

# 9

## An Economic Assessment of Botswana's National Strategic Framework for HIV/AIDS

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Botswana's economic transformation during the past 30 years is one of the most highly regarded success stories of the African continent. Real GDP grew at an average annual rate of 13.9 percent between 1965 and 1980, and 11.3 percent between 1980 and 1989, making Botswana the world's fastest-growing economy during the period. Between 1990 and 1998, however, GDP growth averaged only 4.75 percent a year. Real GDP per capita increased by an average of 5 percent a year, reaching \$3,417 in 1997/98 and \$3,170 in 2003. Botswana made major strides in terms of standard development indices as well. The under-5 mortality rate, which had been 151 per 1,000 live births in 1971, declined to 48 per 1,000 by 1991. By 1996 net primary enrollment was 95 percent, more than double the 1971 rate. In 1993, 47 percent of Botswana (the name for the people of Botswana) lived below the official poverty threshold, compared with 59 percent in 1985. These substantial economic gains resulted in part from the discovery of large mineral deposits in 1968, and mining value added now accounts for about a third of GDP. But in addition to the discovery of diamonds, the pursuit of prudent and consistent macroeconomic policies has resulted in a stable macroeconomic environment.

These gains, however, are gravely threatened by the scourge of HIV/AIDS. Botswana has one of the highest HIV/AIDS prevalence rates in the world: a 2002 survey estimated that about 35.4 percent of adults aged 15–49 years carried the virus. The overall prevalence rate has more than doubled since 1992, and an estimated 138,000 Botswana had died of

AIDS by 2002, out of a population of about 1½ million. The high prevalence rate has resulted in declining life expectancy, from 65 years in 1991 to 56 years in 2001, according to official census data. The infant mortality rate is estimated at 55.2 per 1,000 live births, compared with 48 per 1,000 in 1991, and in contrast to an estimated 26.3 per 1,000 in the absence of AIDS. The U.S. Census Bureau (2003) projects that population growth during 2010–20 will average –2.1 percent a year, compared with +3.6 percent a year during 1980–90. In addition to the human consequences, the macroeconomic impact of the epidemic has been researched, and many studies, drawing on demographic projections and standard economic theory, have modeled the long-term negative impact of HIV/AIDS on total factor productivity, labor, capital, and output, among other variables.<sup>1</sup>

The HIV/AIDS epidemic poses a serious challenge to achieving the government's objectives of poverty reduction, economic diversification, and growth. These objectives, formally articulated in Botswana's medium-term economic framework, the National Development Plan 9 (NDP-9, covering 2003–09), depend crucially on the government's ability to attract foreign investment into areas outside of mining, and to undertake the structural reforms needed to increase private sector participation in the economy. The National Strategy for Poverty recognizes that HIV/AIDS is both cause and consequence of poverty, unemployment, and inequality and aims to eliminate poverty in Botswana by 2016. The strategy seeks to direct antipoverty interventions toward the root causes affecting income, capacity, and participation, by integrating poverty reduction strategies into the medium-term economic framework. The costs of these programs are increased further by the huge outlays required to manage the HIV/AIDS epidemic. Coming at a time when diamond output is plateauing, the immediate challenge facing the government is how to finance the cost of fighting the epidemic while mitigating its adverse consequences. Effective management of the epidemic would enable Botswana to moderate the decline in human development indices and the adverse macroeconomic impact of the disease.

The government of Botswana has developed a National Strategic Framework (NSF) for HIV/AIDS covering the period 2003–09. The NSF is a comprehensive, multisector program for managing the epidemic, with the objective of having an HIV-free generation by 2016. This chapter assesses the macroeconomic impact of HIV/AIDS in Botswana under the assump-

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<sup>1</sup>See Bloom and Mahal (1995), Green and others (2002), and Haacker (2002a).

tion that implementation of the NSF program succeeds in lowering the HIV prevalence rate. This assessment is undertaken by incorporating the improvements that are hoped to ensue under the NSF program scenario into existing macroeconomic models of the impact of HIV/AIDS.

The plan of the chapter is as follows. The first section discusses the management of HIV/AIDS in Botswana, with particular focus on the new NSF. The second section discusses the broad macroeconomic repercussions of the NSF. To the extent the demographic impact of HIV/AIDS is mitigated, the economic effects, for example on GDP growth, will also be less pronounced. To assess the impact of HIV/AIDS on government finance, it is therefore important to take into account these indirect effects of government efforts to combat the epidemic. The final section concludes.

## **Response to HIV/AIDS in Botswana**

The approach taken by the government of Botswana to managing the HIV epidemic has evolved as the infection has spread through the population. Whereas the focus in the early phase was mainly on preventive health care, by 1993, with prevalence rates already as high as 23 percent, comprehensive medical and social care was included in the overall HIV/AIDS management scheme. Although the government of Botswana does not disaggregate expenditure on HIV/AIDS *ex ante*, budgetary allocations to the health sector have increased substantially, from 2.2 percent of GDP in 2000/01 to 4.0 percent in 2003/04, and both the public and the private sectors in Botswana have put in place extensive awareness programs and integrated health care arrangements for HIV-positive employees.<sup>2</sup>

The Medium-Term Program II for HIV/AIDS (1996–2002) was the first framework to take a multisectoral approach, consolidating program activities over a dispersed number of agencies. The NSF, the successor to the Medium-Term Program II, represents the most ambitious attempt so far to grapple with the epidemic. The framework offers a systematic, multi-

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<sup>2</sup>According to Botswana's National AIDS Coordinating Agency (NACA, 2003), the private sector, state enterprises, and civil society are expected to implement an agreed Minimum Internal Package for HIV/AIDS prevention. Debswana Corporation, Botswana Telecommunications, Barclays Bank of Botswana, Standard Chartered Bank, and Botswana Power Corporation are some of the firms that are implementing comprehensive workplace AIDS policies, some of which extend to their subcontractors.

**Box 9.1. Objectives of the National Strategic Framework**

- Increase the number of persons within the sexually active population (especially those aged 15–24) who adopt HIV prevention behaviors in Botswana by 2009.
- Decrease HIV transmission from HIV-positive mothers to their newborns by 2009.
- Decrease the prevalence of HIV in transfused blood in the country.
- Increase the level of productivity of people living with HIV/AIDS, especially those on antiretroviral therapy.
- Decrease the incidence of tuberculosis among HIV-positive patients in the country.
- Broaden the skills of health workers (doctors and nurses) to accurately diagnose and treat opportunistic infections.
- Ensure the implementation of the NSF Minimum HIV/AIDS Response Packages by all sectors, ministries, districts, and state enterprises.
- Ensure the full implementation of all planned HIV/AIDS activities at all levels.
- Minimize the impact of the epidemic on the persons infected, those otherwise affected, public services, and the economy.
- Create a supportive, ethical, legal, and human rights-based environment conforming to international standards for the implementation of the National Response.

sectoral approach to managing the epidemic and makes the National AIDS Coordinating Agency (NACA), chaired by the president of Botswana, the focal point for facilitating and coordinating the various HIV/AIDS interventions in the country. The overriding objective of the NSF is “to eliminate the incidence of HIV and reduce the impact of AIDS in Botswana” (NACA, 2003).

The NSF formulates a broad response to HIV/AIDS in the areas of prevention, care, and support; management of the national response; mitigation of the economic impact; and strengthening of the legal and ethical environment. It specifies 10 objectives (see Box 9.1) and defines time-bound quantitative targets and indicators by which to measure progress within the framework (Table 9.1). Treatment focuses on the administration of antiretroviral drugs, to prolong the life span of infected persons and increase average productivity. The mother-to-child transmission program provides treatment for pregnant women to reduce the transmission of HIV at birth. In addition, treatment of tuberculosis and opportunistic and sexually transmitted diseases as well as voluntary counseling and test-

**Table 9.1. Botswana: Quantitative Targets and Outcome Indicators of the National Strategic Framework for the Population at Risk**  
(Percent except where stated otherwise)

Target and Outcome Indicator <sup>1</sup>	Baseline	2006	2009
Voluntary counseling and testing			
Increase in HIV prevention and knowledge	34	80	100
Adoption of HIV prevention behavior	...	50	80
Decrease in HIV prevalence among sexually active population	6	50	80
Increase in number of people who utilize services	8	70	95
Mother-to-child transmission			
Share of HIV-positive women receiving complete course of antiretroviral therapy	34	70	100
Reduction in infected infants born to HIV-positive mothers	40	20	10
Antiretroviral therapy			
Number of HIV-positive persons eligible for and receiving therapy in 12-month period	8,000	45,000	85,000
Share of people living with AIDS returning to productive life	...	100	100
Sexually transmitted diseases			
Decrease in prevalence among sexually active population	2	50	100

Source: NACA (2003).

<sup>1</sup>Table does not include all targets and outcome indicators. See source for details.

ing, which are targeted at a wider audience than the HIV infected, are intended to reduce the rate of new HIV infections.<sup>3</sup>

Many of the specific measures undertaken within the NSF are directed toward bringing down the number of new HIV infections through voluntary counseling and testing, the treatment of sexually transmitted diseases, and programs to reduce mother-to-child transmission. The NSF targets an increase in the adoption of preventive behavior from a baseline 34 percent of the 15–49 age group in 2001 to 80 percent in 2006 and 100 percent in 2009. The treatment of other STDs, targeted to reach 100 percent of the population at risk by 2009, is intended to reduce the risk of contracting or passing on the virus, and—combined with counseling and testing—to help modify risky behavior among the sexually active population. In the 2001 baseline period, 34.3 percent of HIV-positive pregnant women were receiving a course of antiretroviral treatment to reduce mother-to-child transmission. The NSF targets 70 percent coverage by 2006 and 100 percent by 2009.

The NSF also aims to substantially improve the treatment available to people living with HIV/AIDS, especially by expanding access to highly

<sup>3</sup>Patients with tuberculosis and other infectious diseases have a higher rate of susceptibility to HIV/AIDS because of their compromised immune system.

**Table 9.2. Botswana: Projected Program Cost for the HIV/AIDS National Strategic Framework<sup>1</sup>***(Millions of pula except where stated otherwise)*

Item	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	Average
Prevention of HIV infection	185.8	241.0	264.5	234.3	164.3	156.70	207.8
Provision of care and support	408.9	641.6	781.0	1,117.1	1,577.4	2,229.90	1,126.0
ART drugs	38.6	139.2	251.0	374.0	504.0	642.00	324.8
Other costs	354.3	299.4	455.5	617.6	868.3	1,419.40	669.1
Total program cost	949.0	1,182.0	1,501.0	1,969.0	2,610.0	3,806.00	2,002.8
Percent of GDP	2.78	3.16	4.04	4.84	5.92	8.00	4.99

Source: NACA (2003).

<sup>1</sup>Years are fiscal years beginning April 1.

active antiretroviral treatment. Under the program, the number of patients receiving treatment is slated to rise from 8,500 to 45,000 by 2006 and 85,000 by 2009. By 2009 the goal is to have all people living with HIV/AIDS return to productive life.

The projected cost of implementing the NSF is approximately 12 billion pula (about \$2.4 billion) over the program years (Table 9.2). This translates into an average of 5 percent of GDP devoted to HIV-related spending a year, compared with an annual average of 4 percent of GDP spent on the entire health sector in the past three years. Botswana has already received extensive support from its development partners, who are also expected to support the new medium-term framework financially. Such support would be expected in the areas of financial and human resources, material supplies, and mitigation of the fiscal burden.

Apart from program support from the UN agencies, other partnerships include the African Comprehensive HIV/AIDS Partnership, a partnership between the Bill and Melinda Gates Foundation and the Merck Pharmaceutical Foundation, which is committed to disbursing \$100 million over 2000–05. The Botswana Harvard AIDS Institute Laboratory in Gaborone is the largest of its kind in Africa, and the government has established partnerships with the U.S. Centers for Disease Control and a host of other governments and agencies. In December 2003 Botswana signed an agreement for an \$18.5 million grant from the Global Fund for HIV/AIDS, Malaria, and Tuberculosis, funding a two-year program aimed at recruitment and training; strengthening treatment, care, and support activities; scaling up prevention programs; and reducing the stigma and discrimination associated with HIV infection.

As part of efforts to keep track of developments arising from the framework's implementation, the Botswana HIV Response Information Man-

agement System (BHIVRIMS) was developed to gather information and to monitor and evaluate trends and progress, as well as progress in international agreements and financial commitments. The BHIVRIMS is expected to become the institutional memory in the management of the HIV pandemic.

## **Demographic and Economic Impact of Botswana's National Strategic Framework**

The measures spelled out in the NSF are expected to reduce the number of new infections and, through improvements in treatments available to people living with HIV/AIDS, reduce mortality among those infected. These efforts will also mitigate the adverse impact of HIV/AIDS on the economy. The analysis below shows that the potential demographic and economic effects of the NSF are substantial. This means that it is important to assess how the NSF, beyond its direct costs, will affect the fiscal balance. For example, government revenue is related to the level of economic activity, and reductions in HIV/AIDS-related mortality and morbidity affect various categories of government expenditure. An analysis of the demographic impact of the NSF, using a simple macroeconomic framework, is presented below, as well as an assessment of the effect on GDP. Finally, a preliminary assessment is made of the NSF's fiscal repercussions, through its demographic and economic effects.

### **Demographic Impact**

The demographic estimates for the simulation were generated with the Spectrum AIM program,<sup>4</sup> using initial values from the Botswana Central Statistics Office, the population census projection for 1991, and the latest available data on labor force participation rates by five-year cohort from the 1995/96 labor force survey. The Spectrum population projection model makes use of detailed assumptions about fertility, mortality, and HIV prevalence rates. The projection parameters are based on information

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<sup>4</sup>The Spectrum AIM model, developed by The Futures Group, is a Windows-based program designed to calculate the demographic consequences of HIV/AIDS; it can be downloaded from [www.tfgi.com](http://www.tfgi.com). Demographic data for 1991–2003 match the actual values, and the parameters used to generate the remaining years are from UN and U.S. Census Bureau projections. Epidemiological data from NACA were used for the AIDS-without-intervention scenario, and the NSF targets for the AIDS-with-intervention scenario.

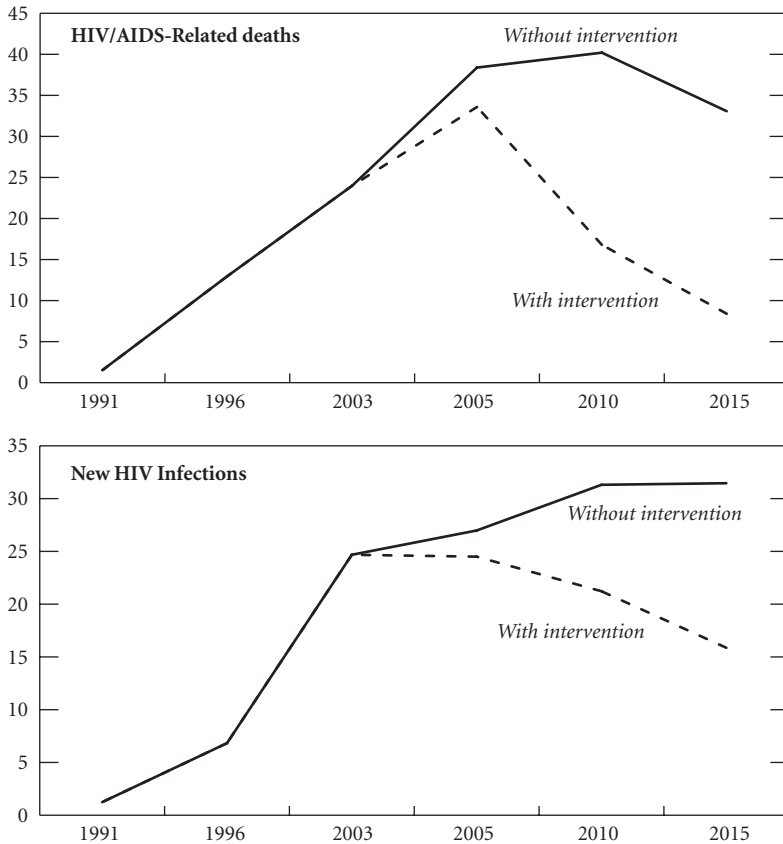
from the 1991 census and HIV prevalence survey data. In simulating the projections for the impact of AIDS, historical data and NSF program baseline data were used for the AIDS-without-intervention scenario. For the AIDS-with-intervention scenario, pre-2002 data are the same as for the AIDS-without-intervention scenario, and the expected changes in population and in prevalence rates during 2003–16 reflect the targets set in the NSF. The key assumptions of the AIDS-with-intervention scenario are the following. First, prevention of mother-to-child transmission, which covered 34 percent of the at-risk population at baseline in 2002, will gradually expand to cover 70 percent by 2006. Second, voluntary counseling and testing, which also covered 34 percent of the at-risk population in 2002, will reach 80 percent coverage in 2006. Third, antiretroviral therapy will reach 90 percent coverage by 2006. Fourth, sexually transmitted disease prevalence rates will decline by 50 percent by 2006. Although the NSF's target for each of the programs is 100 percent coverage of all at-risk groups by 2009, in view of reservations about implementation capacity and possible program reach, the targets were relaxed for the purpose of the simulation, so that beyond 2006 all interventions remain at 90 percent coverage.

The simulations suggest that the program laid out in the NSF would result in a substantial decline in new HIV infections (Figure 9.1), reaching about 15,000 by 2015, compared with more than twice as many in the AIDS-without-intervention scenario. By 2005, as the antiretroviral therapy program expands, AIDS deaths would start falling rapidly, to fewer than 10,000 in 2015, compared with more than 30,000 in the same year under the AIDS-without-intervention scenario. As a consequence, the model predicts that the demographic impact of HIV/AIDS would be mitigated substantially (Figure 9.2). The overall population growth rate in 2015 would be 2 percent, compared with 0.9 percent in the AIDS-without-intervention scenario and 2.9 percent in a no-AIDS scenario.

The impact of the mother-to-child transmission program on infant mortality is a significant factor in increasing the growth rate of the population. In 1997 it was estimated that 18 percent of reported HIV cases were in children under the age of 4. Most of these children are born HIV-positive, whereas others become infected in infancy (usually through breastfeeding). For these children the progression to AIDS generally takes about one to two years, with death occurring in the third or the fourth year. NACA estimates that only about 34 percent of pregnancies benefited from the mother-to-child transmission program in the 2002 baseline period. Under the assumption that the targeted increase in participation, to 70 percent by 2006 and 100 percent by the end of the program, is achieved, the decline in the infant mortality rate arising from an effectively imple-



**Figure 9.1. Botswana: HIV/AIDS-Related Deaths and New Infections Under Alternative Scenarios**  
(Thousands)



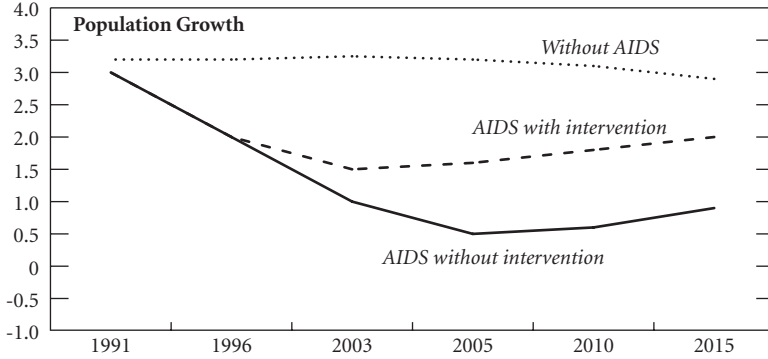
Source: Authors' calculations using data from Botswana national authorities and the Spectrum model.

mented mother-to-child transmission program results in a higher rate of population growth.

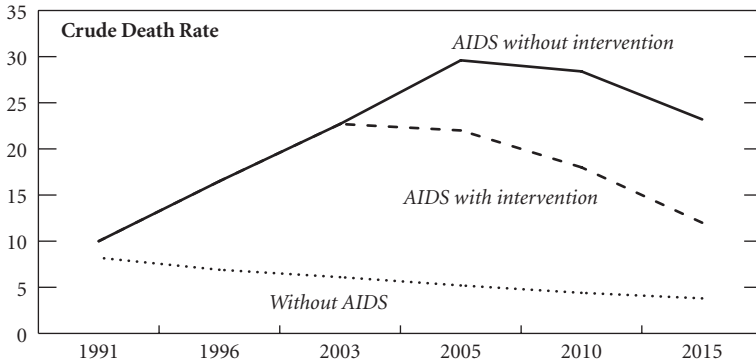
The NSF results in higher population growth rates than in the AIDS-without-intervention scenario for several reasons. First, the life span of those receiving antiretroviral treatment is extended, and mortality rates decline initially. Later on, although a number of patients on antiretroviral treatment eventually die (raising mortality in later years, other things equal), increasing coverage rates of antiretroviral treatment and a decline in new infections mean that mortality stays lower throughout the time

**Figure 9.2. Botswana: Population Growth, Crude Death Rate, and Infant Mortality Under Alternative Scenarios**

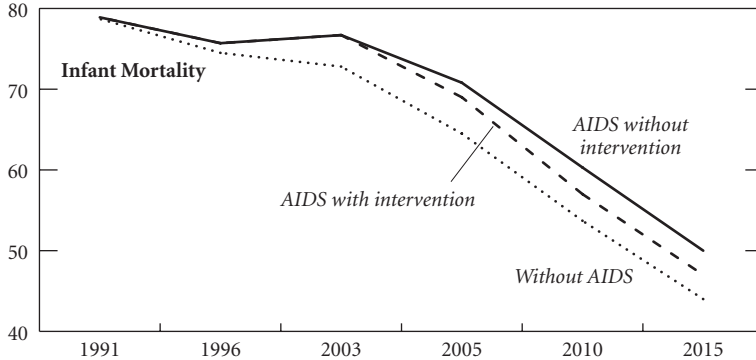
Percent a year



Deaths per thousand



Deaths per thousand



Source: Authors' calculations using data from Botswana national authorities and the Spectrum model.

horizon of the NSF. Second, lower mortality and morbidity among the sexually active population also mean that the decline in birthrates associated with HIV/AIDS is mitigated.

### **A Macroeconomic Framework**

One of the earliest attempts to model the impact of the HIV/AIDS epidemic in Africa was that by Over (1992), which was based on an econometric estimation of growth in a cross section of 30 countries, looking in particular at differences in impacts by skill level and at the financing of private health expenditure. Cuddington (1993a, 1993b) and Cuddington and Hancock (1995) explored the impact of HIV/AIDS in a neoclassical growth model with one or two sectors, including a link between the age structure of the workforce and productivity, through experience or on-the-job learning.

A major study of the impact of HIV/AIDS on Botswana's economy (and still one of the most comprehensive studies available internationally) was prepared by the Botswana Institute for Development and Policy Analysis (BIDPA, 2000). Using a Solow-type production function, the study analyzed the impact in a two-sector model, using calibrated estimates. Using population projections based on the expected future path of HIV, the study derived projections of the size of the labor force and the subsequent effect of HIV/AIDS on aggregate output and output per capita through 2021, the distribution of income among different groups, and the long-term fiscal outlook. The study showed that HIV/AIDS would reduce the annual growth rate of the economy by an average of 1.5 percentage points, so that after 25 years the economy would be 31 percent smaller than it would otherwise have been.

Drawing on the BIDPA model, MacFarlan and Sgherri (2001) focused on the effect of HIV/AIDS on the long-term productive capacity of the economy. The channels through which the impacts are transmitted are labor supply and productivity, which in turn affect saving and investment, financial intermediation, and the prospects for economic diversification. The results of high HIV prevalence rates are declining productivity and increased mortality among the most economically active members of the population, leading to a reduction in capital and human resources available for production and investment, and reductions in the saving rate and real income. Assuming higher prevalence rates than used in the BIDPA study, MacFarlan and Sgherri predicted that annual GDP growth outside the mining sector would fall by 3 to 4 percentage points on average over the decade.

The principal objective of this chapter is to assess the macroeconomic effects of a comprehensive program of enhanced prevention measures and increased access to health care. Because the demographic projections do not allow for a differentiation of the impact of HIV/AIDS by sector, the model adopted is a relatively simple growth model that follows Cuddington (1993a) but extends the framework by allowing for changes in the size and productivity of the labor force arising from the implementation of a package of HIV-related interventions. The model presented is highly generalized, but it does capture the moderating effect of changing demographic patterns on the evolution of HIV/AIDS and, subsequently, its macroeconomic effect through the labor force and the capital stock.

Production in the economy,  $Y$ , is characterized by a Cobb-Douglas-type technology with constant returns to scale. Equation (1) specifies that output is a function of labor, capital, and total factor productivity:

$$Y_t = \alpha \gamma^t L_t^\beta K_t^{(1-\beta)}, \quad (1)$$

where  $Y_t$  is aggregate output,  $L_t$  represents the labor input measured in efficiency units, and  $K_t$  is the capital input. The variable  $\gamma$  is the rate of technological change over time,  $\beta$  is the share of labor in aggregate output, and capital's share is derived residually. Finally,  $\alpha$  is a scale factor adjusted to fit the actual data in the base year.

In studies of countries in which resource extraction (such as minerals, oil, or timber) makes up a large share of GDP, it is often useful to account for this sector separately, because it is vulnerable to changes in the world prices of the extracted goods, or because the large share of economic rents in resource extraction may account for a significant share of its value added. The latter consideration also means that this sector is less sensitive to changes in domestic factor markets; this is reinforced if companies in the sector (for example, multinational mining corporations) bring in key personnel from abroad. Thus mining companies may have some scope for absorbing additional HIV/AIDS-related expenditures, and the impact of HIV/AIDS on output could be minimal.<sup>5</sup>

This consideration is particularly relevant for Botswana, where mining output constitutes more than a third of value added in output, as noted previously, and more than half of domestic government revenue. The analysis

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<sup>5</sup>On the other hand, if profit margins are low, an increase in production costs by several percentage points (not an unusual number in the context of HIV/AIDS) could turn an operation unprofitable and even result in its closure. This consideration is particularly relevant in the longer run, when start-up and investment costs need to be considered and do not constitute sunk costs as they do in the short run.

in this chapter assumes that mining output and the number of people working in the mining sector are not affected by HIV/AIDS. This implies that mining workers who die or retire are replaced by workers from other sectors, thus exacerbating the impact of HIV/AIDS on nonmining GDP.

HIV/AIDS has an impact on labor in two ways, through the productivity of the labor force and through its size. The efficiency unit of labor is a function of the number of HIV-infected workers, as well as of the proportion of the work period lost to absence or reduced productivity:

$$L_t = \sum_{i=15}^{64} (1 - z_t a_{it}) \rho_{it} E_{it}. \quad (2)$$

In equation (2) the effective labor supply,  $L$ , is a function of the fraction  $z$  of the work year lost per infected worker because of HIV-related absences and reduced productivity, and the proportion  $a$  of the population that is infected with HIV.  $E_{it}$  is the employed workforce of age  $i$  at time  $t$ , and  $\rho$  measures the productivity gain that comes with experience on the job.<sup>6</sup> The efficiency of labor depends not only on the labor force participation rate but also on the workers' experience, which is increasing in the number of years spent working. As prevalence rates rise, progression to AIDS means that the labor force becomes younger as older and more experienced workers drop out of the labor force and are replaced by younger, less experienced workers. Denoting the population growth rate as  $gn$ ,

$$gn_t = gn_t(a_t). \quad (3)$$

By equation (3) the population growth rate is a function of  $a$ , the proportion of persons infected with HIV. Higher rates of infection would result in future declines in the population, depending on how rapidly HIV infection progresses to AIDS. Capital accumulation is financed by domestic saving and foreign capital inflows, as expressed by

$$\Delta K = f(S, S_f), \quad (4)$$

where  $S$  is domestic saving and  $S_f$  net capital inflows.

The increasing cost of managing the epidemic imposes certain constraints on public and private saving, directly or indirectly. In Botswana some health care expenditure is categorized as "development" or capital expenditure. As morbidity and mortality rise, health care expenditure by

<sup>6</sup>Following Cuddington (1993a), the productivity gain is defined as a worker's experience, proxied by taking the worker's age and subtracting 15, the assumed age of entry into the labor force. BIDPA's estimate of the earnings function for Botswana assumes a starting age of 20 years in the formal sector, as follows:  $\rho = \delta_1 + \delta_2(i - 20) + \delta_3(i - 20)$ , where the  $\delta$ s are estimated from the earnings function of the labor force.

the government, households, and firms will be increasing in the number of HIV patients, as prevalence rates rise. Public expenditure will consist of direct health expenditure on treatment or prevention as well as some spending for training to replace absent or dead HIV-infected workers. Private sector saving is also affected, as firms increase the share of expenditure allocated to HIV prevention and care. Households will also spend more of their income on medications, funerals, visits to hospitals, and so forth. It is likely that some of these expenditures will come from income that would otherwise have been saved, thereby adversely affecting the saving rate, or from reduction of other current expenditure. Therefore the evolution of total domestic saving  $S_t$  in the presence of HIV is

$$S_t = s_t Y_t - x p a_t L_p \quad (5)$$

where  $s_t$  is the domestic saving rate. In the AIDS-without-intervention scenario, in other words, domestic saving  $S_t$  will equal the national saving rate times income, less  $x$ , the proportion of annual AIDS expenditure financed out of savings;  $p$ , the cost per patient in pula; and  $a_t L_p$ , the number of HIV-infected workers in the labor force.

For simplicity, assume that net inflows of foreign direct investment are constant as a proportion of GDP. (For countries exporting capital, this investment may well be negative, in which case domestic saving exceeds domestic investment.) To the extent that HIV/AIDS results in capital flight and reduces this ratio, the impact of HIV/AIDS on GDP (and thus the macroeconomic benefits from its mitigation) will be stronger than in the model discussed here.<sup>7</sup>

If capital is expressed in terms of the labor force,  $K/L = k$ , then the period-to-period change in the capital-labor ratio is

$$\Delta k = [s(a) + s_f] f(ka) - gn(a)k - \theta k, \quad (6)$$

where  $\theta$  is the depreciation rate and  $s_f$  the ratio of net capital inflows to GDP. The equation specifies the capital-labor ratio as a function of the total saving rate, production per worker, the HIV prevalence rate  $a$ , the population growth rate  $gn$ , and the depreciation rate  $\theta$ .

### Macroeconomic Impact of Botswana's National Strategic Framework

In the model under consideration, the macroeconomic impact of HIV/AIDS could be moderated through effective intervention programs.

<sup>7</sup>See Haacker (2002b) for a more detailed discussion of this point.

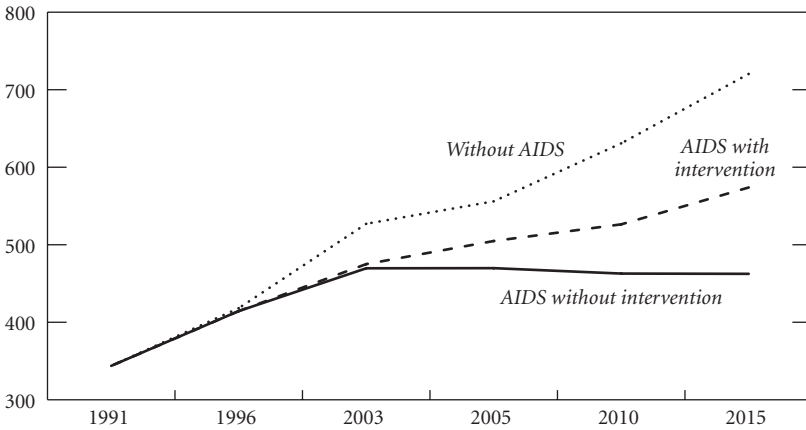
The negative effect on the labor force would be ameliorated as the rate of new infections slows and the useful life span of the infected is extended, and this will raise productivity as less working time is lost and the decline in workers' experience is mitigated. In the short run, the effect on capital accumulation will be negative, especially if a substantial proportion of the cost is financed from saving, possibly with the addition of donor-supported capital inflows. These effects could therefore result in a less pessimistic outlook for output growth than in a without-intervention scenario.

The specified model is simulated over the period 1991–2016, based on the actual values of the variables in 1991, and under three alternative scenarios: no AIDS, AIDS without intervention, and AIDS with intervention. Data for 1991 are used for the initial values of real GDP, the capital stock, and gross domestic investment. Following closely on previous work on Botswana, the labor-output and capital-output ratios are assumed to be 0.3 and 0.7, respectively, and the exogenous technological trend is set at 0.004. The depreciation rate is set at 7 percent, in line with CSO practice. In the preprogram years, separate data did not exist for the cost of HIV/AIDS treatment, but a range of 400 to 954 pula per patient was estimated based on expenditure data from the Ministry of Health. In the program years, the average cost per patient was 7,383 pula a year. In the past Botswana was able to run a surplus on the recurrent budget, which includes health care costs. In the medium-term program, however, it is assumed that Botswana finances 50 percent of the program cost from savings.

### ***Labor force and human capital***

The positive effect of the NSF program on the labor force (Figure 9.3) arises from the expanded labor force, the higher participation rate, and the impact on skill accumulation in the economy. The labor force becomes larger than in the AIDS-without-intervention scenario because various treatment options prolong the life of AIDS patients, enabling them to participate in the labor force. Furthermore, the slowdown in new infections means that newer entrants to the labor force are virtually HIV-free and not likely to drop out because of HIV-related illnesses.

In addition to the positive effect on labor force size, productivity and the efficiency of labor improve relative to the AIDS-without-intervention scenario. Although the lost human capital can only be replaced in the long run as new entrants to the labor force acquire more experience, the use of antiretroviral therapy results in a more productive life than would otherwise be the case. Although the impact of productivity may be difficult to

**Figure 9.3. Botswana: Labor Force Size***(Thousands)*

Source: Authors' calculations using data from Botswana national authorities and The Spectrum model.

measure, an analysis of the contribution to economic growth in the three scenarios (Table 9.3) shows that, in the AIDS-with-intervention scenario, the contribution of labor to changes in the growth rate improves remarkably in the medium term.

### *Saving and capital accumulation*

The NSF program involves the commitment of substantial resources to financing the HIV/AIDS program. Therefore the effect on public and private saving in the initial program years is remarkable. Even though the model assumes that only half of the cost is financed from savings, by 2008 the contribution of capital to the change in real output is lower than in either the AIDS-without-intervention or the no-AIDS scenario. This comes about mainly because, in the AIDS-without-intervention scenario, there is no programmatic spending on HIV outside of the allocation in the health ministry's budget. Apart from public saving, private saving would also fall as firms' health care costs increase and households assume some of those costs. However, because these are one-time effects, by 2013 the capital contribution to GDP resumes its upward trend.

The implication of declining saving is a slower rate of capital accumulation in the program years. A crucial determinant of the overall outcome is the extent to which Botswana can attract the financial support of devel-



**Table 9.3. Botswana: Contributions to Projected Changes in GDP Under Alternative Scenarios**  
(Percentage points)

Scenario and Year	Change in Real Output Growth	Contribution of Change in:		
		Total factor productivity	Capital	Labor
<b>No AIDS</b>				
2005	5.5	0.4	4.3	0.8
2008	5.2	0.4	4.0	0.8
2011	5.1	0.4	3.9	0.8
2012	5.0	0.4	3.8	0.8
2013	5.0	0.4	3.8	0.8
2014	4.9	0.4	3.7	0.8
2015	4.9	0.4	3.7	0.8
<b>AIDS without intervention</b>				
2005	4.0	0.3	3.8	-0.2
2008	3.5	0.3	3.3	-0.2
2011	3.2	0.2	2.9	-0.1
2012	3.1	0.2	2.8	-0.1
2013	3.0	0.2	2.7	-0.1
2014	3.0	0.2	2.6	0.0
2015	2.9	0.2	2.5	0.0
<b>AIDS with intervention</b>				
2005	4.8	0.3	3.9	0.2
2008	4.1	0.3	2.5	0.2
2011	4.0	0.3	2.5	0.4
2012	4.1	0.4	2.7	0.5
2013	4.1	0.4	2.7	0.5
2014	4.1	0.4	2.8	0.6
2015	4.1	0.4	3.1	0.6

Sources: Spectrum model software and author's calculations.

opment partners in managing the epidemic. Again, the current results are based on the assumption that 50 percent of the cost is financed from savings. Should donor support fail to materialize, requiring a greater reliance on domestic saving than projected, the outlook may be much worse than expected, because the negative effect on capital accumulation would be greater.

### **Overall economic growth**

The most significant macroeconomic impact is the increase in the growth rate of the economy under the AIDS-with-intervention scenario compared with the AIDS-without-intervention scenario. Under the with-intervention scenario, GDP is projected to grow at an annual rate of 4.1 percent by the end of the program in 2008, compared with 3.5 percent in the absence of

intervention. By 2015 GDP is growing at a rate of 4.1 percent a year under the AIDS-with-intervention scenario, compared with 2.9 percent under the without-intervention scenario; however, even the higher rate is still less than the 4.9 percent rate projected in the absence of AIDS.

A growth accounting exercise (Table 9.3) illuminates some of the dynamics of the growth simulation, in particular how the relative sizes of the mining and nonmining sectors in Botswana condition the outcome. In the AIDS-without-intervention scenario, the contribution of labor to growth is negative until 2013, since in the absence of intervention the size and productivity of the labor force contract over time. Following from the initial assumption that the effect of HIV/AIDS on the mining sector is negligible, this outcome is mainly driven by the contraction in labor force participation in the highly labor-intensive nonmining sector. The decline in capital's contribution, however, is not as remarkable because of the assumed negligible effect in the mining sector and lower capital accumulation in the nonmining sector.

### **Direct and Indirect Effects on Government Finances**

The most thorough assessment of the fiscal effects of HIV/AIDS in Botswana is that in BIDPA (2000). The demographic projections used here correspond most closely to BIDPA's "high" scenario, to which all citations below refer.<sup>8</sup>

According to BIDPA, in the high scenario direct and indirect expenditure on HIV/AIDS exceeds 5 percent of GDP by 2010. Direct costs, such as the clinical cost of AIDS treatment and care, as well as the cost of awareness campaigns and other HIV/AIDS prevention measures, are projected to reach about 3.5 percent of GDP. Indirect costs (a term that is used in this chapter for all expenditures not included in specific HIV/AIDS budget line items) for social expenditure are approximately 1.5 percent of GDP. Social expenditure—mainly poverty alleviation programs aimed at redistributing income—are projected to increase by 10 percent, roughly in line with the decrease in income among those falling below the poverty line as a result of HIV/AIDS-related morbidity and mortality. The increase in allowances for the destitute and for orphans would also be commensurate with the increase in those groups, as HIV infection spreads and more income earners die from AIDS-related illnesses.

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<sup>8</sup>The presentation differs, however, in that it presents estimates as percentages of GDP, whereas BIDPA presents expenditure as a percentage of recurrent expenditure, and revenue as a percentage of total revenue.

**Table 9.4. Botswana: Comparison of Changes in Expenditure Categories in 2010 Projected by BIDPA (2000) and NACA (2003)**  
(Percent of GDP)

Item	Source of Projection		Indirect Fiscal Gains
	BIDPA	NSF	
Health and prevention	3.5	5.0	—
Social expenditure	1.5	0.7	0.8
Public service	0.8	0.3	0.5
Education	0.3	0.1	-0.2
Other	0.2	3.0	—
Indirect fiscal gains (sum)			1.1

Sources: BIDPA (2000), NACA (2003), and author's calculations.

These, however, are not the only indirect costs. BIDPA's projection envisages increased staff costs in the public service arising from an increase in the government's wage bill by about 6 percent, as a shortage of skilled labor causes their wages to be bid up. It is also expected that the increase in deaths will raise death-related benefits, funeral expenses, and disability benefits. To some extent, however, these costs could be offset by the reduction in the government's pension obligations from the higher mortality rate. Although staff costs could also arise from training and recruitment expenditure, as recruitment rises and newly recruited staff require training, declining expenditure on education would dampen some of these adverse impacts.

Table 9.4 presents BIDPA's estimates of the impact of HIV/AIDS on government expenditure in 2010; these estimates do not include a feedback effect from prevention and treatment efforts. The estimates for the indirect fiscal effects of the NSF are then obtained by, first, replacing the BIDPA estimates for health expenditure with the latest projections specified under the NACA (2003). Second, BIDPA (2000) does not include most of the overhead and other expenses related to the NSF, which are summarized under "other costs." Fiscal savings arise in the various areas of social expenditure and the costs of the public service (for example, owing to reduced costs of benefits). These are largely associated with lower mortality due to HIV/AIDS owing to measures implemented within the NSF. To obtain estimates of the savings in these expenditure categories, most of which are not budgeted for in the NSF, the projected costs of HIV/AIDS from BIDPA are then scaled down in line with lower mortality under the NSF.

Table 9.4 shows that the savings owing to feedback effects from HIV/AIDS programs can contribute to the financing of a comprehensive HIV/AIDS framework. The NSF envisages higher expenditure on health services, reflecting, to a large extent, increased access to antiretroviral treat-

ment. "Other costs" include investment costs and smaller items that, owing to different coverage, are not comparable between BIDPA and the NSF. The savings in the areas of social expenditure, public service, and education, amount to 1.1 percent of GDP, or about 14 percent of the costs of the NSF. However, these numbers most likely understate the fiscal savings associated with the NSF, because they do not include savings within the line items of our highly aggregate presentation. Such savings arise, for example, if prevention efforts contribute to a decline in treatment costs.

Worldwide, a substantial proportion of HIV/AIDS-related expenditure is financed by external grants; the Joint United Nations Programme on HIV/AIDS (UNAIDS, 2003) estimates that, in 2003, more than three-fourths of institutional HIV/AIDS spending worldwide came from international sources, including bilateral sources, the U.N. system, the grant component of World Bank loans, and international nongovernmental organizations. For Botswana, Martin (2003) estimates that HIV/AIDS-related expenditure in 2001/02 amounted to \$113 million, of which donors financed \$96 million. Although Botswana's NSF does not provide any estimates of expected donor assistance, it makes repeated reference to the important role of Botswana's development partners. More generally, a broad national strategy on HIV/AIDS, developed with inputs from all layers of government, civil society, and development partners, can be used to mobilize additional funding from international donors and facilitate coordination among them.

Regarding the impact of HIV/AIDS on domestic revenue, many components of tax and other revenue can be expected to change at about the same rate as GDP. According to estimates in Kibuka and others (2004), for example, government revenue amounted to 41.9 percent of GDP in 2002/03. Excluding items such as mineral revenue (21.9 percent of GDP), interest, asset sales, and grants, revenue that would grow at a similar rate as overall economic activity accounts for 19 percent of GDP. Given that GDP increases by 25 percent by 2010 in this chapter's AIDS-with-intervention scenario, relative to the scenario without intervention, this would mean that government revenue grows by 3.8 percent of GDP. However, not all of this additional revenue can be mobilized for the financing of the NSF, because an increase in GDP and, in particular, in the size of the population also implies an increase in the demand for general government services.

Although simplistic, this analysis of the fiscal repercussions of the NSF suggests that the indirect fiscal effects of a comprehensive prevention and treatment program can contribute significantly to the program's own financing. (Of course, the indirect fiscal benefits are only part of the

broader social and economic benefits arising from a successful HIV/AIDS program.) These indirect gains, in turn, are interrelated with the macroeconomic effects, which this chapter's analysis of the fiscal effects does not include explicitly. Given the size of the indirect fiscal gains (whether they can be mobilized for a program like the NSF or not), a fuller analysis is warranted, including a more disaggregated analysis of government expenditure and taking into account the linkages between the broad macroeconomic effects and the fiscal effects.

## Conclusions

Botswana's NSF formulates a broad response to the HIV/AIDS epidemic around the "central goal of the National Response to HIV/AIDS," namely, "to eliminate the incidence of HIV and reduce the impact of AIDS in Botswana" (NACA, 2003), and it defines HIV/AIDS-related actions for all functional and regional divisions of government. The NSF does not spell out its potential impact in terms of human development and macroeconomic performance. However, it envisages that HIV-related death rates will be lower, that patients will have longer and more productive lives, that the number of orphans will be fewer, and that mother-to-child transmission rates can be considerably reduced.

Using a simple macroeconomic model, this chapter has sketched how to expand this strategic framework, focusing in particular on the impact on government finance. The NSF envisages a substantial allocation of resources to fighting the epidemic. However, through its demographic and macroeconomic effects, which in themselves are highly desirable, it also helps contain certain categories of expenditure, and, by mitigating the adverse effects of HIV/AIDS on the tax base, it mobilizes domestic revenue to offset some of the fiscal costs of the program.

This analysis demonstrates the benefits of integrating a strategic framework on HIV/AIDS, such as Botswana's NSF, into a broader economic and fiscal framework and, vice versa, incorporating an assessment of the indirect economic and fiscal benefits of reduced HIV incidence and improved access to treatment into a strategic framework for dealing with HIV/AIDS. From this analysis, looking narrowly at the financial costs and benefits of HIV/AIDS interventions, it appears that the indirect macroeconomic and fiscal effects are an important part of the picture. Taking a wider perspective, an analysis of the broad development impact of HIV/AIDS, and thus also of a strategic framework on HIV/AIDS, can help in defining the operational targets of such a strategy.

## Appendix: Assumptions Used in the Demographic Projections

The demographic projection was generated using Spectrum, a Windows-based program developed by The Futures Group with funding from the U.S. Agency for International Development. The program uses current information on population, fertility, mortality, and migration to project the future demographic trend of a population group. There are six modules in the program, the most relevant to this exercise being the DemProj, which was used to generate the population trend, and the AIDS Impact Module (AIM), which was used to project the consequences of the AIDS epidemic.

The following information was used to generate the demographic projection for Botswana:

- Population by age and sex in the base year 1991 is presented in Table 9.A1 and is from the 2001 Botswana Central Statistics Office (CSO) *Statistical Bulletin*.
- Total fertility rates are defined as the average number of births that a female in the 15–49 age group would be expected to have in her lifetime, based on existing fertility patterns. According to the latest census data from the CSO *Statistical Bulletin*, 2001, p. 15, the total fertility rate was 6.5 for 1971, 6.6 for 1981, and 5.2 for 1991.
- Age-specific fertility rates, defined as the number of live births per 1,000 women in each age group, are averages for all of sub-Saharan Africa and are from the United Nations; they are incorporated into the Spectrum model as the default.
- Sex ratio at birth in 1991 is 92 males per 100 females and is from the CSO *Statistical Bulletin*, 2001, p. 14.
- Life expectancy at birth in the absence of AIDS is 63.3 years for males and 67.1 for females; data are from the CSO *Statistical Bulletin*, 2001, p. 15, for 1991 and United Nations population projections for subsequent years.
- Infant mortality is 87.5 per 1,000 births in 1991 and is from the *Statistical Bulletin*, 1991; for other years the Spectrum model uses the United Nations General Life Table, which translates to an assumed infant mortality rate of 54 per 1,000 births.
- Crude death rates are 13.9 per 1,000 population for 1981 and 11.5 per 1,000 for 1991, from CSO *Statistical Bulletin*, 2001, p. 15; for other years the Spectrum model uses the United Nations General Life Table, which translates to an assumed crude death rate of 8.2 per 1,000.
- International migration (net) is the model default, taken from United Nations data.

**Table 9.A1. Botswana: Population by Age and Sex, 1991**

Age (years)	Males	Females	Total
0–4	96,676	96,989	193,665
5–9	97,563	99,051	196,614
10–14	89,887	93,596	183,483
15–19	73,112	79,413	152,525
20–24	54,261	62,622	116,883
25–29	45,408	54,440	99,848
30–34	36,620	44,013	80,633
35–39	30,487	35,741	66,228
40–44	23,197	25,001	48,198
45–49	18,553	20,496	39,049
50–54	16,192	17,519	33,711
55–59	12,746	15,003	27,749
60–64	10,485	12,271	22,756
65–69	8,688	11,155	19,843
70–74	6,857	7,872	14,729
75+	13,668	17,214	30,882
Total	634,400	692,396	1,326,796

Source: Botswana Central Statistical Office (2001), p. 13.

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