this study); rather, the purpose of the survey was to gather a mixture of qualitative and quantitative information on the impact of HIV/AIDS from a variety of firms in a way that would supplement the detailed quantitative analysis in the various modelling exercises. The results should be interpreted accordingly.

a. General Results

i. Characteristics of sample

The distribution of the sample of firms interviewed by sector is shown in Figure 6-1 and by ownership in Figure 6-2. The sample of 25 firms is biased towards manufacturing, including textiles, carpentry, abattoirs, etc, while nearly half of the firms are foreign owned, at 48 percent, followed by citizen-owned firms at 40 percent.

Figure 6-1: Distribution of firms by sector

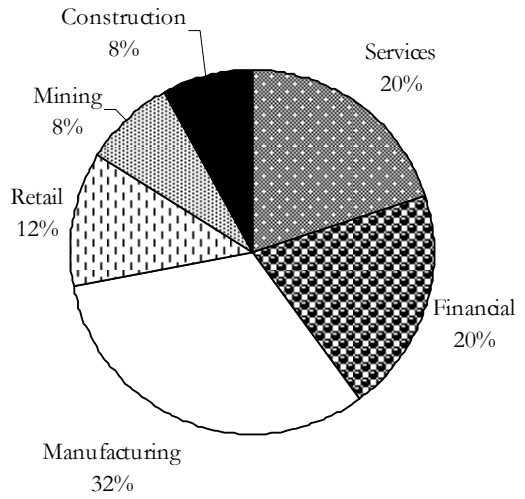
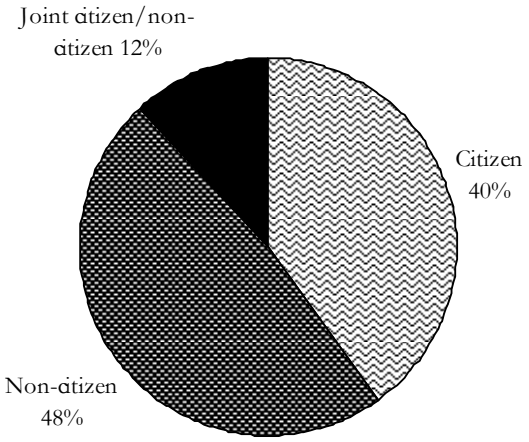


Figure 6-2: Distribution of Firms by Ownership



[10] For most of the companies, information was collected by the Human Resources office from all the relevant officers and that was then followed with an intensive interview that was meant to probe on most of the crucial questions. Larger companies usually had an HIV/AIDS special office, which had all the information on figures about deaths, sicknesses, sick leave, etc.

ii. Impact on Workforce

Table 6-1 shows the average number of workers lost due to death and illness by skill level and industry, as well as the average number of workers on prolonged sick leave or working at less than an optimal level in the past two years. There is generally a bigger loss of unskilled workers due to death in the last five years than skilled workers (22 compared to 7 of unskilled and skilled respectively). This is true for all sectors except the financial sector, reflecting the fact that the financial sector tends to be made up of mainly professional workers.

In terms of workers lost due to illness, there is similarly a bigger loss of unskilled workers than skilled workers (17 unskilled compared to 6 skilled), for firms in all sectors. In terms of workers who are sick or working less than optimally, firms in manufacturing and mining have the highest means of 44 and 75 workers respectively, while retail has the lowest average with about 3 people. One explanation of this phenomenon may be that retail companies mainly hire school leavers, who usually leave the company after 2 to 3 years, as there is generally a high turnover for this group that goes into looking for other careers after a few years of work. By the time they leave, the negative impact of the disease may not have become serious enough to lead to sicknesses and absenteeism and thus the low sick leave recorded. The results from the sample generally show more impact on unskilled workers in terms of death and illness.

Table 6-1: Summary of workers lost due to death, and illness and sick leave by skill.

	Lost due to death-skilled	Lost due to death-unskilled	Lost due to illness-skilled	Lost due to illness-unskilled	On sick leave in past 2 years
Service	11.4	32.0	7.2	25.4	20.6
Financial	3.0	3.0	1.8	2.4	16.4
Manufacturing	6.8	13.8	3.3	8.4	44.8
Retail	0.3	3.0	-	2.7	2.7
Mining	24.5	101.5	17.5	86.0	75.0
Construction	5.5	26.0	18.0	19.5	13.0
Total	7.5	22.0	5.7	17.0	29.1

Table 6-2 shows the workers lost due to death and illness as a proportion of the total workforce by sector. Overall, unskilled workers lost due to death in the last five years make up a higher proportion of the total workforce compared to skilled workers lost due to death (4.0 percent compared to 1.1 percent). The same trend is observed for workers lost due to illness as a proportion of total workforce. Unskilled workers make up a higher ratio of 2.2 percent compared 1.0 percent of skilled workers lost due to illness. In terms of loss of skilled versus unskilled workers due to death by sector, the proportion of unskilled workers as a ratio of total workers is higher than for skilled workers for all sectors except for financial sector. The highest percentage of unskilled workers lost due to death is in the construction sector with 9.3 percent followed by service sector with 8.5 percent. The results are similar for workers lost due to illness.

Table 6-2: Workers lost through death and illness (as a percentage of total number of workers by sector).

	Skilled workers dead	Unskilled workers sick	Skilled workers ill	Unskilled workers ill
Service	1.45	8.52	0.69	1.81
Financial	1.25	0.98	0.78	0.95
Manufacturing	1.13	3.38	0.76	2.45
Retail	0.24	1.51	0.00	1.28
Mining	0.45	2.13	0.33	1.85
Construction	2.15	9.33	5.94	7.61
Total	1.14	4.08	1.04	2.24

iii. Impact of HIV/AIDS on Output

There are generally several channels through which HIV/AIDS impacts firms. One such channel is in terms of loss of output and profit, while another impact is through loss of productivity as workers become sick, and take frequent sick leave or are unable to work normally. A second form of productivity loss is felt when infected workers die and have to be replaced with new ones who need to be trained. The replacement of workers is associated with transactions costs in the form of recruitment and training expenses. These costs are usually bigger for skilled labour, as it takes more time to find substitute workers and may take more resources to train the new workers.

Unfortunately most firms are unable to accurately measure the effects of the disease in terms of these aggregates, and responses were therefore recorded in terms of whether the sickness or loss of the workers from the disease has a "significant", "marginal" or "no" effect on their performance in terms of these measures. Figure 6-3 shows that more than half of the firms surveyed responded that the disease has had a significant impact on their output; where figures as to the extent of output loss were indicated, firms suggested that their loss could be as much as 10-30 percent.

Figure 6-3: Impact on Output

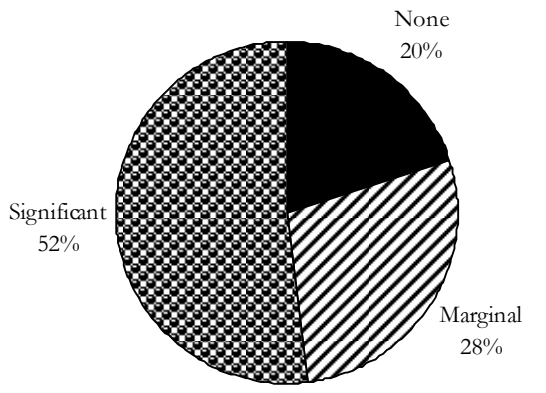
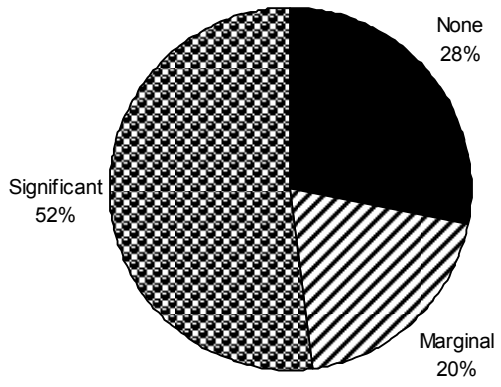


Figure 6-4: Impact on Productivity



In terms of responses to impact on productivity by sector as shown in Table 6-3, most firms in manufacturing argued that the disease has a marginal to significant impact on their output. For most of these firms, mainly in textiles, they were unable to meet target outputs for their major markets due to sickness of some of their workers and death of others. It was not easy for them to quickly replace the workers even though training is not usually long-term. This result may be an outcome of the fact that most firms in manufacturing, especially textiles, are able to easily measure their output, given that they have targets for their markets, which they can tell if they are not meeting them easily. Textile firms in particular reported that they are regularly unable to meet deadlines for their orders due to sickness or death of workers. They also face a very high turnover of workers, which further complicates their situation. In the mining sector, all firms reported being significantly impacted in terms of output. Firms in financial sector, service sector, and retail sector reported smaller (nil or marginal) output losses, reflecting the fact that most of these firms experienced very few deaths and sick workers. The service sector is, however, an exception due to the inclusion of hotel and catering under this broad category. One hotel company, for instance, reported losses of major customers, especially corporate clients due to the deterioration of their service.

Table 6-3: Impact of HIV/AIDS on output by sector

	No effect	Marginal effect	Significant effect	Total
Service	1	2	2	5
Financial	1	3	1	5
Manufacturing	2	0	6	8
Retail	1	2	0	3
Mining	0	0	2	2
Construction	0	0	2	2
Total	5	7	13	25

iv. Impact of HIV/AIDS on Productivity

The results on impact of the disease on productivity, as shown in Figure 6-4, are very similar to those reported on impact on output. Fifty-two percent reported significant impacts while 28 and 20 percent reported nil and marginal effects respectively. In terms of sectors, as shown in Table 6-4, the mining and manufacturing sector firms reported significant impacts (75 percent for manufacturing and 100 percent for mining). Financial sector firms reported only nil and marginal effects on productivity, as did firms in retail. Firms in the service sector reported mixed results, with 60 percent reporting significant effects. One company that was able to quantify the effects on productivity reported that they lost 19276 man hours per quarter on average over the past five years. Another aspect of productivity loss results from some sick workers having to be assigned light duties, with a resulting productivity loss from the worker redeployed. In addition, firms sometimes have to engage workers on overtime to be able to meet their deadlines, which adds to costs. Because of low productivity, the quality and timely delivery of the product is affected making the firm's product less competitive in the external market. Some of the firms reported that ARV treatment has been a major mitigating factor to the potential negative impacts of the disease. One firm for instance has observed death rates falling from 45 workers per year in 2002 to about 10 workers per year in 2005. During the same period, ARV enrolment among workers rose from about 100 in 2002 to about 330 in 2005.

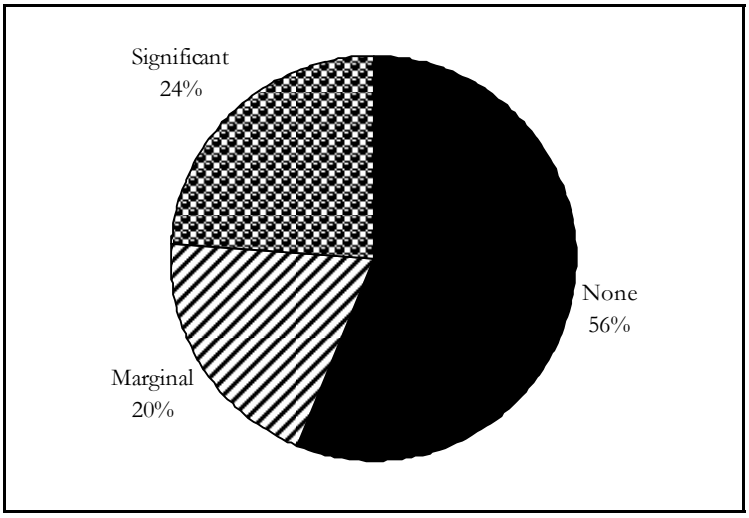
Table 6-4: Impact of HIV/AIDS on productivity by sector.

	No effect	Marginal effect	Significant effect	Total
Service	1	1	3	5
Financial	2	3	0	5
Manufacturing	2	0	6	8
Retail	2	1	0	3
Mining	0	0	2	2
Construction	0	0	2	2
Total	7	5	13	25

v. Impact of HIV/AIDS on Investment

Most firms (56 percent) responded that the disease has no significant impact on investment Figure 6-5. Out of the 6 firms that reported a significant impact of HIV/AIDS on investment, 5 were in manufacturing and one was in service Table 6-5. One argued that due to low productivity, cash flows fluctuate a great deal, making business predictions difficult and therefore making it more difficult to make investment decisions. Most of those who reported no significant impact of HIV/AIDS on their investment decisions argued that the decisions depend more on other factors including profitability of the enterprise. Most of those who reported no significant impact of HIV/AIDS on their investment decisions argued that the decisions depend more on other factors determining the profitability of the enterprise. Where an impact was reported, in the service sector, this was due to losses of important customers.

Figure 6-5: Impact on Investment



Apart from productivity, output, and investment impacts, some firms reported that HIV/AIDS also affects their business in terms of diverted expenditure that they have to put into treatment and development of workers. Such huge expenditures could have been used to expand the firms, and some firms have had to delay or put off altogether a planned expansion due to death or sickness of some key workers.

Table 6-5: Impact of HIV/AIDS on Investment by sector.

	No effect	Marginal effect	Significant effect	Total
Service	4	0	1	5
Financial	3	2	0	5
Manufacturing	2	1	5	8
Retail	3	0	0	3
Mining	2	0	0	2
Construction	0	2	0	2
Total	14	5	6	25

It should be noted that these results are largely consistent with the results of larger company surveys on the impact of HIV/AIDS carried out in South Africa. If we combine the ratings of the impact of HIV/AIDS on output, productivity and investment, we can rank the overall impact on the different economic sectors, as shown in Table 6-6 below. The ordering of sectors by degree of impact is similar in Botswana and South Africa, with the retail/trade sector least affected and mining and manufacturing more seriously affected. The main contrast between the countries relates to construction, which in Botswana is the most seriously affected sector, but is the second least affected sector in South Africa.

Table 6-6: Severity of HIV/AIDS Impact, by Sector

		Botswana	South Africa
	Rank	Sector	
Least	1	Retail trade	Trade
	2	Financial	Construction
	3	Services	Financial
	4	Mining	Transport
	5	Manufacturing	Manufacturing
Most	6	Construction	Mining

Sources: Botswana survey; BER (2006)

b. Response to HIV/AIDS by firms

We also set out to find out how firms have been responding to the HIV/AIDS in terms of training, hiring and dealing with productivity losses. The interviews revealed that firms have been quite innovative, especially those that were impacted much more negatively. As shown in Table 6-7, Table 6-8 and Table 6-9, most response has come from firms in mining, manufacturing service and construction. Among the responses were in terms of training more workers than was needed. In hotel and catering for instance, firms trained what they called "relief managers" and more casual workers who were kept on standby. They normally trained 30 percent more workers than they needed as a way of insurance. One company now takes 12 recruits into their graduate management programme instead of 6. All of this tended to increase training costs significantly, along with employment costs, but helps to offset potential output losses. Once one of the workers is unable to come to work, they would bring in the "relief worker", which then would not lead to any loss of output. These relief workers have their skills protected from loss through constant training, for one firm every two weeks. They are then guaranteed a minimum wage, which they get even if they do not work. Fortunately for the firm, no worker has had to spend more than two weeks without being returned to work to provide a relief.

Another impact of the disease on training for some companies is that it has affected the companies' succession plans. Companies had to keep older workers as a cushion against sickness and absenteeism, especially as older workers tended to have lower HIV prevalence rates than the youth. But that can have negative effects since older workers are more resistant to change. One firm makes its proactive HIV/AIDS plan through employing 1.5X for positions identified as critical. Other firms have had to engage temporary staff members as a way of dealing with the potential productivity losses.

A further innovative response that firms have employed to deal with training needs is making their workers multi-skilled. In textile, for instance, the workers are trained in several areas so that when some workers are absent due to sickness or death, other workers can easily be re-deployed so that a customer's order is met easily. Firms indicate that such innovative strategies have significantly mitigated the potential negative effects of the disease. Other responses have included greater reliance on overtime, or mechanization of some processes. As would be expected, the firms that reported no major impact of the disease in terms of productivity and output did not respond to output and productivity losses. They were, however, cautious as they were aware that the disease has a potential to affect them in the future and therefore became proactive in terms of coming up with HIV/AIDS policies and programmes. In fact almost all the firms interviewed had an HIV/AIDS policy or programme and had run in-house training. The only two that did not have the policy had one in a draft form and were in the process of rolling it out. One firm tried to deal with the loss due to workers leaving to go and collect their medication by introducing a special dispensary programme for anybody taking regular medicine. The worker would only become absent once in three months when they had to go for medical check-up with the doctor. According to the company, this reduced absenteeism by about 50 percent.

Table 6-7: Response to HIV/AIDS in terms of Training

	No response in training	Train more	Multi-skilling	Total
Service	2	1	2	5
Financial	5	0	0	5
Manufacturing	3	0	5	8
Retail	2	1	0	3
Mining	0	0	2	2
Construction	1	0	1	2
Total	13	2	10	25

Table 6-8: Response to HIV/AIDS in terms of Hiring

	No response	Hire more	Hiring temporary workers	Total
Service	1	4	0	5
Financial	4	1	0	5
Manufacturing	2	4	2	8
Retail	3	0	0	3
Mining	0	2	0	2
Construction	1	1	0	2
Total	11	12	2	25

Table 6-9: Response to HIV/AIDS in terms of Productivity

	No response	Multi-skilling	Provide overtime/ multi-skilling/ mechanisation	Workers complement each other	Total
Service	2	0	3	0	5
Financial	4	1	0	0	5
Manufacturing	2	1	5	0	8
Retail	1	1	0	1	3
Mining	0	0	2	0	2
Construction	0	0	2	0	2
Total	9	3	12	1	25

As shown in Figure 6-6 and Figure 6-7, firms that have a high proportion of skilled labour generally tended not to respond in terms of training and hiring. This is not surprising given that they are not significantly impacted by the disease. In terms of sectors, the sectors with a high proportion of skilled labour and therefore those unlikely to be significantly impacted by HIV/AIDS is financial sector and retail. The sectors with the least proportion of skilled labour and therefore likely to be significantly impacted by the disease are manufacturing and mining sectors.

Figure 6-6: Firms' Training Response by Skill Level

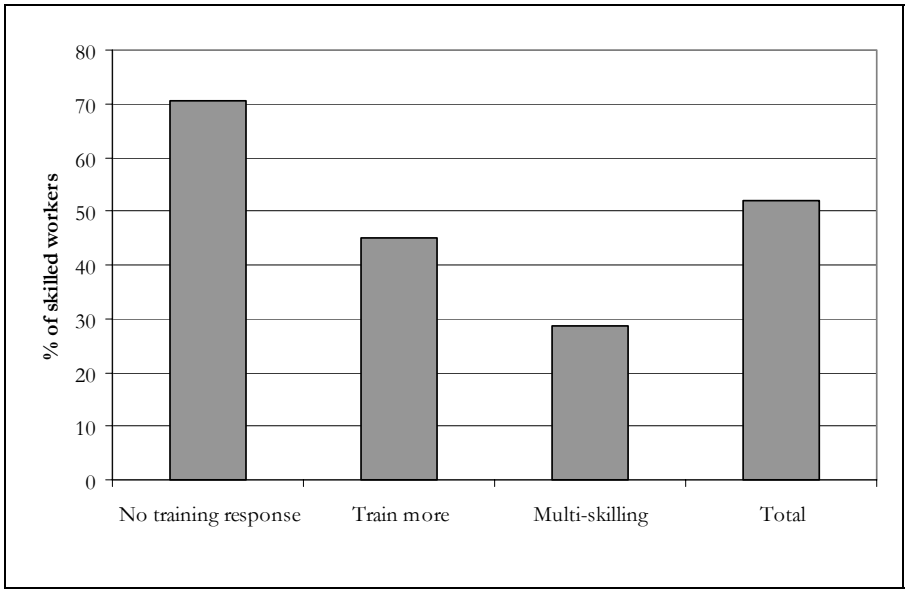


Figure 6-7: Firms' Hiring Response by Skill Level

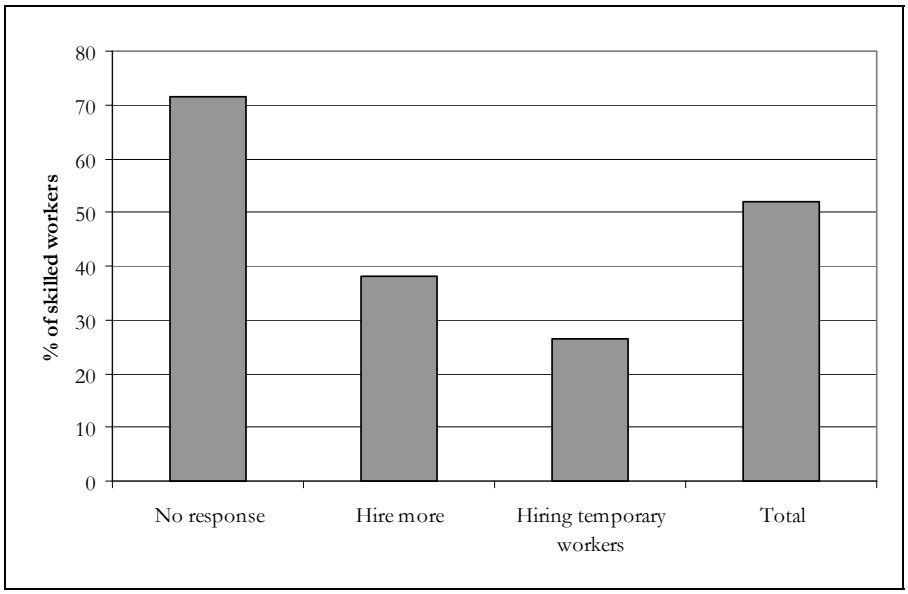
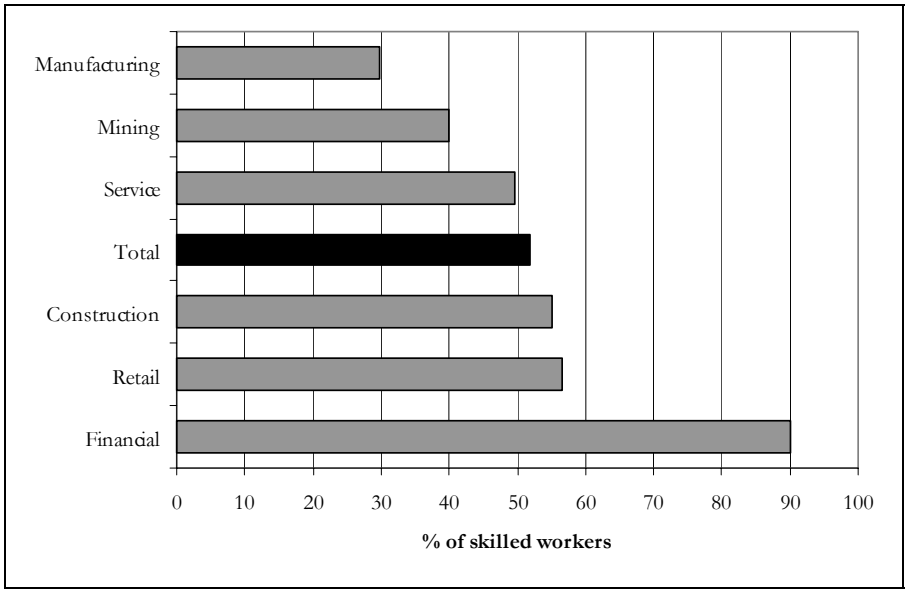


Figure 6-8: Proportion of Skilled Workers by Sector



Although some of these results may seem counter-intuitive – firms with higher skill needs tend to do least in terms of training and hiring responses – this essentially reflects the smaller impact of HIV/AIDS on skilled workers, through lower HIV prevalence rates and earlier access to ART through private medical aid schemes. It is also important to note that these results are entirely consistent with those from South Africa (BER, 2006), where the impact of HIV/AIDS was much higher in firms with predominantly unskilled and semi-skilled workers and least in those with skilled workers.

c. HIV/AIDS policies and programmes

Most firms interviewed had an HIV/AIDS workplace policy. Policies ranged from being very detailed and covering a wide range of issues to being very narrow. The common features of most of these policies are non-discrimination for HIV positive people, provision of counselling, and encouragement of voluntary testing. For some of the bigger companies it extends to free provision of ARVs. Workers who are not fit for work are entitled to benefits just like any other sick work. They are entitled to such sick leave as is allowable under the Employment Act and may be given light duty, but should the employee be declared permanently unfit to work due to ill health, he or she will be relieved of their duty after all the normal procedure has been followed. Most firms interviewed subsidise medical aid, with 50 percent participating in a special HIV/AIDS special schemes. Except for two firms whose HIV policy was still in draft form, most of the firms interviewed had organized in house training for their staff.

d. Summary of results

The main results are as follows:

- There is an indication from the data provided by firms that there are more losses in terms of death and illness for unskilled workers than skilled workers.
- For firms using highly skilled workers, the impact is between being not significant to being just marginal.
- The impact is more for firms in some sectors than others. Those with high impact are generally in mining, manufacturing, especially textiles, construction and some service sectors. The financial sector is the least affected. This could be because they use few unskilled workers. One of the hypotheses as to why unskilled workers may be more impacted may result from an inclination to be less consistent with treatment once enrolled in ARV programmes. Interviews with some managers revealed that the non-significant impact of HIV does not mean there are not many of their workers that are HIV positive, but that they have taken care of themselves through the ARV programme such that they are almost back to normal. They argue that unskilled labour has a tendency not to be compliant in general and therefore the large impact in firms that use most of them like in textiles, construction and mining.
- Firms reported a reduced effect of the disease due to the availability of ARV since 2001/2002. This has reversed the effect of HIV/AIDS quite significantly for most firms.
- Firms have been very proactive in dealing with the output and productivity losses through hiring more, multi-skilling, overtraining, etc.
- Most firms have been actively involved in HIV/AIDS issues at policy level and training at work. Firms have also contributed generously to mitigating the effects of the disease by subsiding medical aid schemes, giving out free ARVs to their employees, getting into special aid schemes.
- However, what seems to have remained a major problem is the level of stigmatization of HIV positive staff within the firms/ companies, which inhibits open discussion of the impact of the disease and possible responses.

7. The Household Level Impacts of HIV/AIDS

a. Approach to the Analysis

i. Preliminary Results from HIES 2002/03

Following the methodology used in the BIDPA (2000) study, the analysis presented here makes use of household level income and expenditure data, derived from the Household Income and Expenditure Survey (HIES) conducted in 2002/03. Preliminary results from that study indicate that the overall poverty rate in Botswana has declined from 38 percent recorded in 1993/94 to about 33 percent in 2002/03[11]. Some of the highlights from these latest data are:

- the risk of being poor is greater in rural areas than in urban settlements; this suggests that poverty in Botswana is primarily a rural phenomenon;
- a higher concentration of poor people (in terms of poverty rates) is observed in the west of the country relative to the east. However, in terms of contribution to total poverty, more poor people live in the eastern region simply because the population is concentrated in the east; as a result 69 percent of the poor in 2002-03 lived in the rural areas of south east and north east Botswana;
- poverty among households headed by females is higher than poverty among male-headed households;
- the larger the household , in terms of the number of children, the higher the incidence of poverty; the risk of poverty is highest among households with five or more individuals;
- there was a decrease in the number of children per household over the 10-year period; the average number of children per household was 1.86 in 2002/03 compared to 2.5 in 1993/94. However, this largely reflected smaller households in general, as at the same time the average child dependency ratio (children per adult) increased from 1.18 in 1993/94 to 1.23 in 2002/03.
- at the national level, the gini coefficient (a measure of income inequality) based on disposable income increased slightly between the two periods, from 0.537 to 0.573;
- unemployment was estimated at 23.8 percent of the labour force, and it is higher for the youth and those with less education and training.

Table 7-1 summarises poverty rates for the whole country by region. The national poverty rate is 33 percent, and it is highest for Rural South-West with 53 percent, and lowest for Gaborone at 7 percent.

[11] This poverty rate is measured in relation to Poverty Datum Lines (PDL) specified for each household type. This differs from the poverty rates discussed in Chapter 9, which calculate poverty in relation to a notional "dollar a day" poverty line. Hence the calculated poverty rates are different.

Table 7-1: Poverty Rates by Region

Region	Poverty Rate
Gaborone	0.07
Francistown	0.15
Other Cities & Towns	0.15
Rural South-East	0.33
Rural North-East	0.42
Rural North-West	0.46
Rural South-West	0.53
National	0.33

Source (for all tables): analysis based on HIES 2002/03 data

ii. Simulating HIV/AIDS

The analysis made use of person-level data from the 2002/03 HIES. Each person was assigned a probability of being infected with HIV in accordance to the prevalence rates recorded by the BIAS II survey, which averaged 17.5 percent nationally but varied across the population according to demographic and other factors[12]. A random number between 0 and 1 was then assigned to each person. All people for whom the random number was less than or equal to the probability of being HIV positive were deemed to be infected. This resulted in a pattern of infection which resembled very closely that observed in the BIAS II survey. The person level information was then aggregated back to household level in order to simulate the household impacts. Using certain assumptions about costs of HIV/AIDS to the affected households, the income effects, and the existence of orphan support programmes, we simulate the impact of HIV/AIDS on poverty, income per capita, and income dependency ratios. We also simulate the impact of HIV/AIDS on income dependency ratio and income per capita of the lower quintile of the income distribution as a way of assessing the impact on those who are particularly vulnerable.

iii. Key Assumptions

The objective of the analysis was to combine the most recent sources of information about household structure, sources of income and HIV prevalence. The validity of the analysis rests on a number of key assumptions, as described below.

First, the analysis simulates the impact of HIV by initially assuming that all HIV positive people in the modelled population will die within a 10 year period. Although in reality some would live longer than that, depending upon treatment regimes and general health considerations, it would also be true that others would live for a much shorter period. In particular, HIV positive people could have been so for up to 10 years prior to the BAIS II survey. The assumption does not therefore seem unreasonable. We later allow the some of the HIV-infected to survive beyond the

[12] Although there is a one to two year gap in the data sets, since BIAS II was done in 2004 while HIES was done in 2002/03, the relatively slow pace of change in HIV prevalence should result in little or no bias being introduced in the results. Although contemporaneous HIV prevalence data for 2002/03 could have been obtained from the ANC sentinel surveillance surveys, as was done in the analysis for the BIDPA (2000) report, the much smaller sample size for the ANC SS, and the restriction of that survey to pregnant women, makes it much less suitable than the BAIS II data.

10-year period due to the availability of ART treatment, adding some of the associated costs to their expenditure but avoiding the loss of income.

Second, in the normal course of events, household composition, structures and income sources would change. There would be some population growth over a 10 year period - i.e. there would be more births than deaths, which would add to the expenditure requirements of households. Furthermore, some households would fragment as people leave home and form their own new households. However, some people who are below working age would become eligible for jobs, and add to the income of the family during the same period. The analysis essentially assumes that these effects will roughly cancel out in terms of income distribution.

It is however true that over a 10 year period, the average age of the population would remain about the same. Changes in overall demographic structure are comparatively slow. The analysis here essentially assumes that the population structure will be in a steady state, apart from the effects of HIV/AIDS. This assumption isolates the impact of HIV/AIDS from the impact of other demographic changes taking place at the same time.

iv. Impacts of HIV/AIDS

HIV/AIDS economically affects households by both increasing its required expenditures and reducing its income because of morbidity and mortality.

Expenditure Effects

The most obvious impacts of HIV/AIDS apply to the expenditure needs of households. Affected households face additional costs of two major kinds. The first is the increased costs of medical treatment for HIV positive members who are beginning to develop symptoms of AIDS, and are experiencing more frequent illnesses. The total expenditure of a household will depend on the household income and circumstances. Wealthy households may opt for private treatment financed by medical insurance, but this typically does not cover the full cost of medication and associated expenses. The poorest households will be forced to rely on state medical provision, which is free, but will still face additional costs in terms of transport and special dietary requirements.

The second is the cost of a funeral when a person with AIDS dies. Funerals can be very expensive in Botswana, and usually involve feeding a large number of people for many days in addition to the direct costs of the casket and ceremony. The total amount spent will also depend upon the household income, but can add as much as five percent to total household expenditure.

Since these expenditures are almost indispensable to the household, we reflect them as additions to their minimum expenditure or Poverty Datum Line (following Salinas and Haacker, 2006). The approach taken here was to add these additional expenditure requirements to the package of basic needs of a household. In other words, there is an addition to the PDL of households affected by HIV/AIDS. The effect of this is to re-define the level of income which constitutes poverty - a family affected by HIV/AIDS is therefore more likely to be classified as poor. We

assume that HIV health-related expenditures are equivalent to 5 percent of the income of the household and increase the PDL by that amount[13].

However, there is a second expenditure related effect. At the end of the 10 year period, the infected household members die. Therefore, the household no longer has to meet their expenditure requirements. This has the opposite effect to the additional expenditures described above. In this analysis, the PDL requirement of infected household members is subtracted from the household PDL at the end of the 10 year period. This effect makes it less likely that an HIV affected household will be classified as poor. We assume that funeral expense for every HIV casualty are equivalent to five months of household expenditures. Whether the expenditure effects described here increase or decrease the overall levels of poverty depends upon the magnitude of the expenditures considered.

Income Effects

HIV/AIDS affects individuals and households through higher mortality and morbidity. The first income effect of HIV/AIDS is the loss of income from infected household members who die of AIDS. If a household member without income dies, the income is therefore divided amongst fewer household members. This will therefore make the household to be less likely to be poor and the per capita income of the household will increase. But if the household member who dies is an income earner, it will mean the income of the household goes down, and even though it is divided between fewer members, the per capita income of the household may be lower because of the lost income.

While households losing income earners may lose financially, there are other dynamics that may cause the household income to rise or fall; these are issues related to the response of the other household members in terms of taking up employment. These depend on the nature of the labour market and the skill level of the lost person. We assume that there is a 45 percent loss of income of any worker who is HIV infected in the last two years of the infection. We simulated two scenarios, one where there is no worker replacement, and assume household income declines by 45 percent as a result of the death of the breadwinner. The other scenario is one where there is worker replacement, and we assume income of the household still declines but by a lower percentage of 15 percent. Given that the replacement worker may not have the same experience and skill as the lost workers, we assume that he or she will only earn two-thirds of the income of the member of household lost due to death.

We lastly allow for government intervention in the form of social support system and assume the allowance adds P218 adjusted to 2002 prices to the household that has orphans that have lost both parents.

v. Indicators

The analysis calculates the values of a number of key indicators of poverty and inequality before and after the 10 year period. The indicators considered were as follows:

[13] In 2002/2003 HIES data, medical/health care on average was 2.1 percent of total consumption. Given that an HIV positive person will need more expenditure than the average we add 3 percent more and simulate that effect on poverty of that household.

Poverty Levels

Poverty levels are measured in the same way as they were in the HIES 2002/03. Households are classified as poor if their income is less than their PDL. We use household poverty, which is the percentage of households below the PDL.

Household Per-Capita Income

The household per-capita income is the household disposable income reported in the HIES, divided by the number of household members. It is important to note that this is not the same as per-capita GDP, and should be expected to be substantially lower. A large portion of national income accrues to Government rather than to households. This applies particularly to mineral revenues.

Income Dependency

Another useful statistic is the income dependency ratio. This is the average number of people (within a household) who are supported by each household member who is employed and earning an income. This is usually considered to be a sensitive indicator of household poverty, and of the vulnerability of a household to the loss of an income earner.

Situation of the Poorest Households

The situation of the poorest households is represented by the lowest income quartile - that is the 25 percent of households with the lowest per-capita incomes. The two statistics chosen to measure the situation of the poorest households are the first quartile household income, and the first quartile income dependency ratio, both as defined above.

b. Results: Impact of HIV/AIDS on poverty

i. Expenditure Effects

Table 7-2 presents a base case scenario in which HIV related expenditure increases by 5 percent for HIV/AIDS affected households. We do not allow for all the other effects to take place. As a result of expenditures increasing by 5 percent due to HIV/AIDS, poverty increases to 34 percent, an increase of 1 percentage point. What these results indicate is not that poverty will be higher in 2016, but rather that it will be 1 percentage point higher than it would have been because of this effect. In other words, if poverty would have decreased to 15 percent by 2016, it will be 16 percent instead due to the 5 percent increase in expenditure. The biggest increases are found in Francistown, rural North-East and rural North-West. As shown in Table 7-3, adding funeral costs does not change the results significantly from the base case results. Poverty increases overall by one percentage point.

Table 7-2: Changes in Poverty Rates - Health Expenditure Effect

Region	Poverty Rate		
	without HIV/AIDS	with HIV/AIDS exp.	Change (% points)
Gaborone	0.07	0.07	0.00
Francistown	0.15	0.15	0.00
Other Cities & Towns	0.15	0.15	0.00
Rural South-East	0.33	0.33	0.00
Rural North-East	0.42	0.42	0.00
Rural North-West	0.46	0.46	0.00
Rural South-West	0.53	0.54	0.01
National	0.33	0.34	0.01

Table 7-3: Changes in Poverty Rates – Health and Funeral Costs Effect

Region	Poverty Rate		
	without HIV/AIDS	with HIV/AIDS exp. & funeral costs	Change (% points)
Gaborone	0.07	0.08	0.01
Francistown	0.15	0.15	0.01
Other Cities & Towns	0.15	0.15	0.01
Rural South-East	0.33	0.33	0.01
Rural North-East	0.42	0.42	0.01
Rural North-West	0.46	0.47	0.01
Rural South-West	0.53	0.54	0.01
National	0.33	0.34	0.01

ii. Income effects

As noted, the income effects come into play when the HIV infected person dies and household incomes begin to decline. Assuming no worker replacement, household income is assumed to fall by 45 percent. The results are shown in Table 7-4. As a result, overall poverty rises by three percentage points. If we allow for worker replacement so that the household income only fall by 15 percent, the poverty rates are only changed slightly, with poverty at 34 percent. This is shown in Table 7-5.

Table 7-4: Changes in Poverty Rates – Income Loss due to Death

Region	Poverty Rate		
	with no HIV/AIDS	with 45 percent decline in income	Change (% points)
Gaborone	0.07	0.10	0.03
Francistown	0.15	0.19	0.04
Other Cities & Towns	0.15	0.16	0.01
Rural South-East	0.33	0.35	0.02
Rural North-East	0.42	0.46	0.04
Rural North-West	0.46	0.49	0.03
Rural South-West	0.53	0.56	0.03
National	0.33	0.36	0.03

Table 7-5: Changes in Poverty Rates – Income Loss with Worker Replacement

Region	Poverty Rate		
	with no HIV/AIDS	with 15 percent decline in income	Change (% points)
Gaborone	0.07	0.08	0.01
Francistown	0.15	0.15	0.00
Other Cities & Towns	0.15	0.15	0.00
Rural South-East	0.33	0.34	0.01
Rural North-East	0.42	0.42	0.00
Rural North-West	0.46	0.47	0.01
Rural South-West	0.53	0.55	0.02
National	0.33	0.34	0.01

iii. Combined Expenditure and Income Effects

In Table 7-6 we have allowed the income of the worker in the household who is HIV infected to fall by 45 percent in the last two years as well having the expenditure increase by 5 percent for HIV/AIDS health-related expenditure. The income of the affected households is therefore declining by an effective total of 50 percent. Overall, the poverty rate increases by 3 percentage points as a result of those changes. Over time, if we assume no ART, HIV/AIDS will have up to three percentage point influence in terms of increasing poverty of households.

Table 7-6: Changes in Poverty Rates – Expenditure and Income Effects Combined

Region	Poverty Rate		
	without HIV/AIDS	with HIV/AIDS exp. & income effects	Change (% points)
Gaborone	0.07	0.10	0.03
Francistown	0.15	0.19	0.04
Other Cities & Towns	0.15	0.16	0.01
Rural South-East	0.33	0.35	0.02
Rural North-East	0.42	0.46	0.04
Rural North-West	0.46	0.49	0.03
Rural South-West	0.53	0.56	0.03
National	0.33	0.36	0.03

iv. Adding the impact of ART.

Our earlier analysis assumed that HIV+ household members die at the end of the 10 years period. In the next table we allow for some 38 percent of the HIV+ household members to still be alive after 10 years, as a result of successful ART, while 62 percent of HIV+ households would die (in line with the with-ART demographic projections). In other words, we include a 62 percent probability of dying, based on the demographic figures. What that means is that 62 percent of the HIV positive households will experience income falls of up to 50 percent, while the other 38 percent only have a 5 percent increase in their expenditure for medical costs. With ART, poverty would be 2 percentage points higher than without AIDS by 2016. The simulation results show that ART mitigates the impact of HIV/AIDS on poverty by about one percentage point.

Table 7-7: Changes in Poverty Rates – Adding the effect of ART

Region	Poverty Rate		
	without HIV/AIDS	with HIV/AIDS &ART	Change (% points)
Gaborone	0.07	0.08	0.01
Francistown	0.15	0.16	0.01
Other Cities & Towns	0.15	0.18	0.03
Rural South-East	0.33	0.34	0.01
Rural North-East	0.42	0.43	0.01
Rural North-West	0.46	0.48	0.02
Rural South-West	0.53	0.54	0.01
National	0.33	0.35	0.02

v. Impact of Labour Market Changes

One of the ways in which HIV/AIDS affects poverty is through its effect on the labour market. Based on the labour market simulation results as described in chapter 5, we simulate the changes in poverty over the 10 years by using the changes in average wages for the three scenarios; no AIDS, AIDS with ART and AIDS without ART. The results of the simulation exercise are

shown in Table 7-8. As is shown in the table, with no HIV/AIDS poverty could be reduced to 27 percent, which is by 6 percentage points due to labour market dynamics, assuming all other factors remain constant. In other words, if other factors could reduce poverty to say 25 percent by 2016, the labour market dynamics without HIV/AIDS would reduce it further by 6 percentage points to 19 percent. On the other hand, if there is HIV/AIDS and ART, poverty could decline to 29 percent in the next 10 years due to changes in labour market dynamics and assuming other things do not change. This is a reduction of 4 percentage points in the ten year period. Lastly, if we assume HIV/AIDS with no ART, poverty would decline to 31 percent in the ten years, which is a decline of 2 percentage points.

Table 7-8: Changes in Poverty Rates – Expected Wage Changes Included

Region	Poverty Rate			
	Without HIV/AIDS	Without HIV/AIDS	With AIDS and ART	With AIDS and no ART
Gaborone	0.07	0.04	0.05	0.06
Francistown	0.15	0.10	0.12	0.13
Other Cities & Towns	0.15	0.11	0.13	0.13
Rural South-East	0.33	0.26	0.28	0.30
Rural North-East	0.42	0.35	0.37	0.39
Rural North-West	0.46	0.39	0.41	0.42
Rural South-West	0.53	0.46	0.48	0.49
National	0.33	0.27	0.29	0.31

vi. Impact of Orphan Allowance

The Government of Botswana has an orphan care programme that gives out food and money to children who are orphans. The orphan care programme is valued at P218 per child per month including both food and cash components. The programme is offered to children who lose both parents and have no other means of support. The effect of that subsidy is to add to the income (and hence expenditure) of the household and allow some households that would otherwise have been poor to become non-poor or to at least subsist. We adjusted the expenditure by this allowance to the 2002/03 prices and added it to 50 percent of the households with HIV positive members. The results show a small decline in poverty rates. The overall rate declines to 32 percent from 33 percent, a fall of one percentage point. In terms of poverty, these results indicate that such government intervention strategies have a positive impact in preventing HIV/AIDS infected families from becoming poorer in terms of their consumption spending.

Table 7-9: Changes in Poverty Rates – Orphan Allowance Included

Region	Poverty Rate		
	without HIV/AIDS	with orphan allowance	Change (% points)
Gaborone	0.07	0.06	0.01
Francistown	0.15	0.14	0.01
Other Cities & Towns	0.15	0.14	0.01
Rural South-East	0.33	0.32	0.01
Rural North-East	0.42	0.39	0.03
Rural North-West	0.46	0.45	0.01
Rural South-West	0.53	0.51	0.02
National	0.33	0.32	0.01

vii. Changes in Per Capita income and Income Dependency Ratio

The analysis indicates that the overall per-capita income of households will fall by 4.2 percent as a result of HIV/AIDS and the loss of income earners, in the absence of any effects on unemployment or wages.

The analysis also shows an increase in national income dependency from 2.3 to 3.1, an increase of 35 percent. This means that every income earner can on average expect almost one extra dependent as a result of HIV/AIDS over the next 10 years. These results are similar to the results obtained in BIDPA (2000), where the income dependency ratio was rising as a result of HIV/AIDS.

Situation of the Poorest Households

In order to assess the situation of the poorest households we assessed the situation of the lowest income quartile. Table 7-10 indicates the changes in per capital income and the changes in income dependency ratios with and without HIV/AIDS.

In terms of income dependency ratio, the situation does not seem different from the national level, although the increase of the dependency ratio is by a lower percentage of 7.7 percent. It is with respect to per capita income that the poorer households are harder-hit, with their income per capita falling by 36 percent compared to a decline of 4.2 percent for all households. These results are also similar to BIDPA (2000) in terms of direction except for the magnitude differences. The analysis implies that the poor are particularly vulnerable to the impacts of HIV/AIDS.

Table 7-10: Changes in dependency ratios and PCI with and without AIDS

Indicator	Per-Capita Income	Income Dependency Ratio (IDR)	IDR 1st Quartile	Income 1st Quartile
Without AIDS:	P2558.30	2.36	2.6	P585.11
With AIDS:	P2450.11	3.19	2.8	P370.44
Difference	-P108.19	0.83	0.2	-P214.67
% Difference	-4.2	35.2	7.7	-36.7

c. Sensitivity Analysis

i. Varying the expenditure assumption

Table 7-11 summarises the relationship between changes in expenditure and change in household poverty. The results suggest that the poverty measures are sensitive to the assumption used for expenditure up to a limit of about 30 percent. As can be seen, the effect of the assumption about proportion of household per-capita expenditure is approximately linear up to expenditure increases of 30 percent. Each 10 percent added to the proportion adds about 1 percentage point to the estimate of household poverty with an upper limit of 30 percent. Any increase in expenditure beyond 30 percent does not change the household poverty head count, even though it does change the depth of poverty.

Table 7-11: Sensitivity of poverty estimates to proportion of expenditure

Expenditure Proportion change	Household Poverty head Count
0	33%
15	34%
35	36%
45	36%

d. Data Limitations

Before discussing the conclusions and possible policy recommendations of these results, it is important to discuss the differences between the data used for this data in comparison to the methodology used in BIDPA (2000). While the BIPDA 1996 Poverty Study uses the income approach to measure household poverty, more recent work on the 2002/03 HIES data mainly relied on the expenditure approach to measure poverty. The income presented in the data is therefore aggregated at the household level and is not shown by income sources by type or by individual. We therefore had to make assumptions about percentage changes to the PDL as a result of HIV/AIDS. The results may therefore not be accurate in terms of magnitudes, but they are quite useful for showing direction of changes and how sensitive the changes would be to our assumptions. The superiority of the data used in this study compared to the BIDPA (2000) is that we had prevalence rates from BIAS II, which are more representative than the Sentinel Surveillance data used previously. The time period between the two data sets is also very small, about one year in between. The methodology used in this study also allows for Government

intervention in terms of provision of free ART, and therefore allowing the person not to die at the end of 10 years. Free ART was not available at the time of doing BIDPA (2000) study, and therefore was not considered in the analysis explicitly. What we do is add the necessary expenditures to the household's PDL.

e. Conclusions

The principal conclusions of the analysis are as follows:

- the HIV epidemic is likely to work against the efforts to reduce poverty. Having HIV infected persons in household's increases household poverty levels by about one percentage point due to expenditure effects;
- due to income effects of HIV/AIDS, poverty is estimated to increase by a further three percentage points;
- Government intervention programmes in the form of orphan care and others are quite effective in reducing the likelihood of households falling into poverty. Poverty falls by an estimated 1 percentage point with a government orphan allowance equivalent to P218 a month in current prices;
- Botswana society is very vulnerable to the income impacts of HIV/AIDS. Overall household per capita income falls by approximately 4 percent as a result of the loss of an income earner due to HIV/AIDS;
- with HIV/AIDS, income dependency increases by about 35 percent. Each family would expect an extra dependent in the next 10 years due to HIV/AIDS;
- poor households will become more vulnerable. Households in the lower quartile would experience at decline of per capita income of about 36 percent in the next 10 years due to HIV/AIDS.

f. Policy Recommendations

The results from this study are not significantly different to those in the BIDPA (2000) study in terms of direction. The only major differences apart from the methodology, is the fact that the estimated changes to poverty are much smaller. The conclusions of the study point unequivocally to both an increase and a deepening of poverty in Botswana resulting from HIV/AIDS. At a general level therefore, a prime recommendation would be to redouble the efforts to implement the country's poverty reduction strategy which was adopted in 2003. The mechanisms by which HIV/AIDS impact upon poverty do however suggest particular areas of emphasis. These are broadly as follows:

i. Social Safety Nets

Botswana has had a well developed social safety net system over the years even though it may not always be well coordinated. Of particular importance to HIV/AIDS is the orphan care programme. These results do indicate that such programmes can mitigate the negative impact of HIV/AIDS quite significantly through the support they provide to potentially vulnerable families. Such programmes will continue to be needed, even though there may be a need to make them well targeted to avoid abuse and dependency. However, it will also be important to not

target them so tightly that they exclude children and households in genuine need or become inefficient and impractical to administer. A specific issue for consideration is whether orphanhood is an appropriate and sufficient targeting criterion, when it may not correlate well with vulnerability.

It should be emphasised that the negative impacts of HIV/AIDS apply principally to households, not to government (although this may change with the provision of ART). Taken together, the studies of aggregate and household income impacts imply that overall per capita income will remain stable, while household income will fall. The implication is that government revenue will be less affected as a result of HIV/AIDS. The impacts of HIV/AIDS can to some extent be mitigated by an increase in transfers from government to the poor, and expenditure on the provision of ART.

ii. Basic Services for Human Capability Development

This recommendation, which was made in BIDPA (2000) continues to be relevant for the present study. The areas of greatest importance in basic services would seem to be as follows:

Promotion of basic health and nutrition: There is abundant evidence that good nutrition and basic health will significantly extend the productive lives of HIV infected people. Greater effort in this area will serve to mitigate the income and productivity impacts of HIV/AIDS.

Counselling and support for youth: It is clear that sexually active young people are at risk of contracting HIV, and should be a prime target for prevention campaigning.

Public information and communication: There will need to be better research into increasing the effectiveness of the current anti AIDS campaign in Botswana.

8. Impact of HIV and AIDS on Government Spending

a. Introduction

A model to integrate the main components of fiscal impact i.e. health care and social grant spending was developed. Projections of need, service utilization and cost estimates were generated. The approach and assumptions used were discussed with the reference group and key stakeholders.

b. Methodological Issues

Cost and other projections are intended for use in determining possible scenarios of overall levels of government spending. They would need refinement before they can be used for health and other planning tasks that may require more accuracy in relation to various sub-components of the programme or services. An understanding of the input data limitations, assumptions and limitations of projections themselves is important before the projections are used.

The following key methodological approaches and assumptions were used to generate estimates

- Demographic projections of the size of the population and scale of HIV/AIDS and other needs were provided by the Demographic Impact Study project. The projections have important implications for projections of need and costs as well as the policy decisions that are assumed. They also affect some other calibrations such as unit costs. Any methodological issues and uncertainties identified in the Demographic Impact study should therefore be borne in mind. For the purposes of health and welfare related costs, certain assumptions may have particular impact on estimates. These include assumptions about:
    - Rates of scale-up, and uptake of ART
    - Rates of failure and length of survival on ART. Longer survival on ART could have important implications for capacity requirements and costs of ART and terminal care.[14]
    - Projections of orphan numbers. Demographic projections of paternal and double orphanhood have been obtained, but can pose particular methodological challenges. Notably, it is unknown what proportion of double orphans and other children will access the grants in practice[15].
- Projections assume various scenarios for change and responses. In some cases these are guided by the National Strategic Framework. In others a "realistic scenario" approach is used based on actual NACA expenditure and, for example, assuming gradual rather than rapid change in the scale of various services and interventions.
- All costs are estimated in 2004/5 prices.

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[14] Demographic projections were not available at the time of writing this report to assess the effects of longer survival times or people on ART. Particularly for health sector planning sector planning, it is likely to be important to assess possible implications and monitor survival times to inform planning.

[15] Under the orphan care programme, children with no parental care are eligible. This includes double orphans (both parents have died) and single orphans where one parent has died and the other is absent and untraceable.

- Fiscal costs of ART, inpatient and outpatient care have been reduced by 5 percent to reflect coverage of the private health care sector.[16]
- Certain approaches have been used to generate cost estimates for specific items:
    - ART cost estimates use unit cost data from MASA. These include drugs, staff, laboratory tests and management overhead costs.[17]
    - Orphan Basket costs use the monthly cost per beneficiary plus a 10 percent allowance for program implementation costs. The number of beneficiaries due to AIDS was assumed to be all double orphans and 10 percent of maternal orphans.[18]
    - Home Based Care expenditure has been scaled in line with the NSP from 2004/5 levels to raise estimated coverage of HBC from around 10 000 (30 percent of the terminally ill) to around 25 000, equivalent to around 100 percent of people projected to die of AIDS.
    - Government prevention expenditure (of which about 50 percent is for PMTCT) is assumed to rise to P 100 million in 2005/6. Projections then assume 10 percent (real) growth p.a for 5 years followed by 3 percent real growth p.a. for the balance of the period.[19]
    - Programme management costs were assumed to be a pro-rata amount of other programme expenditures in line with recent NACA patterns.
- *Inpatient and outpatient utilization* projections have been produced based on previous utilisation estimates for Botswana, Swaziland and South Africa. In general, fairly conservative assumptions were made of hospital utilisation at each stage of disease[20]. Unit costs were derived from MOH and MLG financial data combined with available HIS utilisation statistics.

  There is still some uncertainty about what *inpatient capacity scenarios* are realistic. Projections indicate that there is a need to increase bed capacity by around an extra 50 percent above 2003 levels. Anecdotal information suggests that primary hospital capacity is not yet fully

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16 An estimated 10% of people have private sector coverage, but half of medical aid premiums benefit from a tax deduction. Furthermore, private medical schemes do not cover the full cost of ART, so some medical aid members use the free ART provided by the public health service.

17 Around 10% of people projected to be on ART are children. Costs of paediatric ART services were not available and thus adult cost estimates were used.

18 These assumptions resulted in projected expenditures that seemed in line with trends and levels of recent OVC expenditure by NACA or possibly slightly lower.

19 There appears to be general agreement that the focus on prevention and behaviour change must be maintained or increased despite the increasing prominence of ART. However, it is uncertain what expenditure implications of this will be in the longer term. Preliminary estimates of P100m per annum in 2005/6, followed by 2% real growth per annum, seemed to be in line with NSF estimates and historical expenditure. However the Reference Group considered these to be low in view of factors such as the policy environment and possible government takeover of funding of certain donor projects.

20 Inpatient, ambulatory and ART projections do include some TB care. However, it is uncertain whether they do this adequately. Actual TB utilisation is likely to be heavily influenced by e.g. ART coverage and timing or initiation of ART. Adequate data was not readily available to this project to assess the utilisation or costs associated with TB specifically.

used, although referral hospitals' medical wards are full with patients of whom an 80-90 percent have HIV and AIDS related illness.

Scenarios presented here assume that GOB rapidly commits to increasing hospital capacity up to the projected level. This is probably an extreme assumption, both in terms of cost and feasibility.

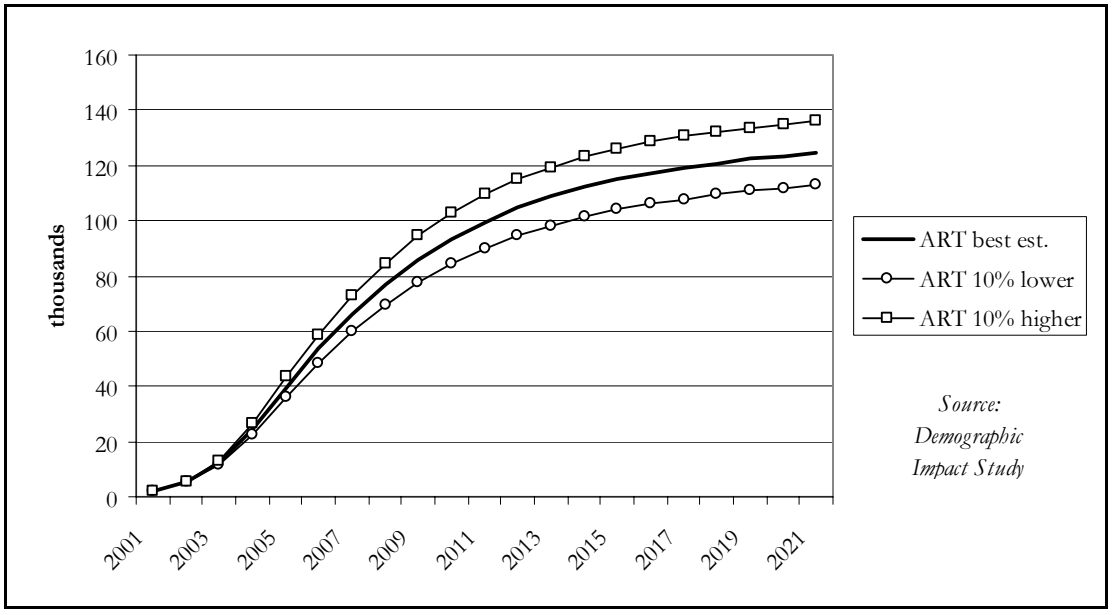
- *Programme costs currently funded by donors* that are likely to require future funding from GOB were identified with NACA and incorporated into cost projections from government. Important examples include some initiatives supported by ACHAP and the Global Fund.
- *Capital costs of establishing new in- or outpatient capacity* have not been explicitly factors into projections, and the focus is on recurrent cots. The current primary hospital programme is assumed to be implemented and to be a "sunk cost". The teaching hospital proposed in NDP 9 is also not assumed to be an HIV and AIDS related cost in this study.

c. Results

A scan of available data and key informants indicated that the largest HIV and AIDS related costs to government are currently ART, Orphan support and Home Based Care. These contributed an estimated 26 percent (excluding donated ARV drugs), 33 percent and 15 percent of NACA expenditure respectively in 2004/5. Prevention activities (13 percent) and management (9 percent) made up the main other components. Thus the analysis has focused on these main components of the fiscal impact of HIV and AIDS.

Projected numbers of adults and children on ART under the three scenarios used in costing are shown in the following graph. Around 10 percent of people on ART are assumed to be children.

Figure 8-1: Projected numbers of adults and children on ART



Estimates of the main cost components and how they compare are shown in the following graph. The largest cost is ART, followed by hospital admission costs. Home based care and prevention spending are projected to be the next largest components, and could be more or less costly, depending on policy decisions about coverage. Although relatively large now and a major component of costs under the no-ART scenario, orphan support becomes a less important cost driver in future if good ART coverage is assumed.

Figure 8-2: Projected Total Costs – ART "Best estimate" Scenario

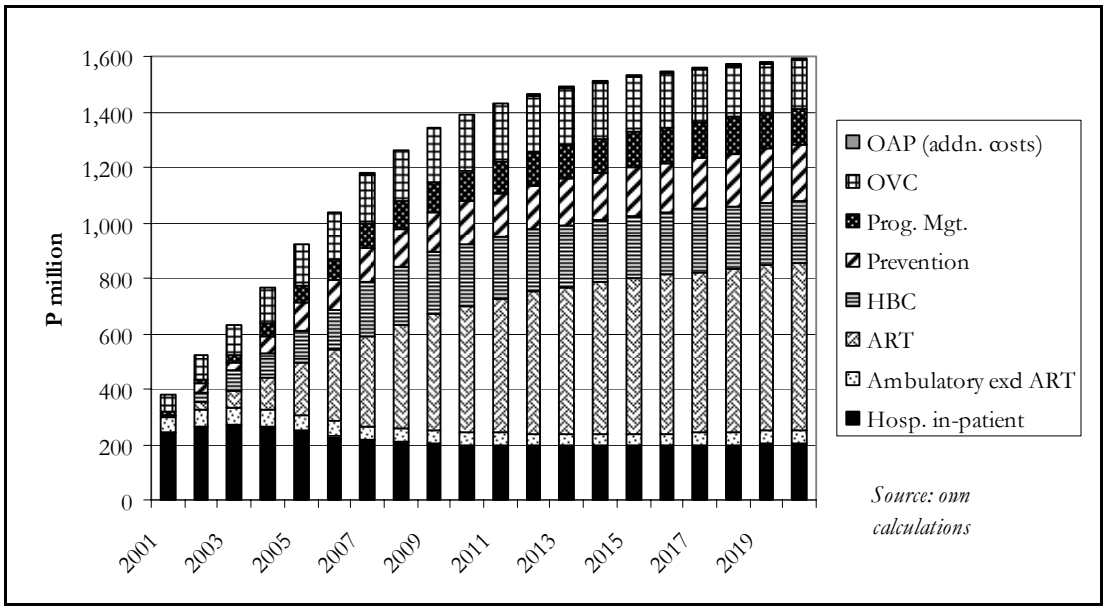
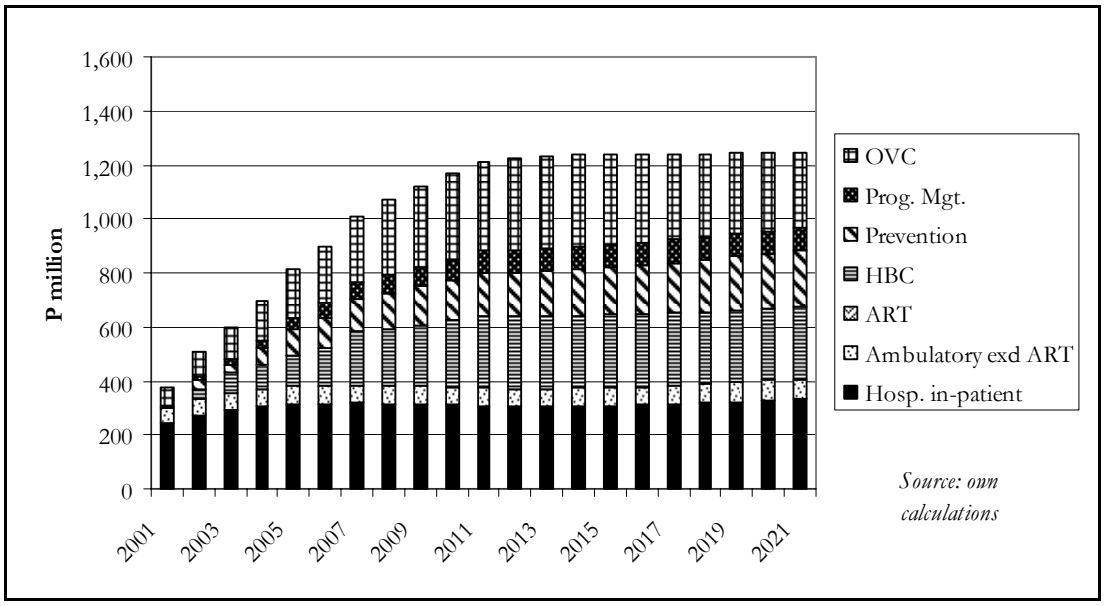
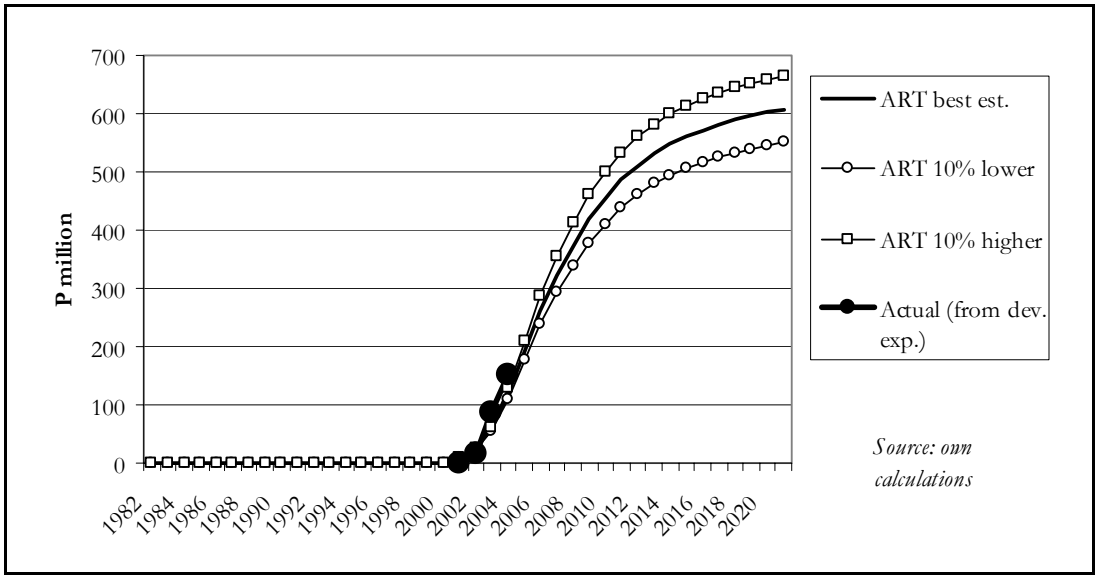


Figure 8-3: Projected Total Costs – No ART Scenario



The *ART cost projections* assume an average cost of P5 100 per patient per year, all borne by government. Actual costs may be heavily influenced by coverage, survival on treatment and changes in prices of drugs.[21]

Figure 8-4: Projected ART costs[22]



Projections of *orphan basket costs* are based on costs of orphan basket and estimated numbers of children that are double orphans. Projections seem plausible when compared to recent Development Expenditure on OVC support, which includes not only orphan basket costs but also social welfare staff that administer the benefit. However, future policy on orphan support and uptake rates may change. Some informants suggested that there is scope for better targeting and efficiency, and reducing abuse of the benefit.

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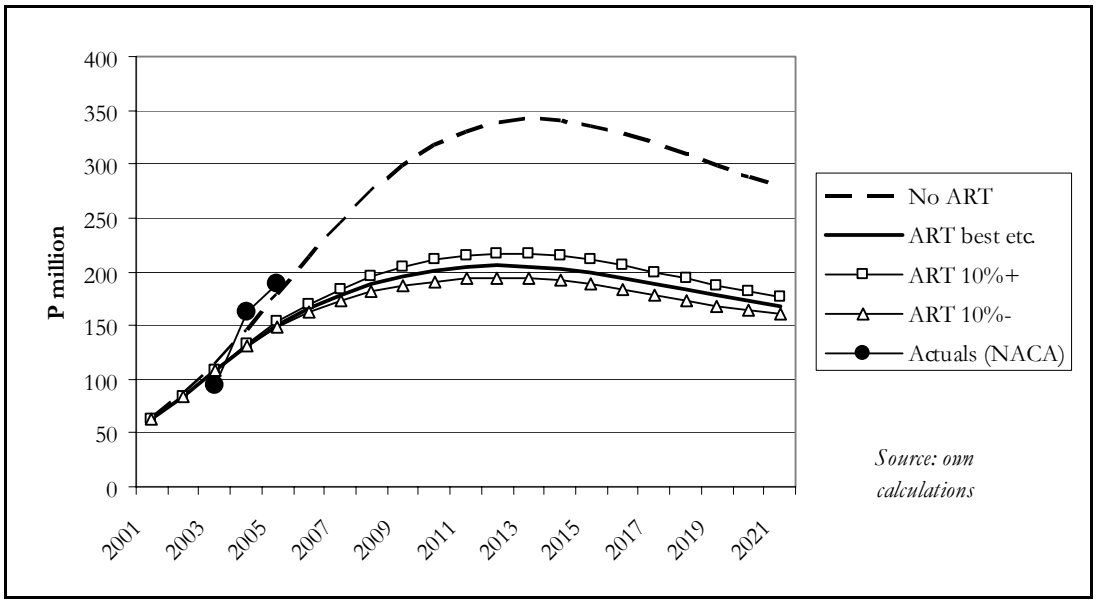
[21] Projections are based on MASA unit cost estimates that include lab, drugs and consultations. Current costs of regimens are estimated to be as follows: First Line P 5 130; Second Line P 8 055; Third line P12 205. The vast majority of people are on first line and, given the potential for reduction in drug prices in future, the first line unit cost is used for all patients over time. The cost of first-line provision is very close to the cost reported for ART provision in Thailand, which was reported at $842 per patient p.a. in 2004 (Revenga *et al*, 2006) (=P5052 at an exchange rate of P6=$1).

[22] 2004/5 Development Expenditure figure from NACA may be incomplete. Historical data on development expenditure on ART were adjusted to reflect personnel expenditure by Government and some donors that was not included in original tabulations. Costs of drugs donated by BMS (Stocrin; Crixivan) in recent years were not are not fully reflected in actual expenditure figures presented above as accurate estimates of these costs were not available.

Figure 8-5: Projected Orphan Basket costs and comparison to actual expenditure[23]

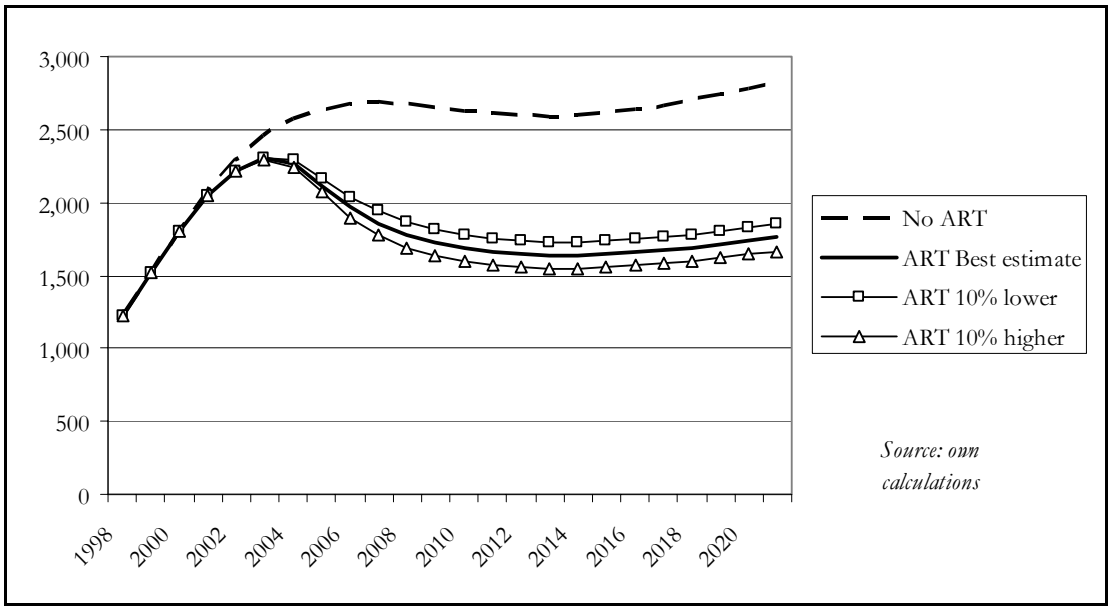


Important projections of need for, or potential utilisation of, certain services underlie several of the cost projections.

Projected needs for *inpatient care* drop quite substantially under ART scenarios, but remain significant. The actual cost impact of this need will depend on policy and planning scenarios in relation to providing more hospital and clinic capacity, as well as alternatives such as HBC. For the purposes of the scenarios presented here, and to illustrate possible effect of ART on hospital costs, it is assumed that projected extra hospital needs are met during the period. However, particularly in the short run, it seems unlikely that these costs would be fully incurred. Most the extra burden will be absorbed either by existing hospital capacity or households.

[23] Projected costs include a 10% allowance for implementation costs but exclude other overheads e.g. MLG managers, social workers, transport etc. Available data did not allow for confident estimation of MLG overhead costs related to administration of orphan or destitute benefits.

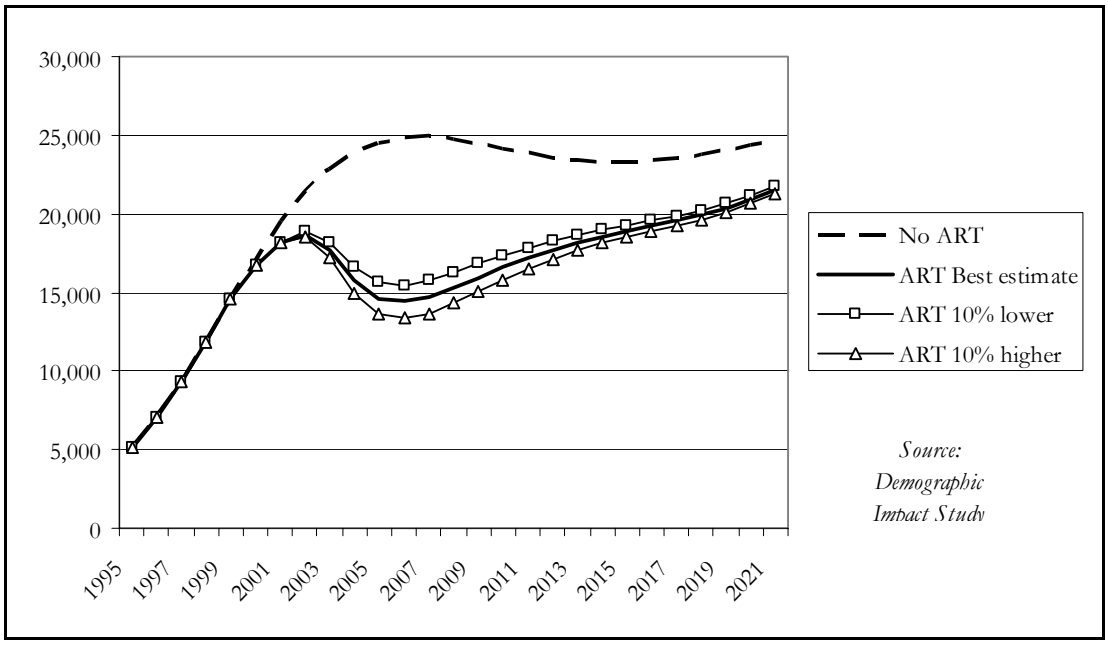
Figure 8-6: Projected Inpatient Bed needs for HIV and AIDS



Informants suggested that referral hospitals have undesirably high inpatient loads due to HIV and AIDS but that District and Primary hospitals bed capacity outside the main centres is often not fully utilized.

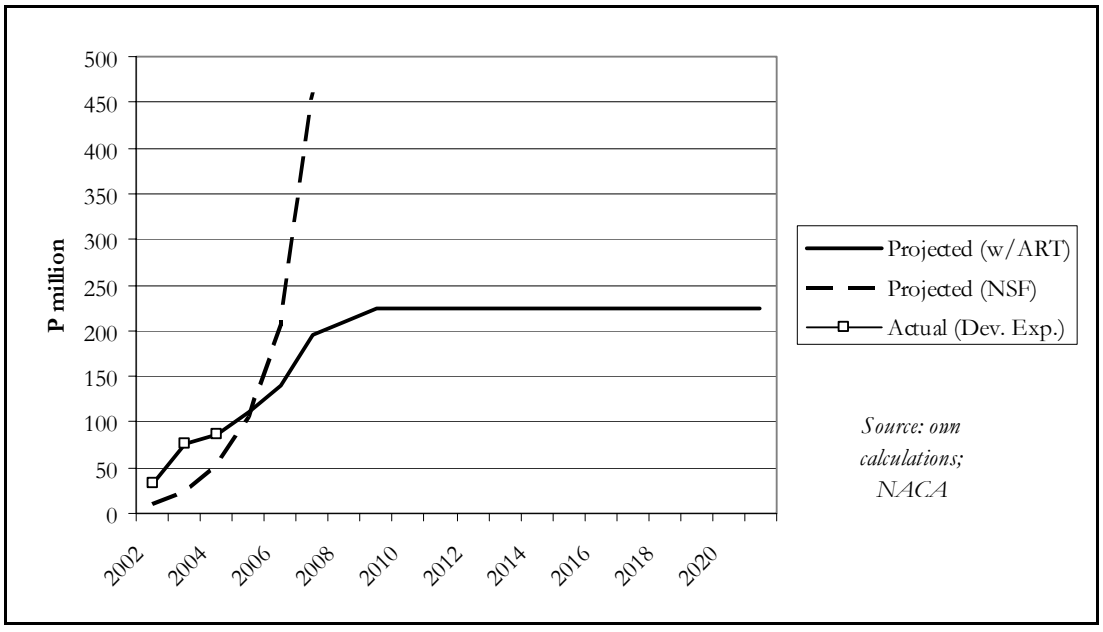
The projected number of *AIDS deaths* is shown below. Current projections suggest that more limited expansion of *Home Based Care* (HBC) capacity and costs may be required than assumed in the NSF. However, informants indicated that substantial numbers of people still go through terminal illness with very limited care and support and that a doubling of current, severely stretched HBC capacity seemed appropriate. In addition, it was noted that HBC models and roles may also be altered, with increasing inputs into ART mobilization and adherence.

Figure 8-7: Projected numbers of AIDS deaths by scenario



The projected costs of HBC in comparison to actual and planned expenditure are shown in the following figure.

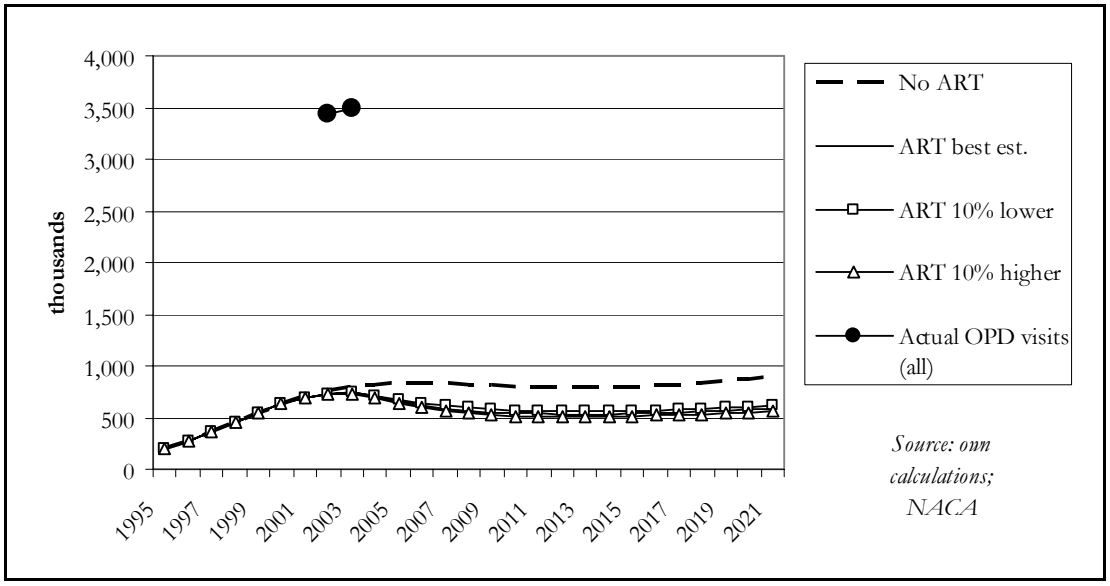
Figure 8-8: Projected costs of Home Based Care compared with actual and planned NSF expenditure



The projections indicate that around a quarter of ambulatory curative care consultations have probably been HIV and AIDS related in recent years. However, actual use and costs are

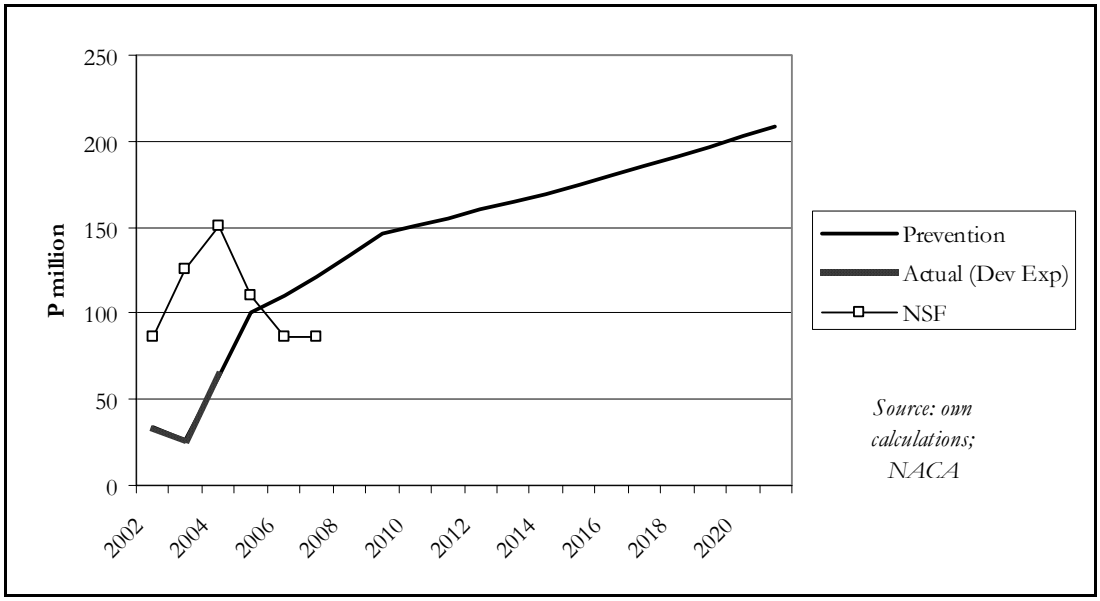
influenced by many factors including policy on capacity and accessibility of services.

Figure 8-9: Projected HIV and AIDS related outpatient visits (excluding ART consultations)



Projected *costs of prevention programmes* are shown in the following figure and compared with actual and proposed expenditure in terms of the NSF.

Figure 8-10: Costs of prevention activities – actual, planned and projected (Pula)



Total cost projections are given in the following chart and table. The projected costs are large and amount to an approximate doubling of current expenditure levels if ART is provided. However, one important finding is that the difference in total cost between the with-ART and no-ART

scenarios is not large. Under the no-ART scenario, total costs rise to P1.25 billion a year in 2015 (at 2004/05 prices), and then remain constant. Under the best-estimate with-ART scenario, total costs rise to P1.6 billion by 2021. Of this, ART costs amount to P607 million, or around 38 percent of total costs. The difference in total costs is, however, much less than the expenditure on ART, as this is offset to a certain extent by savings on HBC and OVC support, both of which rise rapidly in the no-ART scenario. The projections contained here indicate that around 40 percent of the costs of ART (P250m in 2021) would be met by offsetting savings from lower expenditure in other areas.

Figure 8-11: Total Costs by Scenario

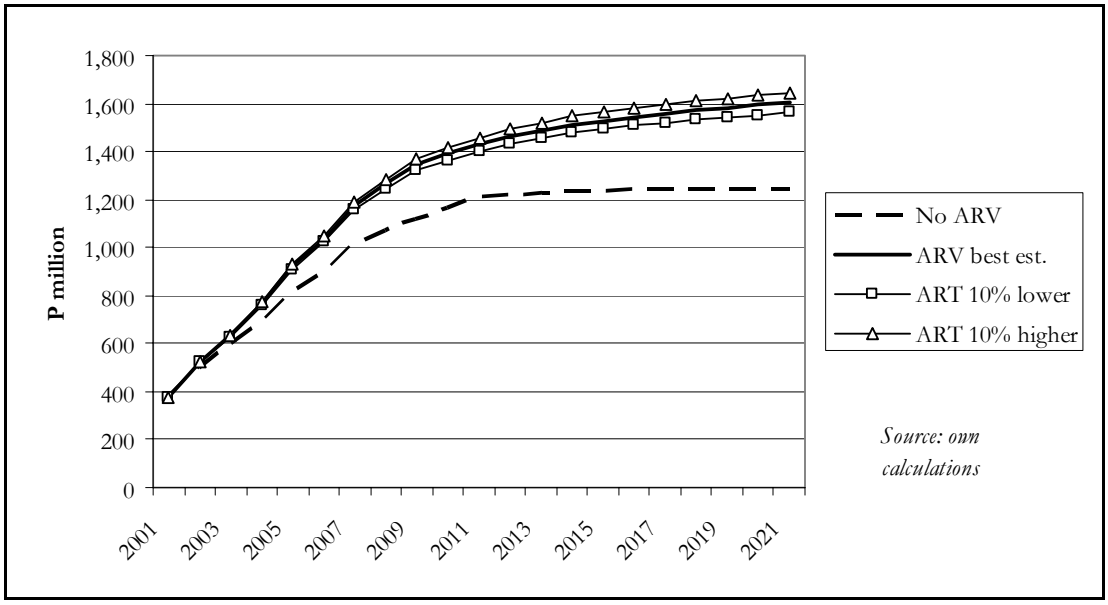


Table 8-1: Total Costs by Scenario (P million, 2004/05 prices)

	No ARV	ARV best estimate	ART 10% lower	ART 10% higher
2000	317	317	317	317
2001	373	380	380	380
2002	505	522	522	522
2003	595	630	628	633
2004	698	767	761	773
2005	815	921	912	931
2006	899	1,036	1,023	1,049
2007	1,009	1,177	1,160	1,193
2008	1,068	1,264	1,244	1,284
2009	1,122	1,344	1,322	1,367
2010	1,170	1,391	1,366	1,417
2011	1,211	1,430	1,402	1,458
2012	1,224	1,463	1,433	1,493
2013	1,232	1,490	1,458	1,522
2014	1,237	1,512	1,478	1,546
2015	1,240	1,530	1,495	1,565
2016	1,242	1,545	1,508	1,582
2017	1,242	1,558	1,520	1,596
2018	1,242	1,570	1,531	1,609
2019	1,242	1,581	1,542	1,621
2020	1,244	1,594	1,553	1,634
2021	1,246	1,605	1,564	1,646

Source: NACA, MoH, MLG, own calculations

d. Fiscal Impact

By combining the above data on the projected expenditure impact with the GDP projections derived in chapter 5 we can estimate the fiscal impact of HIV/AIDS in relation to overall GDP and government spending. The results are summarised in figure 8-12 below, and show that the maximum (proportionate) impact will be reached between 2010 and 2012. At this time, expenditure on HIV/AIDS-related programmes will reach an estimated 8.8 percent of government spending and 3.5 percent of GDP if ART is provided, and 7.8 percent of government spending and 3.1 percent of GDP if it is not. Therefore, while the total costs of HIV/AIDS-related spending are considerable, the additional costs to government of providing ART are not large in relation to overall costs (the additional costs will rise to around P360 million a year (at 2004/5 prices) by 2021, but this will only amount to some 1.1 percent of government spending at the time, or around 0.3 percent of GDP). This is largely because of higher spending on healthcare, HBC and orphan care if ART is not provided.

Some of the additional fiscal costs will be offset by donor support. The largest single component of donor funding for Botswana feeding directly into the government budget is through ACHAP, which receives funds from Merck & Co. and the Bill & Melinda Gates Foundation. Current

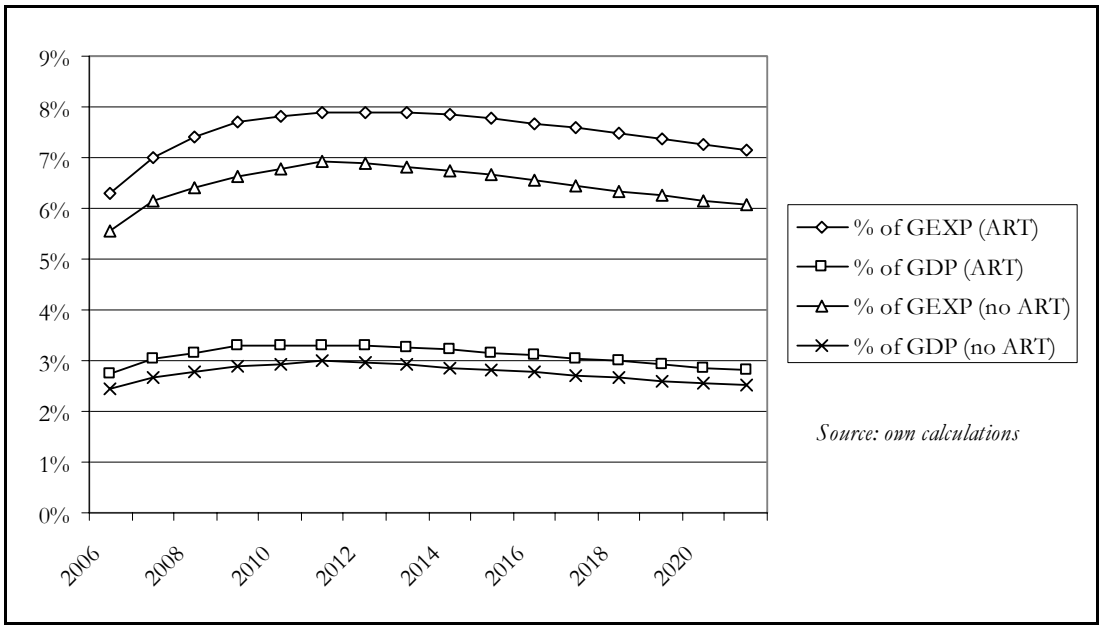
funding amounts to US$96 million (approximately P600 million), or around P80 million a year. Of this, around 30 percent is devoted to each of prevention of infection, treatment (ART), and programme management. Public finance data indicates that total additional donor support in recent years (above long-term trend levels) amounts to some P250m a year, most of which is likely to be devoted to HIV/AIDS. Although not all of this funding is related directly to ART provision, it is Botswana's concerted response to HIV/AIDS through the ART programme that has unlocked donor funding, and it is likely that the level of donor support would be much lower in the absence of the ART programme. Hence donor funding is likely to cover much of the incremental cost of the ART programme, at least in the early years.

Furthermore, this incremental government spending (on ART) will help to unlock additional GDP. The models used here suggest that the additional spending on ART rising to P360m a year will lead to additional GDP amounting P7.6 billion a year by 2021 (at 2004/05 prices) (GDP is estimated to be 20 percent higher in the AIDS-with-ART scenario than in the no ART scenario). The additional GDP results from a larger population and labour force, a healthier and more productive population, and an improved economic and social environment resulting in higher investment. Higher GDP in the with-ART scenario generates additional government revenues, as well as higher non-health spending requirements due to the higher population and increased economic activity. These incremental revenues on the additional GDP - net of other costs associated with there being a higher population and larger economy - should also cover part of the costs of ART.

Nevertheless, the fiscal costs of HIV/AIDS are high whether or not ART is provided, and there are major implications for fiscal balance. This is especially the case when overall government revenue growth is likely to slow because of anticipated slow growth of diamond production, and rapid growth of HIV/AIDS-related spending will make it even more difficult to sustain fiscal balance than it would be otherwise. In order to maintain fiscal balance, the costs of HIV/AIDS spending will have to be met by cutting back spending in other areas, possibly including lower priority areas of HIV/AIDS response. This would require prioritising of expenditures and strict budgetary controls. Alternatively, if HIV/AIDS-related spending is financed through budget deficits, there will be upward pressure on interest rates and a crowding out of private sector activity. Fully funding HIV/AIDS-related spending out of budget deficits is not feasible or sustainable, and hence some tough spending trade-offs will be necessary, and those trade-offs will be more severe if ART is provided.

It should also be noted that the cost projections are based upon demographic projections provided by the parallel demographic study, which assume a median survival time of patents on ART of around 7 years. A longer survival period would increase the number of people taking ART, and hence the cost and the fiscal burden on government, while of course yielding social and economic benefits through higher life expectancy and improved labour availability.

Figure 8-12: HIV/AIDS-relate spending as percent of GDP and total Government spending



e. Conclusions

The main conclusions of the fiscal impact analysis are as follows:

- Updated HIV and AIDS projections from the Demographic Impact Study assume a high rate of ART uptake. This reduces deaths but increases costs, particularly of ART
- Projections seem broadly consistent with available cost and utilisation data although consistency will have to be monitored and policy may alter cost patterns.
- *Overall projections of costs are large in relation to current health expenditure* and represent a significant fiscal challenge.
    - Projected overall costs will increase by at least 50 percent from current levels in real terms (from approximately P1 billion per year at 2004/05 prices to P1.6 billion) in the absence of policy changes or other developments (such as significantly reduced drug prices);
    - this means that there may need to be significant tradeoffs and prioritisation between expenditure on a) certain aspects of the HIV and AIDS response b) HIV and AIDS and other health services and c) recurrent expenditure and investment-related development expenditure.
    - Cost levels, profiles and trends may be significantly influenced by the survival time of people on ART. Data was not available at the time of writing to assess possible influences of this on projections. However, it is recommended that sensitivities to this survival time are considered, particularly in more detailed health sector planning.

- *Effective prevention programmes are critical* to managing the longer term fiscal and human impact of the epidemic. Projections indicate that costs will continue to rise for the foreseeable future. A key way to limit those future costs will be prevention of more adult and child infections.
- *Certain costs can potentially be managed down* through policy and planning decisions. More efficient *referral systems* between higher and lower levels of care and between peripheral and central services seem to have potential for better cost management and efficiency. This means that actual fiscal costs may potentially be reduced to below the levels shown in the "10% lower" ART coverage scenario.
    - Most importantly *ART costs* can potentially be reduced if ARV costs are negotiated and if the number of laboratory tests and visits can be reduced, particularly for people who are stable on treatment.
    - *Hospital inpatient costs* may be managed down by starting ART earlier and/or placing greater emphasis on HBC. As most of the inpatient burden is reported to be in the referral hospitals, rather than district and primary hospitals, costs may also be limited by developing lower cost "step down" or primary hospital models to serve large centres such as Francistown and Gaborone and other mechanisms to channel utilisation to peripheral hospitals.
- ART provision has significant cost implications, but generates economic and financial benefits:
    - Even though the provision of ART leads to some cost savings (e.g. reduced other health care costs), the overall costs of ART provision exceed costs in the No-ART scenario; the additional costs rise from P135m to P360m a year from 2006 to 2021 , or 15 to 30 percent of costs in the No-ART scenario;
    - despite these significant costs, ART provision will help to generate additional economic activity amounting to approximately P7.6 billion a year by 2021, and the additional taxes generated for government from this activity – net of other costs associated with there being a higher population and a larger economy - should be sufficient to pay for some of the additional ART-related health care costs;
    - donor funding also helps to alleviate part of the costs associated with HIV/AIDS (currently around 20 percent of the total), and although the majority of donor funds are not directly tied to ART provision, the adoption of a comprehensive strategy to deal with HIV/AIDS, including ART provision, will tend to unlock more donor funding than a strategy that does not include this element. Hence donor funds will also meet part of the additional costs of HIV/AIDS;
    - overall, the provision of ART should not have a major adverse impact on the government budget, given that (i) the majority of HIV/AIDS-related costs will need to be met whether or not ART is provided, and (ii) the provision of ART will unlock greater economic activity and increased donor support that should meet most of the additional costs.
- *HBC cost and coverage assumptions made here,* are in line with 100 percent coverage targets proposed in the NSF. It is uncertain whether this is required or efficient. At the same time

however, it is possible that HBC teams will increasingly be required to play new roles in ART mobilisation and adherence support.

- *Orphan basket* costs are felt by some informants to be inflated by abuse. Costs may be reduced if not all double orphans require support. However, this could be counteracted if other vulnerable children, not just orphans, may also be seen as deserving of orphan basket support in future.
- *Public private partnerships and other innovative approaches* need to be considered. They may assist with issues such as capacity and efficiency of service delivery, reinforcing adherence to ART, and managing costs of drugs or high cost conditions.
- *Costs could be higher than the figures presented here* if ART is successful in leading to longer survival times on ART than that assumed in preparing the parallel Demographic Study.

Table 8-2: All costs – ART Best estimate scenario (P mn; 2004/05 prices)

	Hospital In-patient	Ambulatory excl ART	ART	HBC	Prevention	Programme Management	OVC	Old age pensions - Cost vs No ART	TOTAL
2000	213	53				5	46		317
2001	242	58	9			8	63	0	380
2002	262	61	27	34	34	20	84	0	522
2003	271	61	59	76	26	30	108	0	630
2004	267	58	119	85	63	44	131	0	767
2005	250	54	194	112	100	61	151	0	921
2006	232	51	262	140	110	75	166	0	1,036
2007	219	49	323	196	121	90	178	1	1,177
2008	210	47	375	210	133	100	188	1	1,264
2009	203	46	419	224	146	108	196	1	1,344
2010	199	45	456	224	151	113	201	2	1,391
2011	196	45	486	224	155	118	204	2	1,430
2012	194	44	510	224	160	121	206	3	1,463
2013	193	44	531	224	165	124	205	4	1,490
2014	193	45	547	224	170	126	203	4	1,512
2015	194	45	561	224	175	127	199	5	1,530
2016	195	45	572	224	180	129	195	5	1,545
2017	197	46	581	224	185	130	189	6	1,558
2018	199	47	589	224	191	131	183	7	1,570
2019	201	47	596	224	197	131	178	7	1,581
2020	204	48	602	224	203	132	173	8	1,594
2021	207	49	607	224	209	133	168	8	1,605

Source: NACA, MoH, MLG, own calculations

Table 8-3: All costs – No ART scenario (P mn; 2004/05 prices)

	Hospital In-patient	Ambulatory excl ART	ART	HBC	Prevention	Programme Management	OVC	Old age pensions - Cost vs No ART	TOTAL
2000	213	53	-	-	-	5	46	-	317
2001	244	59	-	-	-	7	64	-	373
2002	270	63	-	34	34	17	86	-	505
2003	289	67	-	76	26	24	114	-	595
2004	303	69	-	85	63	32	145	-	698
2005	312	69	-	112	100	43	179	-	815
2006	316	69	-	140	110	51	213	-	899
2007	317	69	-	196	121	62	245	-	1,009
2008	315	68	-	210	133	68	274	-	1,068
2009	312	67	-	224	146	74	299	-	1,122
2010	310	67	-	246	151	79	317	-	1,170
2011	307	66	-	269	155	83	331	-	1,211
2012	306	66	-	269	160	84	339	-	1,224
2013	306	66	-	269	165	85	342	-	1,232
2014	306	66	-	269	170	86	341	-	1,237
2015	308	67	-	269	175	86	336	-	1,240
2016	311	68	-	269	180	85	329	-	1,242
2017	314	69	-	269	185	85	319	-	1,242
2018	318	70	-	269	191	85	309	-	1,242
2019	323	71	-	269	197	84	299	-	1,242
2020	328	72	-	269	203	84	289	-	1,244
2021	333	73	-	269	209	83	279	-	1,246

9. CGE Modelling of the Macroeconomic Impact of HIV/AIDS

a. Introduction

The approach followed in the previous chapter deals with the economy at an aggregate level, and does not disaggregate the impact of HIV/AIDS by sector, or attempt to model the evolution of the economy on a sectoral level. It includes only a limited distinction between economic activities, through the model's division into formal and informal sector economic activities and skilled and unskilled labour. However, a richer analysis of the impact of HIV/AIDS on an economy can be obtained from a modelling approach that incorporates different sectors. In practice, the economic impact of HIV/AIDS will vary across sectors, depending on a number of factors such as the degree of labour/capital intensity in the production structure of each sector, and its use of skilled and unskilled labour. Given that HIV/AIDS has its impact through various different channels, including investment, labour availability and productivity, and public spending, the sectoral impacts may well vary.

As discussed in chapter 4, such a disaggregated approach can be modelled using a computable general equilibrium model (CGE). In this study, a CGE has been constructed specifically to model the impact of HIV/AIDS on the economy, both at an overall and sectoral level, as well as to model the linkages with households and labour categories. The model is described in more detail below

b. Description of the Model

The CGE model extends aggregate growth models of Botswana by estimating the impact of AIDS on individual sectors. To reflect the heterogeneity of Botswana's producers, the CGE model is calibrated to a purpose-built 2002/03 social accounting matrix (SAM) that distinguishes between 26 productive sectors.[24] Segmented markets are assumed for the 30 different labour types identified in the model. Given the different prevalence rates from the BAISII survey, labour is disaggregated across five occupational categories (professional, managerial, clerical, manual, and unskilled), three geographic regions (cities, towns/villages, and rural areas), and male and female workers. Unemployment rates are held constant, while labour is fully employed and mobile across sectors with flexible real wages.[25] By contrast, capital is immobile earning flexible activity-specific returns. Although producers maximize profits, they are constrained by factor market imperfections, such as segmented markets for skilled and unskilled labour. A nested production system is employed. At the lower levels, a constant elasticity of substitution function defines factor demand, while at the highest level, fixed-share intermediates are combined with factor value-added. Within the regional nesting of labour demand, a worker's occupation is

[24] See Dervis *et al.* (1982) for a description of this class of models, and Lofgren *et al.* (2002) for a mathematical description of a static version of the model.

[25] Assuming full employment may appear to be a rigid assumption but it allows labour supply to adjust exogenously in response to the demographic projections. This assumption effectively implies that current unemployment rates are maintained (or do not change dramatically) and that new workers find some form of employment. In other words, if formal labour demand is insufficient then workers are forced to work in lower paying informal sectors.

considered more important than their gender. By disaggregating production across sectors the model captures the changing structure of growth caused by the pandemic. Furthermore, the detailed labour disaggregation allows the model to incorporate differences in workers' prevalence rates and its effect on employment and wages.[26]

In order to capture the economy-wide impact of AIDS, the model considers a number of 'institutions', including the government, enterprises and households. Enterprises are divided into three categories (mining, private non-mining, and public non-mining). The 60 household groups in the model are derived from the 2002/03 Household Income and Expenditure Survey (HIES) (CSO, 2004b) and are disaggregated according to geographic region, the gender of the *de jure* household head, and national expenditure deciles. Households and enterprises receive income in payment for producers' use of their factors of production. These income patterns depend on each household's physical and human capital endowments as reported in the survey. Both types of institutions pay taxes to government (based on fixed tax rates), save (based on marginal propensities to save), and make transfers to the rest of the world. Enterprises pay their remaining income to households. Households use their incomes to consume commodities under a linear expenditure system. The government receives income from direct and indirect taxes, and then makes transfers domestically and abroad. The government also purchases commodities in the form of consumption expenditure and the remaining income is saved. Fiscal expenditure is disaggregated by administration, health and education functions. All private and public savings and foreign inflows are collected in a savings pool from which current investment is financed. By disaggregating households according to their income and expenditure patterns the model captures how AIDS effects households and regions differently. Furthermore, its detailed treatment of public expenditures and tax incidence allows the model to capture the fiscal implications of AIDS and additional health costs under the treatment program.

The model has three macroeconomic accounts: the savings and investment account; the current account, and the government account. A set of 'closure' rules ensure macroeconomic balance. A savings-driven closure is assumed for the savings-investment account, whereby the marginal propensities to save of households and enterprises are fixed, and real investment quantities adjust to ensure that the level of investment and savings are equal at equilibrium. For the current account it is assumed that the *real* exchange rate adjusts to maintain a fixed current account balance measured in foreign currency[27]. Finally, for the government account, tax rates and real government consumption expenditure are fixed. Public administration and economic spending are a fixed share of total expenditure, while education and health spending follow population growth (plus any additional health spending under the treatment program). Under this closure, the fiscal surplus adjusts to ensure that revenues equal recurrent expenditures and public investments. Together these closures allow the model to capture the crowding-out effects of

[26] International trade is also modelled explicitly. Export supply is governed by a constant elasticity of transformation function based on endogenous relative prices. Import demand, for final and intermediates usage, is governed by an Armington function. Under the small country assumption, foreign prices are fixed and include relevant taxes and transactions margins.

[27] The assumption of a fixed current account balance (surplus), resulting in negative foreign savings, ensures that the situation of domestic savings exceeding investment is retained.

government spending; the impact of savings on investment and growth; and the effect of foreign development assistance on the real exchange rate.

The model is recursive dynamic implying that parameters in the current period are determined by results from previous periods. For example, new capital stocks are endogenously determined by past levels of savings and investment, with new capital allocated across sectors according to differences in profit rates. The model therefore captures the impact of AIDS on physical capital accumulation. The model is also exogenously updated to reflect changes in population based on demographic projections. The demographic model projects annual population growth by age cohort and gender. These disaggregated growth rates are mapped onto households in the micro-simulation model according to their initial demographic structure. Survey sample weights are then updated each year to capture different population growth scenarios. Similarly, labour supply is estimated based on the demographic projections, but its mapping to the micro-simulation model is restricted to the economically active population and reflects the prevalence rates of different occupational groups and geographic regions. These population and labour supply projections from the demographic and micro-simulation models are aggregated to determine the growth rates for the representative households and labour categories in the CGE model.[28] Finally, labour and total factor productivity (TFP) are updated exogenously according to the assumed impacts of AIDS (see section c below).

The model is initially calibrated to the information contained in the 2002/03 SAM. The dynamic model is then solved for the 2003-21 period as a series of equilibria, each one representing a single year. By imposing forecasted GDP growth from Botswana's 2003-09 National Development Plan (NDP9) (MFDP, 2003) as well as the population and labour supply projections from the demographic model, the CGE model produces a counterfactual growth path consistent with the current *With AIDS* scenario. This scenario reflects the current growth path of the economy in the presence of AIDS but in the absence of treatment. Two additional scenarios (i.e., *Without AIDS* and *AIDS-with-ART treatment*) are expressed through changes in population, labour supply, productivity and government expenditure. The model is then re-solved for a new series of equilibria and differences between these alternative growth paths and the counterfactual are interpreted as the economy-wide impact of AIDS and its treatment. Finally, changes in poverty and inequality in the micro-simulation module are measured using the same survey that was used to construct the SAM and CGE model. Analogous to sample weights, each representative household in the CGE model is an aggregation of a larger number of households in the survey. Since poverty in this study is defined according to per capita expenditure, changes in each household's expenditure in the CGE model is passed down to the survey, where the poverty measures are updated and poverty and inequality is recalculated.

In summary, the CGE-micro-simulation model is an advance over previous methodologies as it captures the detailed sectoral structure of Botswana's economy and the linkages between

[28] The integration of the demographic, CGE and microsimulation models makes full use of available information. However, it assumes that demographic structures in the survey remain representative over time and in spite of AIDS. In other words, any combining or fragmentation of households randomly nets out and does not dramatically alter the composition of the true population represented by the *households* in the survey sample. Since the survey was conducted at the peaking of the pandemic, it is should remain sufficiently representative over coming years.

producers, markets, households and government. It is based on new estimates of HIV prevalence and integrates the demographic and economic models. The CGE model *exogenously* captures a number of transmission mechanisms linking AIDS to growth and poverty. These include (i) changes in household populations and national demographic structure due to increased mortality; (ii) shifts in the level and skill-composition of labour supply; (iii) falling labour productivity due to morbidity and the productivity losses associated with systemic shocks to the economy; and (iv) changes in the level and composition of government expenditure. The model also *endogenously* captures other mechanisms, such as changes in savings and its impact on investment and capital accumulation. Although not exhaustive, these transmission mechanisms provide a reasonable approximation of the main impacts of AIDS on growth, poverty and inequality.

c. CGE Model Results

Three scenarios are presented. The *With AIDS* scenario captures the current growth path given existing prevalence rates and in the absence of the government's new treatment program. The *Without AIDS* scenario captures how the current growth path would have differed had AIDS never existed. The final *AIDS-with-ART* scenario starts with existing HIV prevalence rates and then considers the impact of the government's current treatment strategy.

i. The 'With AIDS' Scenario

The previous section identified four exogenous transmission mechanisms that are used in the model to simulate the impact of AIDS (i.e., population, labour supply, productivity, and fiscal expenditure). The *With AIDS* scenario draws on the demographic model, national growth projections, and past trends to determine how these factors change over time (see table 9-1). Despite the dominance of mining and the importance of agriculture for rural livelihoods, a majority of Botswana's one and a half million people live in urban areas. However, most of the urban population live in towns and villages rather than in the two main cities. Based on the demographic model's projections, the urban population is expected to grow faster than the rural population during 2003-21 despite having higher HIV prevalence rates. Labour supply grows evenly across the different occupational groups, with the exception of manual and unskilled labour. The former includes agricultural workers and mirrors slower rural population growth. Both labour-specific and total factor productivity remain unchanged, reflecting the general slowdown in the economy. Government expenditures on education follow recent trends. Health expenditures include the projected cost of orphans and health services in the absence of anti-retroviral and other treatment (as discussed in chapter 8). These four sets of assumptions are combined with the sectoral growth projections from the 2003-09 National Development Plan (NDP9).

Table 9-1: Comparison of the Model Scenarios

Transmission channel	Initial value, 2003	Initial HIV prevalence rate (%)	Annual growth rate, 2003-21 (%)		
			With AIDS	Without AIDS	AIDS-with-ART
Population (1000s people)	1,861	17.2	0.9	2.0	1.2
Urban areas	1,043	18.2	1.0	2.3	1.4
Cities	422	20.0	1.1	2.6	1.6
Villages and towns	621	17.0	0.9	2.0	1.2
Rural areas	818	15.0	0.7	1.6	1.0
Labour supply (1000s workers)	462	28.7	1.2	2.5	1.7
Professional	57	18.8	1.2	2.2	1.7
Managerial	13	24.2	1.3	2.7	1.8
Clerical	89	30.4	1.1	2.6	1.7
Manual	100	28.6	1.5	2.8	2.0
Unskilled or elementary	204	34.1	0.9	2.8	1.5
Productivity					
Labour	-	-	0.0	0.5	0.2
TFP (labour and capital)	-	-	0.0	0.4	0.2
Government expenditure (P mn)					
Education and social services	3,112	-	2.8	4.0	3.2
Health	773	-	5.7	2.7	7.2

Source: Botswana CGE-micro-simulation model, 2002/03 Household Income and Expenditure Survey (CSO, 2004b), and 2004 Botswana AIDS Impact Survey (CSO/NACA, 2005).

Note: Education and health spending are 24.5 and 6.1 percent of total government expenditures respectively.

GDP grows at 3.0 percent per year during 2003-21, driven by strong growth in investment and government expenditures (see table 9-2 and figure 9-1). This is in line with past trends and current forecasts. Investment growth accounts for the fast accumulation of capital stocks at 3.7 percent per year. Slower growth in labour supply and productivity partly reflects the impact of AIDS and suggests that production will become increasingly capital-intensive as producers overcome labour constraints by substituting with machinery. At the sectoral level, public services grow alongside government consumption expenditure. Manufacturing and private services expand more quickly than overall GDP, with the former benefiting from the availability of capital. By contrast, agriculture and mining grow slowly at two percent per year in line with recent trends and depleting natural resources.

At the sectoral level, the sectors that are hardest hit by AIDS are those that are particularly labour intensive, including agriculture, manufacturing and trade (wholesale/retail), due to the impact of slower labour force growth (see Table 9-3). Agriculture is particularly badly affected due to its reliance on less skilled labour, where HIV prevalence rates are higher. Mining is not so severely affected, partly because mining growth is forecast to slow anyway as diamond production levels off, and also because it is highly capital intensive and investment is assumed to be largely protected in the mining sector (i.e. it will continue at levels that are unaffected by HIV/AIDS). The sectors that are most affected by HIV/AIDS through labour force effects are the ones that benefit most from the provision of ART, due to its positive impact on the size and health of the labour force.

Figure 9-1: Real GDP Growth Projections

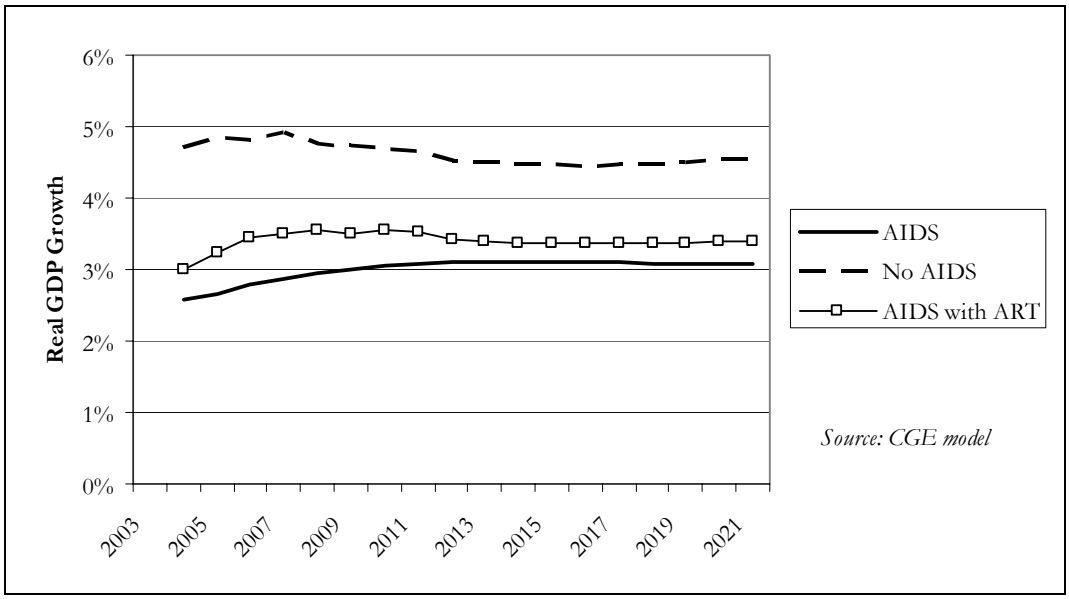


Table 9-2: Macroeconomic and Growth Results

	GDP share, 2003 (%)	With AIDS 2003-21	Without AIDS 2003-21	AIDS-with-ART 2003-21
		Average annual growth rate (%)		
GDP at market prices	100.0	3.0	4.6	3.4
Private consumption	26.6	2.2	4.4	2.9
Government	34.7	3.1	4.5	3.6
Investment	27.7	4.0	5.7	4.1
Exports	43.2	2.6	4.1	2.9
Imports	32.2	2.8	4.6	3.2
GDP at factor cost	100.0	3.0	4.6	3.4
Capital stock	73.0	3.7	4.3	3.7
Labour employment	27.0	1.2	2.5	1.7
TFP (residual)	-	0.0	0.8	0.2
		Point change in share of GDP by 2021 (%)		
Savings or investment	27.7	2.4	4.4	1.1
Public savings	12.0	1.2	1.9	-1.0
Private savings	22.5	1.7	1.7	1.7
Foreign inflows	-6.7	-0.5	0.9	0.4

Source: CGE-micro-simulation model

Table 9-3: Sectoral Growth Results

Sector	GDP share, 2003 (%)	With AIDS 2003-21	Without AIDS 2003-21	AIDS-with-ART 2003-21
		Average annual growth rate (%)		
GDP factor cost	*100.0*	*3.7*	*5.3*	*4.1*
Agriculture	3.1	2.0	4.3	2.4
Mining	38.2	2.0	2.4	2.2
Manufacturing	4.3	3.5	6.6	4.0
Water & electricity	2.2	4.0	6.0	4.6
Construction	5.7	4.0	5.8	4.2
Trade services	6.7	3.0	5.3	3.4
Hotels and catering	2.2	4.0	6.5	4.5
Transport & communications	2.4	4.3	6.4	4.8
Financial services	2.4	4.5	7.6	5.3
Business services	7.5	4.5	7.1	5.0
Other services	2.4	4.0	7.0	4.6
Public administration	14.9	3.1	4.5	3.6
Education & health	6.5	2.7	4.1	3.3

Source: CGE-micro-simulation model

Capital-intensive growth is less likely to translate into broad-based increases in household incomes. This is reflected in the slower growth in private consumption compared to other components of GDP. Combining private consumption growth (2.2 percent) with national population growth (0.9 percent) implies that mean per capita incomes increase by 1.3 percent in the *With AIDS* scenario. However, despite rising average incomes, the share of the population living on less than one dollar a day falls only slightly from 23.4 percent in 2003 to 20.7 percent in 2021 (see table 9-4). This decline in the poverty rate is insufficient to offset population growth such that the number of poor people increases by 90 000 during 2003-21. Furthermore, the decline in national poverty is dominated by falling urban poverty, which is already less severe than in rural areas. This is because industrial growth is concentrated in urban areas. By contrast, rural poverty falls more slowly due to the poor performance of agriculture. Finally, male-headed households benefit as much as female-headed households, despite the fact that the latter have fewer working members and women themselves face higher unemployment.

Table 9-4: Poverty Results

	Poverty rate, 2003	Final year poverty rate, 2021		
		With AIDS	Without AIDS	AIDS-with-ART
Poverty headcount (%)	23.4	20.7	19.2	20.2
Rural areas	36.1	34.4	35.7	35.0
Urban areas	13.5	10.5	7.6	9.5
Cities	5.1	3.8	2.2	3.4
Villages and towns	19.3	15.1	11.7	14.0
Male-headed households	20.6	18.2	15.9	17.5
Female-headed households	26.4	23.5	22.9	23.4

Source: CGE-micro-simulation model.

The *With AIDS* scenario captures the slowdown in Botswana's mining sector and the impact of AIDS on economic growth. Based on the projected level and structure of growth, poverty will decline only slightly and the benefits of growth will not be distributed evenly across the population. Urban poverty declines due to manufacturing growth and employment, but a sluggish agricultural sector constrains rural poverty reduction. This suggests that Botswana's current growth path is less geared towards benefiting the poor. However, what is uncertain is the extent to which these development prospects are a result of AIDS, or rather the weak performance of the mining sector and a lack of alternative sources of growth. The next scenario addresses this question by removing the effects of AIDS from the current path, thereby estimating its contribution to the current slowdown of Botswana's development process.

ii. The 'Without AIDS' Scenario

The *Without AIDS* scenario is identical to the previous scenario except that it removes the impact of the pandemic on population growth, labour supply, productivity and fiscal expenditure (see table 9-1). Both labour supply and productivity grow faster without AIDS, which directly raises production and incomes (see table 9-2). Higher incomes and savings encourages investment and capital accumulation. Faster economic growth also raises government revenues. However, while there is a decline in existing AIDS-related health costs, there is also an increase in the size of the overall population. Since education and social spending is tied to the size of the population, the decline in health costs are partially offset causing only a slight improvement in the fiscal surplus (i.e., public savings) relative to the *With AIDS* scenario. Furthermore, while private savings increase in absolute terms, they do not rise as fast as GDP, and the private sector's share of investment remains constant. The net effect is an acceleration of GDP growth from 3.0 percent under the *With AIDS* scenario to 4.5 percent under the *Without AIDS* scenario. AIDS therefore lowers Botswana's growth rate by approximately 1.6 percent per year.

AIDS also has implications for Botswana's interactions with foreign countries and its overall structure of production. Slower mining sector growth lowers exports while import-intensive investment encourages import demand. This places pressure on the current account and causes a slight depreciation of the *real* exchange rate. This depreciation, together with higher labour supply and productivity, favours labour- and export-intensive sectors. Manufacturing exports are particularly reliant on urban labour, especially workers in lower-skilled occupations for whom HIV prevalence is highest. Accordingly, manufacturing grows more rapidly than other sectors. Higher economy-wide growth also causes an expansion of private services. Despite the stronger performance of agriculture and manufacturing, these two sectors are unable to absorb the increase in labour supply and some workers are forced to work in lower paying informal services. Furthermore, while the mining sector benefits from rising productivity it is constrained by limited natural resources so that additional growth remains marginal. The stronger performance of the non-mining sectors under the *Without AIDS* scenario suggests that the pandemic has not only lowered growth but has also been a constraint to economic diversification.

Economic impact studies based on aggregate growth models typically use per capita GDP to measure the impact of AIDS on households. However, a more relevant measure is private consumption, which reflects how much of growth translates into household incomes. This is especially important in Botswana where GDP growth is dominated by government and investment spending. Under the *Without AIDS* scenario, the increase in the labour supply exceeds

the increase in capital stocks leading to a less capital-intensive growth path. Since households are more reliant on labour incomes, this shift in the structure of growth means that households are more likely to participate in the growth process. For this reason the increase in the growth rate of per capita consumption is larger than for per capita GDP. Therefore, not only would growth have been higher in the absence of AIDS, but more of this growth would have reached households.

Rising average per capita consumption also leads to further declines in poverty under the *Without AIDS* scenario (see table 9-4). The national incidence of poverty falls to 19.2 percent by 2021 compared to 20.7 percent under the *With AIDS* scenario. However, this decline in the poverty rate is offset by a larger population, such that while 638 000 fewer people die in the absence of AIDS, 90 000 of these people are from below the poverty line. The smaller number of poor people in the presence of AIDS does not suggest a 'gift from the dying'. The lower poverty rate under the *Without AIDS* scenario indicates that around 43 000 *uninfected* people have been pulled into poverty due to the slower economic growth caused by AIDS. This is equivalent to 2.3 percent of Botswana's current population. Furthermore, not all groups are affected equally. Rural poverty is higher in the absence of AIDS since there are fewer employment opportunities in rural areas and because increases in the rural labour force and rural incomes are more than offset by a larger rural population. This suggests that, even in the absence of AIDS, agricultural growth and rural development would remain the binding constraint to broad-based poverty reduction. By contrast, urban households benefit more from there being no pandemic, since urban areas have the highest prevalence rates and since increased labour supply is matched by better urban employment opportunities and wages. These distributional differences suggest that AIDS may have in fact narrowed the gap between urban and rural poverty. However, this decline in regional inequality has been at the cost of increased mortality and higher overall poverty.

The results indicate that AIDS reduces GDP growth and raises the incidence of poverty. Each of the transmission mechanisms contributes differently to these outcomes (see table 9-5). Holding other mechanisms constant, changes in TFP generate most of the additional 1.6 percent GDP growth, while changes in labour supply have the largest impact on poverty. The latter is driven by poor households' greater reliance on labour endowments and incomes. However, not all mechanisms have positive effects. The larger population under the *Without AIDS* scenario reduces GDP growth since the decline in the fiscal surplus caused by increased education expenditures crowds-out private investment. The converse is true for health expenditures, which decline under the *Without AIDS* scenario. The expansion of the population also causes an increase in the poverty rate, since it raises dependency ratios.[29] However, in the combined scenario this is more than offset by a larger supply of labour and higher productivity.

[29] This is based on the assumption that the additional population do not join the labour force and find employment. The latter falls within the 'labour supply' mechanism.

Table 9-5: Transmission Channels' Contribution to Changes in Growth and Poverty Rates

	Change in GDP growth rate (%)		Change in poverty headcount (%)	
	Without AIDS	AIDS-with-ART	Without AIDS	AIDS-with-ART
Total point change	1.6	0.4	-1.6	-0.5
Labour supply	0.5	0.2	-4.2	3.3
Labour productivity	0.2	0.1	-1.3	0.8
Total factor productivity	1.2	0.5	-2.2	2.2
Health expenditure	0.7	-0.1	-0.6	-0.6
Population growth	-1.0	-0.3	6.7	-6.3

Source: CGE-micro-simulation model

Note: *Growth rate* is average growth rate for 2003-21; *poverty rate* is overall change in national headcount rate.

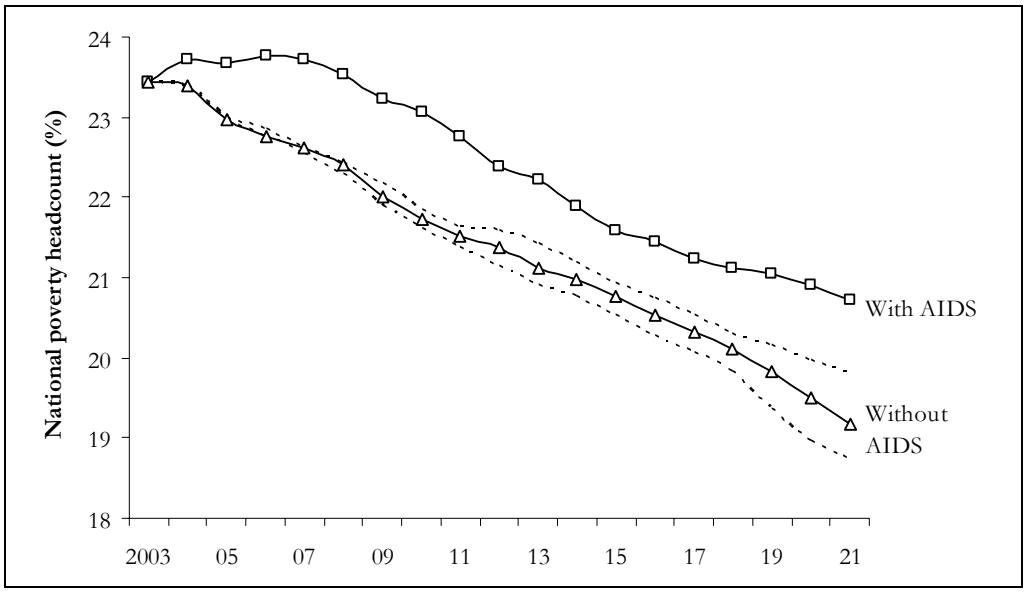
The importance of individual transmission mechanisms highlights the importance of sensitivity analysis. The assumptions underlying certain mechanisms are more robust than others since they are based on more reliable projections or have only a small impact on the results. For example, labour supply and population growth are taken from the demographic projections, while AIDS-related health expenditures are based on detailed cost projections. Furthermore, while it is assumed that workers with full-blown AIDS have 50 percent lower labour productivity, this is a modest estimate for this late stage of the virus and affects around 15 percent of the infected adult population. Accordingly, the sensitivity analysis focuses on TFP, which has a larger effect on the results and where assumptions are most tenuous.[30] Two further scenarios are run that are identical to the *Without AIDS* scenario except that the gain in TFP growth ranges between 0.6 and 0.9 percent per year (i.e., a 25 percent confidence interval around the initial estimate of TFP growth). Under these alternative assumptions the decline in GDP growth caused by AIDS ranges between 1.4 and 1.8 percent. The effect on poverty is more pronounced, with the overall increase in the headcount caused by AIDS ranging from 0.9 to 2.0 percentage points (see figure 9-2). While these upper and lower bounds reflect the difficulty of estimating the impact of the pandemic, they do confirm that AIDS has a negative impact on growth and poverty even under less stringent assumptions.

The findings estimate that AIDS will reduce GDP growth in Botswana by around 1.6 percent per year during 2003-21. This implies that the economy would be a third larger in 2021 were it not for the pandemic. Furthermore, AIDS limits diversification into non-mining labour-intensive sectors. Accordingly, AIDS has a pronounced impact on poverty since labour earnings directly affect household incomes, especially amongst the poor. However, while AIDS has an detrimental impact on growth and poverty, it only explains part of Botswana's failing development prospects. The results suggest that, even in the absence of AIDS, the acceleration and diversification of

[30] MacFarlan and Sgherri (2001) assume a range of TFP losses from zero to 50 percent during 1999-2010. BIDPA (1999) assumes a 0.5 percentage point fall in TFP growth during 1996-2021. World Bank (2001) apply a 20 percent drop in TFP during 1996-2021. Alemu *et al.* (2006) estimate an 18 percent loss in TFP growth during 1989-2002. This paper assumes a 0.4 percentage point drop in TFP growth (i.e., a seven percent absolute loss during 2003-21).

growth, especially in rural areas, remains the binding constraint to broad-based poverty reduction. Despite these broader development challenges, the results do show that AIDS is undermining Botswana's development prospects, and that the loss of life, the worsening of poverty, and the decline in growth all confirm the need to engage the pandemic.

Figure 9-2: National Poverty Headcount



Source: CGE-micro-simulation model.

Note: The poverty line is one international dollar per day in 2003 prices or 104.1 Pula per adult per month. The fainter lines for the *Without AIDS* scenario show the upper/lower bounds from assuming 20 percent weaker (above) or stronger (below) total factor productivity growth.

iii. The AIDS-with-ART Treatment Scenario

The previous scenario estimated the impact of AIDS on growth and poverty by removing its effect on Botswana's current growth path. However, the hypothetical *Without AIDS* scenario should be distinguished from what is actually achievable. Accordingly, the final scenario simulates the impact of implementing the government's treatment program as outlined in the National Strategic Framework. Even under a comprehensive strategy, the population remains well below what it would have been in the absence of AIDS. Given treatment, the population growth rate increases from its current 0.9 percent to 1.2 percent per year. However, the *AIDS-with-ART* scenario is not a scaled-down version of the *Without AIDS* scenario. For instance, average dependency ratios are lower under the *AIDS-with-ART* scenario since ART extends the average life of working age population but does not cure AIDS and significantly increase the number of retired workers.[31] As such, the labour supply growth rate increases by slightly more than the population growth rate.

The *AIDS-with-ART* scenario includes the annual cost of implementing the program, which (as discussed in chapter 8) will reach P1.6 billion or over three percent of GDP by 2021. However,

[31] Since ART slows the progression of HIV into full-blown AIDS, the *Treatment* scenario effectively increases the average age of the infected population.

providing treatment reduces some of the fiscal costs incurred under the *With AIDS* scenario. For instance, while the provision of ART raises government expenditures, it also reduces the number of orphans and the required number of hospital beds. This lowers the opportunity cost of the treatment program such that the additional or net fiscal burden reaches a maximum of P360 million by 2021. Furthermore, in line with recent trends, it is assumed that one fifth of AIDS-related costs will be borne by Botswana's development partners. The *AIDS-with-ART* scenario therefore incorporates both demographic and financial projections into the CGE model when estimating the economic impact of the government's treatment program.

The initial impact of providing treatment is an increase in labour supply as life expectancy rises amongst the more heavily infected working population. The provision of ART also stalls the onset of full-blown AIDS, thus alleviating some of the decline in labour productivity.[32] This enhances the country's productive capacity and accelerates GDP growth (see table 9-2). While economic growth raises incomes and savings, investment remains unchanged since increased health expenditures reduce the fiscal surplus and lower the government's capital expenditures. This is partly offset by the inflow of foreign funds to help finance the treatment program. However, development assistance causes a slight appreciation of the *real* exchange rate, which encourages import demand rather than export growth. Therefore, unlike the *Without AIDS* scenario, the non-traded service sectors benefit as much as capital- and export-intensive manufacturing. This suggests that the treatment program recovers only part of the loss in economic diversification caused by AIDS. Differences in investment and export outcomes under the *AIDS-with-ART* scenario also underline the importance of considering the fiscal implications of providing treatment. However, after accounting for these costs, the treatment program still causes an increase in GDP by an additional 0.4 percent per year during 2003-21, which is one-quarter of the growth currently being lost to AIDS.[33] As in the previous scenario, most of this additional growth arises from higher TFP, although this is now dampened by increased health and education expenditures (see table 9-4).

The larger labour force caused by reduced mortality generates a more labour-intensive growth path under the *AIDS-with-ART* scenario. This favours household incomes and private consumption, which accelerate more rapidly than overall GDP. Rising average consumption spending also translates into a decline in poverty. The national incidence of poverty falls from 23.4 percent in 2003 to 20.2 percent in 2021 (see table 9-4).[34] By reducing the poverty rate by a further 0.5 percentage points compared to the *With AIDS* scenario, the treatment program reduces by one-third the negative impact of AIDS. However, the immediate increase in the population resulting from treatment causes the absolute number of poor people to remain almost unchanged by 2021. The larger decline in the poverty rate relative to the increase in the growth rate is driven by declining dependency ratios, since ART allows the infected population to

[32] ART delays and shortens the final stage of infection and alleviates its symptoms. Therefore, labour productivity is assumed to fall by 25 percent for workers on ART and by 50 percent for those with full-blown AIDS.

[33] This increase in the GDP growth rate ranges from 0.3 to 0.5 percent depending on an assumed ten percent lower and higher take-up of ART respectively. This sensitivity analysis accounts for changes in population, labour supply, labour productivity and treatment costs under the different assumed take-up rates.

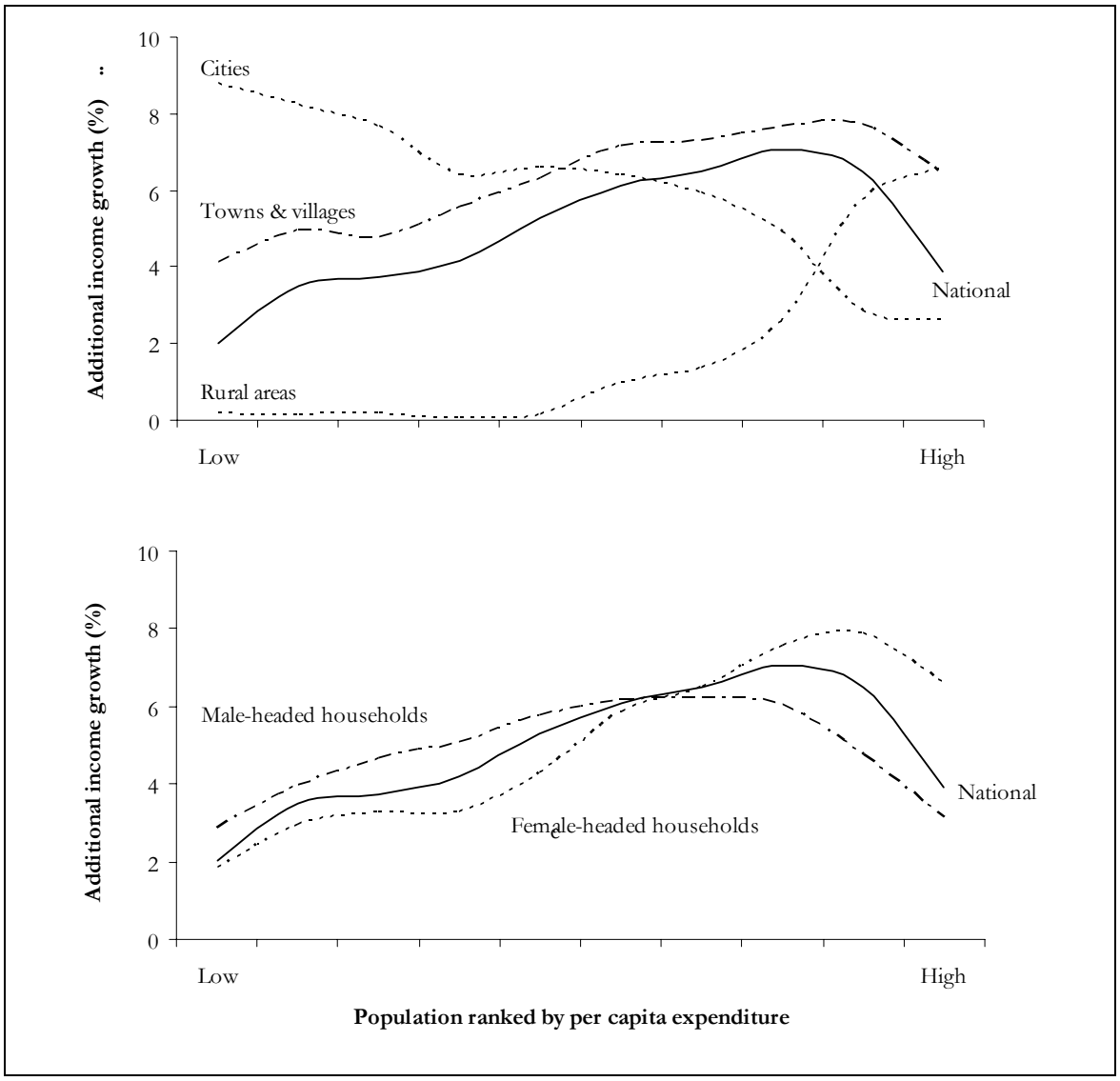
[34] The poverty outcomes are sensitive to changes in the assumed take-up of ART. For instance, increasing the take-up of ART by ten percent of the infected population causes poverty to decline an additional 0.5 percentage points.

continue working during their most productive years but does not increase average life expectancy beyond retirement.

The distributional impact of the treatment program is shown using growth incidence curves (see figure 9-3). These curves show the total additional per capita expenditure resulting from treatment for each percentile of the population ranked according to their initial expenditures. The positive national curve throughout the expenditure distribution suggests that all households benefit, be it either directly through receiving treatment or indirectly through higher economy-wide growth. However, the upward sloping curve indicates that higher-income households benefit more than lower-income households. Furthermore, the higher curves for urban areas suggests that they benefit more than rural areas. This increase in inequality is determined by the structure of employment within each region and by initial occupational prevalence rates. Prevalence is highest amongst unskilled and clerical urban workers, whose incomes primarily benefit middle-income households. Furthermore, only those households with working members are able to translate increased life expectancy into higher incomes. As such, higher-income households experience the largest increases in per capita expenditures. Furthermore, lower-skilled workers fall into the lower end of the expenditure distribution within cities, but into higher percentiles within towns, villages and rural areas. Since these workers are the largest beneficiaries of treatment, inequality rises in towns and rural areas but falls in cities. Finally, male and female-headed households benefit equally under the *AIDS-with-ART* scenario. However, higher-income female-headed households rely more heavily on incomes from lower-skilled workers and so benefit more than higher-income male-headed households.

The results suggest that a comprehensive treatment program cannot eliminate the detrimental impact that AIDS has on Botswana's development prospects. However, providing treatment reclaims approximately one-quarter of the growth lost to the pandemic, and partly reverses the negative impact on economic diversification. However, the treatment program significantly increases life expectancy and eliminates half of the increase in the poverty rate caused by AIDS. Despite declining poverty, the treatment program results in increased inequality, although this outcome is driven by the regional, demographic and occupational distribution of infection rather than the nature of the government's intervention.

Figure 9-3: Growth Incidence Curves for the AIDS-with-ART Scenario, 2003-21



Source: CGE-micro-simulation model.

Note: Populations are ranked *within* their reported group (i.e., low expenditure households in cities may earn more than households in the middle of the rural distribution).

d. Conclusions

This chapter has estimated the economic impact of AIDS in order to determine the contribution of the pandemic to Botswana's failing development prospects. A dynamic CGE and micro-simulation model has been used to capture the various transmission mechanisms linking AIDS to growth, poverty and inequality. The model has extended previous methodologies and demonstrated the importance of incorporating endogenous distributional change when estimating the impact of AIDS. The results indicate that in the absence of treatment, Botswana's current growth path is unlikely to significantly reduce poverty and that rural areas are less likely to participate in the growth process. AIDS is contributing to the slowdown in the economy by

reducing economic growth by approximately 1.6 percent per year. AIDS also limits economic diversification, especially into more labour-intensive sectors. Therefore, while the mining sector is responsible for most of the decline in growth over recent years, the AIDS pandemic has hindered alternative sources of growth. The results indicate that slower labour-intensive growth will cause the national poverty rate to be two percentage points higher in 2021. Furthermore, AIDS will have pulled an additional 43 000 uninfected people into poverty through its negative impact on growth. However, the rural poverty rate rises in the absence of AIDS since increases in labour supply are offset by weaker employment opportunities and a larger rural population. Therefore, while AIDS undermines growth and diversification, its relatively small impact on rural poverty underlines the importance of addressing non-AIDS-related development challenges.

Although the government's treatment program cannot eliminate the pandemic, it can mitigate some of its detrimental impacts. Apart from reducing mortality, the results indicate that providing treatment reclaims a quarter of the decline in growth and a third of the poverty caused by AIDS. However, financing the treatment program crowds-out investment and constrains growth in non-mining industrial sectors. Foreign assistance is therefore important in alleviating the fiscal burden of treatment and avoiding its negative consequences for economic diversification and longer-term development. Although providing treatment is good for growth and poverty reduction, it primarily benefits the employed and higher-income households, resulting in an increase in inequality. Urban households are the main beneficiaries since both prevalence rates and employment opportunities are highest in these areas. The AIDS treatment program is thus 'pro-poor' in *absolute* terms, since all households benefit, but not in *relative* terms, since inequality rises (Ravallion and Chen, 2003). Therefore, while HIV/AIDS is indeed undermining Botswana's success story, both unemployment and a stagnant rural economy remain binding constraints to re-establishing pro-poor growth.

10. Conclusions and Policy Recommendations

a. Objectives of the Study

As specified in the terms of reference, the objectives of this study were as follows:

- Review and update as appropriate, the 2000 study on the macro-economic impacts of HIV/AIDS, with particular emphasis on:
  - ◊ the methodological aspects of the study, including the assumptions that form the basis of current model predictions, and the choice of models;
  - ◊ the findings of the study vis a vis trends since the study was published, with a view to ascertaining the predictive capabilities and suitability of the models chosen;
- Based on quantitative models, analyse the likely impact of HIV/AIDS on the Botswana economy between now and 2021 and contrast the findings with those reached by BIDPA in 2000.
- Estimate the trend paths of key economic variables under alternative HIV/AIDS impact scenarios, including the without-AIDS scenario. The analysis should include such variables as economic growth, savings, investment, human resource capacity, labour supply, productivity, competitiveness and poverty.
- Estimate the disaggregated current and future costs, direct and indirect, to the Government and the economy, of HIV/AIDS, with implications for the Government budget.
- Reconcile model predictions of the micro and macro level impacts of HIV/AIDS. This will involve estimating the household and sectoral impacts of HIV/AIDS.
- Determine what policy levers the Government has at its disposal to mitigate the economic impact of HIV/AIDS, the extent to which such levers have been used and to what effect.
- Investigate the strategies that firms have employed to protect their businesses from HIV/AIDS and the extent to which they have been successful in this regard.

The conclusions of the study with regard to these objectives are presented below.

b. Evaluation of BIDPA (2000) Model and Projections

The BIDPA (2000) model was evaluated in Chapter 4, both with regard to the methodological approach used and the quantitative predictions produced. With regard to methodology, it was concluded that the approaches used by BIDPA were appropriate; the results of the BIDPA study have been disseminated through international publication and have been frequently referenced, and both of the main methodologies (the macroeconomic growth model and the household impact model) have been used subsequently by other researchers.

The assumptions that were used in the models were reasonable at the time, and generally the best that could be made on the basis of the information then available. Inevitably, subsequent

developments have not always been the same as prior assumptions. The main areas where outturns have been different to assumptions are population growth and productivity growth. Projections produced in the parallel demographic study suggest that population growth between 2001 and 2006 averaged 1.6 percent a year, compared to 0.8 percent assumed in the BIDPA study (the latter figure is, however, in line with CSO projections for 2001-2006). With regard to total factor productivity (TFP) growth, the BIDPA study assumed an average rate of 0.25 percent a year, whereas data from BNPC suggests that it was considerably higher, at 1.3 percent a year.

The predictions of the BIDPA models were primarily framed in terms of counterfactuals, i.e., comparing the differences between possible scenarios, such as with-AIDS vs. no-AIDS, with less emphasis on predicting actual outcomes. Evaluating actual predictions against counterfactuals is, of course, impossible; for instance, there is no way of knowing what the outcomes for economic growth or poverty levels would have been without AIDS.

There have also been developments that were not anticipated at the time of the BIDPA study; the most important of these is the widespread use of ARVs, which would have mitigated some of the negative economic impact of HIV/AIDS. Subsequent work on the macroeconomic impact of HIV/AIDS in Botswana has generally corroborated the BIDPA results, although with some suggestion that the BIDPA model may have underestimated the negative impact.

Nevertheless, comparing actual outcomes with predictions shows that growth has been somewhat higher than predicted by BIDPA (4.6 percent average growth for non-mining GDP over 2001/04, compared to 2.9 percent predicted by BIDPA over 2001/05, although *private sector* non-mining growth has been lower, at 3.3 percent a year). The growth of private sector non-mining GDP per capita has been slightly higher than predicted, at 1.6 percent compared to 1.1 percent. This is most likely due to productivity growth being higher than was assumed in the BIDPA projections. Nevertheless, non-mining GDP growth has been declining, as predicted, and the impact of HIV/AIDS is almost certainly one of the reasons for this.

Overall, it can be concluded that the BIDPA projections were largely consistent with subsequent developments, and that the models used were appropriate. However, the areas of divergence between predicted and actual outcomes, and subsequent analysis of the economic impact of HIV/AIDS in other countries in the region, indicates that more attention should be paid to the model assumptions, and also that a richer understanding can be obtained through the use of CGE modelling. Both of these have been incorporated into the modelling in this study.

c. Economic Projections to 2021

This study has produced projections of the economic impact of HIV/AIDS through to 2021, using demographic projections generated by the parallel demographic impact study. The scenarios have also been extended, to incorporate an AIDS-with-ART scenario, along with the no-AIDS and the AIDS-without-ART scenarios previously used. The broad conclusion is that HIV/AIDS is having a substantial negative impact on the economy of Botswana. The detailed projections show that *in the absence of widespread ART provision*:

- average economic growth will be reduced by 1.5 to 2.0 percent a year over the period 2001 - 2021, resulting in the economy being one third smaller as a result of HIV/AIDS than it would have been otherwise;

- this negative impact results from reduced labour force growth, a younger labour force, reduced productivity and reduced investment;
- in terms of its effect on GDP, the impact of HIV/AIDS is approaching the impact that would result from the decline and closure of Botswana's mining sector over 15 years[35];
- population growth is also reduced, from an estimated 2.2 percent a year without AIDS to 1.1 percent a year with AIDS (but without ART)
- as the reduction in economic growth is greater than the reduction in population growth, average income growth will also fall, with the estimated growth rate of GDP per capita falling by 0.5 - 1.0 percent a year, resulting in average real incomes being 10 to 15 percent lower after 20 years as a result of HIV/AIDS;
- these conclusions are robust to different simulation methods, with both the macroeconomic model and the CGE model giving similar estimates of the reduction in growth as a result of HIV/AIDS.

However, the widespread provision of ART to HIV positive individuals through the public health system will offset some of the negative economic impact of HIV/AIDS:

- ART will contribute to raising economic growth, adding a projected 0.4 to 0.8 percent to average annual growth over the 20 year period; this results from a larger and healthier labour force, and reduced negative impact on productivity, compared to the with-AIDS scenario;
- while the provision of ART will mitigate the negative economic impact of HIV/AIDS, it will not eliminate it, and HIV/AIDS will still have a significant negative economic impact even if ART is widely available; this results in part from the very high costs of widespread ART provision;
- even with this mitigated impact, HIV/AIDS in the with-AIDS scenario will cause economic growth to be reduced by an estimated 1.2 percent a year, compared to a no-AIDS scenario, and the economy to be 23 percent smaller after 20 years;
- the provision of ART can therefore offset about one quarter to one third of the negative impact of HIV/AIDS;
- growth in average incomes will also be reduced, but will be higher than in the AIDS-without-ART scenario;
- comparing the AIDS-with-ART and no-AIDS scenarios, nearly half of the reduction in GDP growth is due to reduced investment, some 20 percent is due to reduced TFP growth, and 30 percent due to reduced labour supply.

Compared with the findings of the BIDPA (2000) study, the projected negative impact of HIV/AIDS is slightly larger in this study. This is primarily due to a larger negative impact on investment than that assumed by BIDPA. However, the predicted negative impact of HIV/AIDS is smaller than that forecast in the IMF (2001) study of Botswana, which had an even larger

[35] This refers to the impact on GDP only; the impact of HIV/AIDS on the balance of payments and the government budget is significantly smaller than would be the impact of the demise of the mining sector.

investment impact. Another important contrast with the BIDPA (2000) study is that BIDPA envisaged that, under some scenarios at least, GDP per capita could be higher in 2021 with AIDS than without AIDS; this is no longer the case, and GDP per capita is lower in both of the with-AIDS scenarios than without AIDS.

HIV/AIDS also has a significant impact in the labour market, with different processes leading to conflicting trends:

- lower population and labour force growth leads to reduced supply of labour (thus reducing un-/under-employment);
- however, reduced investment and reduced productivity lead to reduced demand for labour (thus increasing un-/under-employment);
- on balance, HIV/AIDS leads to less favourable employment trends, with the impact of reduced labour demand outweighing reduced labour supply, leading to higher un-/under-employment than in the *No-AIDS* scenario, although the provision of ART helps to improve the situation somewhat;
- the stronger influence of reduced labour supply than reduced labour demand also causes wages to rise more slowly in the *with-AIDS* scenario.

The models can be used to indirectly estimate competitiveness, given that they produce simulated paths for both productivity and real wages. The projections indicate that (productivity-adjusted) real unit labour costs are higher under the with-AIDS scenarios than under the no-AIDS scenario. In other words, HIV and AIDS is adversely affecting Botswana's international competitiveness due to lower productivity, which is only partially offset by lower wages, and this is a major determinant of the lower living standards that result under the with-AIDS scenarios. However, the adverse impact on competitiveness is reduced in the with-ART scenario.

At the sectoral level, the sectors that are hardest hit by AIDS are those that are particularly labour intensive, including agriculture, manufacturing and trade (wholesale/retail), due to the impact of slower labour force growth. Agriculture is particularly badly affected due to its reliance on less skilled labour, where HIV prevalence rates are higher. Mining is not so severely affected, partly because mining growth is forecast to slow anyway as diamond production levels off, and also because it is highly capital intensive and investment is assumed to be largely protected in the sector.

d. Impact on Government Budget

HIV/AIDS will have a substantial impact on the government budget, especially under the current scenario of nationwide provision of free ART. The total cost in 2006 is estimated at P1 billion (at 2004/05 prices), which is equivalent to approximately 6 percent of government spending. These costs include health care costs relating to in-patients, ambulatory patients and the ART programme, as well as related costs such as home-based care, prevention activities, other HIV/AIDS programmes, care of orphans and vulnerable children, and additional old aged pensions. The cost of ART drugs is the largest single component of overall costs.

It is projected that total costs will increase in real terms by some 60 percent by 2021, although as the economy will also be growing, the share of government spending will only rise slowly, to 8 percent in 2011, before falling back to just over 7 percent by 2021[36].

In the AIDS-without-ART scenario, the cost to government would be lower, as the high cost of ART treatment (which accounts for up to 40 percent of total programme costs) would be avoided. However, these savings would be counteracted to a large extent by higher health service costs for in-patient and ambulatory care, and higher social spending on home-based care and orphan care, if policy and capacity allow for estimated increases in spending in these areas. Hence total government spending on HIV/AIDS related costs would be 15-30 percent lower over 2006 – 2021. At the same time, GDP growth would be lower (due to a greater HIV/AIDS impact without ART), and general government revenues and spending lower as a result. Hence HIV/AIDS-related costs to government would be only some 1 percent lower, as a percentage of total spending, in the no-ART scenario.

These data indicate that while the *additional* costs to government of providing ART will rise to around P360 million a year (at 2001 prices) by 2021, this will only amount to some 2 percent of government spending at the time (or less than 1.1 percent of GDP). The *total* costs of HIV/AIDS spending would, however, amount to some 8 percent of government spending and 3 percent of GDP.

In order to maintain fiscal balance, the costs of HIV/AIDS spending would have to be met by cutting back spending in other areas, possibly including lower priority areas of HIV/AIDS response. This would require prioritising of expenditures and strict budgetary controls. Ways to reduce costs of ART drugs and services should also be considered.

Alternatively, if HIV/AIDS-related spending is financed through budget deficits, there will be upward pressure on interest rates and a crowding out of private sector activity. Fully funding HIV/AIDS related spending out of budget deficits is not feasible or sustainable, and hence some tough spending trade-offs will be necessary, and those trade-offs will be more severe if ART is provided.

However, it is important to note that the bulk of HIV/AIDS-related public spending will be required *whether or not ART is provided*; the cost of ART provision adds 15-30 percent to HIV/AIDS-related spending over 2006-2021 (assuming that all HIV/AIDS-related spending needs were met in each scenario). Furthermore, this incremental government spending will help to unlock additional GDP. The models used here suggest that the additional spending on ART rising to P360m a year will lead to additional GDP amounting P7.5 billion a year. The incremental government revenues on this additional GDP (net of other costs associated with there being a higher population) should cover a significant proportion of the costs of ART. In addition, donor funding is expected to cover some 20 percent of HIV/AIDS-related costs. Overall, while HIV/AIDS will have a significant impact on the budget through imposing

[36] The projections assume that hospital and ambulatory capacity for Non-ART care actually increase in line with estimated HIV and AIDS related need. It should be noted that health expenditure and service capacity data do not clearly suggest that expenditure on in-patient and ambulatory care has in fact increased to meet all HIV and AIDS related need. Thus the fiscal impact of HIV and AIDS and its effect on GDP due to these may be somewhat overestimated in the projections.

additional spending demands, most of these demands will be there whether or not ART is provided, and the additional cost burden of ART is relatively small.

It should be noted, however, that one impact of HIV and AIDS is to reduce the overall returns to government spending. For instance, with reduced productivity and life expectancy, the returns to investment in education are lower. This raises further questions regarding the optimal allocation of resources, which government will need to look at carefully.

e. Micro-level Impact

Modelling of the household-level impact indicates that HIV/AIDS will have a negative impact on poverty. The poverty impact simulations indicate a negative impact of up to 3 percentage points on poverty (i.e., with AIDS, the poverty headcount ratio would be up to 3 percentage points higher than in the absence of AIDS). This negative impact arises because of slower income growth and slower employment growth, and also because part of household expenditure has to be diverted towards HIV/AIDS-related spending. In general, household consumption expenditure rises more slowly than overall GDP, reinforcing the negative poverty impact.

Simulations also show that the negative impact of HIV/AIDS on poverty is reduced by approximately one-third to one-half if ART is provided, and that the provision of welfare support through grants to assist in the upbringing of orphans can substantially alleviate the negative poverty impacts.

f. Firm-level Strategies

Information on the response by firms to HIV/AIDS was gathered through an indicative survey of some 25 firms across a range of economic sectors, yielding a number of interesting results. The key results were as follows:

- the majority (70-80 percent) of firms had experienced a negative impact of HIV/AIDS on output and productivity, due primarily to absenteeism (sick leave) and the disruption associated with higher labour turnover and increased recruitment and training;
- notwithstanding the above, a small majority of firms (56 percent) reported that HIV/AIDS had had no impact on investment, primarily because other factors were of greater importance in determining investment decisions;
- across sectors, the HIV/AIDS impact was greatest in construction and mining, and least in retail trade and the financial sector;
- firms with high proportions of skilled workers appeared to experience the least negative effect, for two main reasons; first, because HIV prevalence is lower amongst skilled workers, and second, because skilled workers have had access to ART for longer (through private medical aid schemes) than unskilled workers;
- firms have responded in a variety of ways, including multi-skilling, and higher levels of recruitment and staffing; in addition, most firms have in-house HIV/AIDS policies, which include counselling, the encouragement of voluntary testing, and non-discrimination against HIV-positive staff;
- the Botswana results are generally consistent with those from South Africa.

g. Policy Options Open to Government

The BIDPA (2000) study made a number of policy recommendations, including:

- in order to address the increasingly serious shortage of skilled workers that was likely to result from HIV/AIDS, and reduce the uncertainty facing firms with regard to the recruitment of skilled workers, government should make it easier for firms to recruit non-citizen skilled workers from outside of the country, and improve the efficiency of the system for granting work permits etc.;
- Government should introduce policies to support the rising number of orphans and vulnerable children due to HIV/AIDS, to reduce the burden on households and minimise possible costs of delinquency and criminality;
- in order to improve the supply of skilled labour, government should consider methods of sharing training costs with the private sector;
- as growth and employment would be negatively affected, Government should continue to make efforts to reduce unemployment, through investment promotion and diversification policies;
- as HIV/AIDS would have a negative impact on poverty, government should implement the recommendations of the 1996 Poverty Study and prioritise poverty reduction strategies;
- the provision of basic services focused on human capacity development would help to offset the negative poverty impact, specifically policies focused on basic health and nutrition; HIV-related counselling support for the youth; and improving the effectiveness of the anti-AIDS campaign;
- given the negative budget impacts, particular attention would have to be focused on prioritising expenditures and ensuring that the additional burden of HIV/AIDS-related spending did not lead to an unsustainable budget situation.

There has been a mixed record in terms of implementing these recommendations. While the general economic policy framework has been supportive of economic growth and diversification, in many instances the implementation of policies has not been supportive (see, for instance, the conclusions of the 2003 FIAS study on the investment climate and the 2004 BIDPA/World Bank Export Diversification Study (FIAS, 2003 and BIDPA/World Bank, 2006)). In direct contrast to the recommendation regarding the availability of skilled labour, it has become more difficult to recruit non-citizen skilled workers rather than easier. As a result, the growth rate of the non-mining sector of the economy has been sluggish, and unemployment has continued to increase.

The record on poverty reduction has been mixed. Poverty has continued to decline, but at a slower rate. An unpublished analysis of the poverty results from the 2002/03 HIES concluded that Botswana's growth has not in general been "pro-poor".

However, more specific welfare-oriented interventions have been more successful. An orphan allowance has been introduced, payable to carers, and there is good reason to believe that this has helped to ameliorate some of the worst potential impacts of HIV/AIDS. There have been interventions focused on the youth and voluntary counselling and testing (Tebelopele).

While an assessment of the effectiveness of anti-AIDS publicity campaigns is beyond the scope of this study, the preliminary evidence of a fall in HIV prevalence rates amongst younger age groups suggests that these campaigns are effective, at least to a certain extent.

At the time of the BIDPA study, ART was extremely expensive, and widespread provision of ART was not a feasible option. Subsequently, however, the prices of ART drugs started to fall, in many instances quite dramatically, making improved provision of ART realistic. The MASA programme has been implemented, and Botswana has the most extensive programme of public provision of ART, relative to population size, of any of the countries severely affected by HIV/AIDS in the region. It also appears that the majority of those who could clinically benefit from ART are now enrolled in either public or private sector programmes. Preliminary indications are that the ART programmes are effective at reducing ill-health, prolonging life and mitigating some of the negative economic impact of HIV/AIDS. Evidence also suggests that adherence to the treatment programme is good. While resistance remains a critical concern, it does not yet appear to be a major problem. The introduction of routine HIV testing in health facilities, while opposed by some commentators, has also contributed to improved coverage and effectiveness of ART programmes.

ART provision is, however, expensive, and has – along with other expenditures associated with HIV/AIDS – contributed to a significant rise in the proportion of the government budget devoted to health care and social expenditure. This has been achieved without contributing to an unsustainable budget position, indicating that a prioritisation of expenditures is taking place, as earlier recommended, and that resources have been obtained by reducing unproductive or low priority expenditure. Nevertheless, increased expenditures on HIV/AIDS-related programmes has caused a reduction of spending in other areas, and the postponement of some development programmes.

In terms of policy levers available to government to mitigate the economic impact of HIV/AIDS, many of those remain the same as recommended by the earlier BIDPA study. While some of these have been implemented, others have not, and the need to assist firms to deal with shortages of skilled labour by facilitating the recruitment of non-citizens remains paramount. Similarly, the need to ensure that poverty issues are addressed through the provision of effective social safety nets and focusing economic policies on employment creation needs remains very important.

There are some additional policy issues, however, that have arisen since the BIDPA study, especially those associated with the provision of ART. These include:

- the provision of ART, along with other HIV/AIDS-related spending, imposes a substantial, but manageable, fiscal burden on Botswana;
- in order to preserve fiscal sustainability, there will continue to be a need for fiscal discipline, for cuts in other areas of government spending and the careful prioritisation of fiscal demands and aspects of HIV/AIDS response; there needs to be particular care in decisions that may reduce key investment rather than consumption aspects of government spending;
- in order to minimise the adverse impact of diversion of spending and cutbacks in other priority areas, government should continue to work closely with donors so as to obtain

access to concessional resources that can offset the adverse fiscal impact of HIV/AIDS; making the case to donors should be facilitated by the results of economic projections in this study illustrating that the impact of HIV/AIDS on the Botswana economy is massive – in GDP terms it is akin to decline and closure of the entire minerals sector of the economy over a 15 year period;

- Government should also explore ways of bringing down the costs of ART drugs, which make up the largest component of overall costs, by negotiating better prices with pharmaceutical companies or by exploring the potential for using generic rather than branded drugs; also, it will be critical to ensure that the ART program can avoid the emergence of HIV drug resistance and thus the need for more expensive, newer drugs;
- Government will also need to consider the cost and clinical effectiveness of ART distribution channels, especially given the intention of increasing the number of ART dispensing nodes from just over 30 at present to over 100 by 2009. This should include review of the frequency of tests (viral load and CD4) and consultations, and the extent to which contact with doctors can be substituted with contact with other health system personnel (pharmacists, nurses etc.), especially for patients who are stable on treatment, perhaps by accommodating variations on traditional staffing norms and protocols;
- Government should also consider ways to optimise the mix and models of ART, home-based and inpatient care. Policy decisions in these areas (e.g. earlier ART commencement; HBC capacity) may have a substantial influence on needs and resources for different types of care and associated costs (e.g. hospital inpatient care). In particular government should explore ways to promote the shifting of the in-patient burden from referral hospitals in Gaborone and Francistown to district and primary hospitals where bed capacity seems less fully utilised;
- Government should also work on bringing down the costs of other elements of the HIV/AIDS programme, for instance, by ensuring that the costs of orphan care provision are contained;
- Given that labour supplies will be reduced, especially of skilled labour, it will be important to ensure that workers who are HIV positive are able to remain in their jobs for as long as possible, and are given appropriate protection through labour or other legislation;
- Demographic projections show that HIV prevalence rates will fall only slowly, even with a successful ART rollout, and that the numbers of people receiving ART will remain high for a long period of time. This reinforces the importance of a focus on prevention efforts to reduce the extent of HIV of AIDS as quickly as possible;
- Public sector resource allocation issues go beyond the increased needs of health and related spending. The returns to investment in education and human resource development more generally will be reduced, given reduced productivity and life expectancy. Government therefore needs to consider trade-offs and be aware that, although skilled labour is in short supply, there may be other deserving areas where the allocation of resources could have a larger beneficial impact on economic growth;
- More generally, as the impact of HIV/AIDS on investment has potentially the largest impact on economic growth of all the channels of economic effects, it will be important

to redouble efforts to improve the investment climate and ensure that barriers to investment by both domestic and foreign investors are removed.

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Appendix 1: Firms Questionnaire

QUESTIONNAIRE ON THE IMPACT OF HIV/AIDS ON THE FIRM IN BOTSWANA

Introduction: *As part of a study being carried out for the National AIDS Co-ordinating Agency (NACA), on the Economic Impact of HIV/AIDS in Botswana, Econsult Botswana (Pty) Ltd is investigating the impact of HIV on different firms and industry sectors. This questionnaire is part of the data-gathering exercise for the study, and seeks to find information from firms on the following issues:*

- *the extent of HIV/AIDS in firms, preferably by skill levels*
- *the impact of HIV/AIDS on the firm's productivity and profitability*
- *how the firms has responded to the disease in terms of training and hiring decisions.*

Please feel free to share with us what your company has experienced as a result of the disease. Your answers will be treated confidentially and analysis will not be company-specific.

Thank you

A. Background of Company

1. Type of Business_____
2. Number of employees_____
3. Year of Registration_____
4. Type of Industry_____
5. Location of Headquarters(City/town)_____
6. Majority Ownership:_____**Citizen/ Non-citizen**
7. Parent Company outside Botswana: _____**Yes/no**
8. If Yes, where (Country)_____
9. Title/position of Respondent_____
10. Age of Respondent _____
11. Date of Interview _____

B. HIV/AIDS Prevalence in the Company

1. How many workers have you lost due to death in the last five years? Please categorize them in terms of level of skill.
2. How many workers have you lost due to illness in the last five years? Please categorize them in terms of level of skill.
3. How many workers have you lost due to other reasons in the last five years? Please specify the reasons.
4. How many of your workers have been sick and either on sick leave or working at less than the optimal level in the past 2 years?

5. What has been the effect of having these sick workers in terms of your business? Please elaborate in terms of the type of loss and magnitude in terms of:

   - Output_____
     _____
     _
   - Productivity_____
     _____
   - Training_____
     _____
   - Investment expansion plans_____
     _____
   - Other (specify)_____
     _____

6. What has been the effect of the loss of workers due to sickness and death on your business in terms of productivity and general performance of the firm?
   _____
   _____
   _____
   _____
   _____

C. Response of the firm to HIV/ AIDS

1. What has been your response to any negative effect of HIV/AIDS on your firm in terms of the following areas:

   - Training_____
     _____

- Hiring of workers _____
  _____
- Dealing with productivity losses_____
  _____
- Other (specify) _____
  _____

2. How did HIV/AIDS impact your investment plans. Please specify
   _____
   _____
   _____

3. Does your company have an HIV/AIDS workplace policy _____Y/N

4. If yes, what does it contain?_____
   _____

5. What is the nature of the HIV/AIDS programme offered by the company/firm?
   _____
   _____

6. When an employee can no longer work because of an AIDS-related illness, what do you do for that employee? Explain_____

7. When an employee is diagnosed with HIV, what do you do for that employee?
   Explain._____
   _____

8. Do you subsidise medical aid membership for your staff? _____Yes/No

9. Does it cover all or part of your workforce? _____All/Part.

10. If part of your workforce is covered , what is the proportion of the workforce covered.
_____

11. Which medical aids scheme do you participate in?
_____

12. Does you firm participate in an HIV Special Scheme run by the medical aids?
_____

13. If yes, give the details of the scheme._____
_____

14. Has your organization undertaken any in-house training for staff on HIV/AIDS? Explain the nature of training.
_____
_____

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REPUBLIC OF BOTSWANA

NATIONAL AIDS COORDINATING AGENCY (NACA)
P/BAG 00463
GABORONE

3 February 2006

TO WHOM IT MAY CONCERN

1. The National AIDS Co-ordinating Agency (NACA) and the United Nations Development Programme (UNDP) have commissioned Econsult Botswana (Pty) Ltd to carry out a study on the Economic Impact of HIV/AIDS in Botswana. The study has a number of components, including:

   - projections of the macroeconomic impact of HIV/AIDS, including economic growth, savings, investment, human resource capacity, labour supply, productivity, competitiveness and poverty;
   - estimating the direct and indirect costs of HIV/AIDS including the impact on the government budget;
   - projecting the impact of HIV/AIDS at the household level and on various economic sectors
   - producing policy recommendations and an action plan for minimising the possible negative economic impact of HIV/AIDS.

2. In carrying out this study, Econsult Botswana will need access to a variety of data, and will also be carrying out a range of interviews with private and public sector entities.

3. The lead consultants are Dr K Jefferis, Dr H Siphambe and Dr A Kinghorn. I would be grateful if you could provide them with such assistance as they may require. This will help to ensure the effectiveness and relevance of the study, in order that the results can assist in addressing the economic problems stemming from HIV/AIDS.

4. Thank you in advance for your co-operation.

B C Molomo

National Co-ordinator

Appendix 2: Persons Consulted

Organisation	Contact Person	Position	Email
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UN-WHO	Dr J Kalilani	Country Representative	