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THE MACRO-ECONOMIC IMPACT OF HIV/AIDS IN SOUTH AFRICA

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This *Economic Research Note* is the culmination of months of research. We report the results as comprehensively as possible in the main section. However, for convenience sake we have added an extensive Executive Summary discussing the main results. Furthermore, those readers not interested in the technical analysis of the economic impact channels and our detailed assumptions in this regard, can skip this part of the report *(i.e. pages 14 to 27)*. The Appendix at the end of the report provides macro-economic projections in more detail.

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Executive Summary

South Africa is in the midst of a serious HIV/AIDS epidemic. The trajectory of the local epidemic is such that we are currently in the early stages of an exponential increase in the number of AIDS-related deaths expected over the next 5 to 10 years. Actuarial scientists' grasp of the epidemic is improving, according greater certainty to their demographic projections. However, gaps in the data remain and assumptions have to be made regarding key issues. This also applies to the economic modeller attempting to simulate the impact of the epidemic. *The objective with the current study has been to face this challenge and quantify the macro-economic impact of HIV/AIDS in SA.* The results are discussed and provided below. However, we would like to stress that this study should be seen as a macro-economic sensitivity analysis, rather than claiming to have produced accurate forecasts of the economic reality under an AIDS scenario.

HIV/AIDS demographics

HIV infection has increased sharply in SA over the past decade, from almost zero to a level where between 4-6 million citizens are estimated to be HIV positive (i.e. around 11% of the total population). Given the considerable lag and link between the HIV and AIDS epidemics, the mortality consequences of this exponential increase in HIV infection over the 1990s are more or less matter-of-fact over the coming decade; even drastic interventions can do little to avoid this reality, albeit possibly impacting further beyond.

Both the Actuarial Society of SA (ASSA) and Abt Associates/Metropolitan projections indicate that the total growth in the SA population could amount to a mere 1,5 million people between 2000 and 2015, i.e. more or less 10 million people short compared to a no-AIDS projection. The total labour force is projected to be close to 21% lower by 2015 compared to a no-AIDS scenario, the overall size of the labour force remaining almost stagnant over the next 14 years.

Abt/Metropolitan projects HIV prevalence to increase to 15,1% by 2015 (or 6,6 million people), the increase levelling off from around 2008. ASSA projects HIV prevalence to peak at 16,2% in 2006 (i.e. 7,7 million people) and to decline to 13,5% (6,2 million people) by 2015.

Abt/Metropolitan projects the number of people suffering from full-blown AIDS to increase from 158 250 in 2000 to 518 000 by 2005 and 1,06 million by 2015; the corresponding ASSA2000 numbers are 879 000 (2005) and 1,2 million (2015)

respectively. According to ASSA, AIDS prevalence is projected to peak in 2011 (2,9% of the population), five years later than the peak in HIV prevalence.

The population growth rate is projected to decline from 1,4% in 2000 (and 2,1% in 1990) to zero in 2009 and –0,5% in 2015 according to Abt/Metropolitan. According to ASSA the population peaks in 2007, also declining slightly thereafter.

Abt/Metropolitan projects HIV prevalence to increase from 7,2% in 2000 to a peak of 18,3% in 2015 for highly skilled workers, the increase tapering off over the last part of the projection period[1]. HIV prevalence for skilled and unskilled workers is projected to increase from 12,1% and 14,3% respectively in 2000 to 25,4% and 27,6% in 2015. Prevalence for the unemployed is projected to increase to well above 30% due to a predominantly young, black and female profile. The difference between an AIDS-inclusive and no-AIDS labour force by 2015 could be 16,8% in the case of highly skilled workers, 19,3% for skilled and 22,2% for semi- and unskilled workers.

Economic impact channels

The macro-econometric simulation exercise to model the impact of HIV/AIDS is a complex one. This problem was approached by identifying key macro-economic impact channels, in turn, analysing the impact of each of these independently after making the necessary assumptions and then to combine the model for final (aggregated) simulation results. Five broad economic impact channels, some containing more detail, were identified, namely:

- A lower overall population and labour force, affecting both the production side (the economy's production potential) and the expenditure side of the economy.
- Direct costs to the private business sector, e.g. increased contributions by firms to their employees' pension, life, disability and medical benefit schemes.
- Indirect costs to the private business sector, e.g. firms having to face the costs associated with increased absenteeism, training, recruitment, etc. Reduced labour and multi-factor productivity could present other indirect costs to firms.
- Higher government expenditure due to the increased direct and indirect costs (similar to the case for business), the increased demand for public sector health services and the orphan legacy of the HIV/AIDS epidemic.
- *Finally*, households are likely to face additional out-of-pocket spending on health care products and services (i.e. costs not covered by medical schemes), as well as for funeral services.

Detailed assumptions were made regarding the costs faced by companies and the government in combating the disease, as well as the way in which these costs are financed; *for more detail, including the macro-economic dynamics of each impact channel, see the main text*. We also conducted a macro-economic sensitivity analysis by simulating alternative assumptions, which allowed us to produce range projections and assess the sensitivities involved in the economic impact of HIV/AIDS *(see below)*.

Macro-economic impact: 2002 to 2015

The basis of the economic impact of HIV/AIDS lies *first and foremost* in the demographics; and *secondly*, in the costs of combating the disease. Two important aspects of the economic impact, however, need to be highlighted.

- *Firstly*, whilst the population (and labour force) size is reduced by 18% (21%) respectively compared to a no-AIDS scenario by 2015, the decline in economic production, employment and incomes is substantially less. This could result as labour losses are replaced from unemployed sources; companies strive to maintain production levels, possibly implementing

[1] This is a high infection rate, implying that close to 1-in-5 highly skilled workers could eventually become infected. This projection could be upwardly biased. A lack of data at this stage precludes an analysis of labour force skills HIV prevalence levels independent of age/gender/race and provincial profiles.

more productive technologies; and as incomes could be augmented from insurance payouts, fixed asset sales (of the deceased), etc., countering the negative impact on spending levels.

- *Secondly*, the flip side of the cost pressures arising from the epidemic (directly and - to a lesser extent - indirectly, for both the public and private sectors) is spending in the economy, possibly leading to an increase in GDP. Shifts in spending (e.g. households cutting back on non-health care spending) do not necessarily represent a loss in GDP. To the extent that spending shifts towards less productive avenues, the longer-term implications for the economy could be negative.

With this in mind, the more detailed econometric results are briefly discussed below.

Inflation and interest rates. A key result from the study is a significant impact on inflation and interest rates, in turn, having negative feedback effects on economic growth and job creation. The pressure on inflation stems from the HIV/AIDS-related (direct and indirect) cost pressures faced by companies, which could lead to higher product prices, pressure on salary and wage rates as the epidemic exacerbates SA's skills shortages, increased economy-wide capacity utilisation due to the substantial negative impact on the economy's production potential and some pressure on inflation from a higher budget deficit. Given a monetary policy of inflation targeting, the increase in inflation is likely to spill over to interest rates. Additional pressure is exerted on interest rates due to lower domestic savings compared to a no-AIDS scenario and some deterioration in the overall balance of payments.

In all, producer price inflation is projected to be 2,3% points higher on average over the projection period (2002-15), the deviation increasing from 1,4% points (2002/05) to 2,3% points (2006-10). The projected increase in consumer inflation is slightly larger. *Prime overdraft interest rates are projected to be 2,9% points above that of a no-AIDS scenario over the projection period; this deviation rising from 1,4% points (2002/05) to 3% points (2006-10)*. The increase in the nominal prime rate is higher than the increase in inflation, implying a small increase in real prime overdraft rates compared to a no-AIDS scenario. *The sensitivity analysis indicates impact ranges of 1,9% to 3,3% for PPI inflation and 2,4% to 4,7% for prime interest rates (2002-15)*.

Final household consumption expenditure (FCE). The overall impact on FCE is negative as should be expected in a country where the total population declines by around 10 million compared to a no-AIDS scenario. However, the impact on this sector is not that straightforward. This sector is likely to witness substantial shifts in spending, changes in the distribution of income and the activation of savings in order to protect living standards in the face of increased health-related expenditure. The negative impact on FCE stems from the projected decline in the population, as well as the decline in employment and income levels and the increase in interest rates. Employment levels decline compared to a no-AIDS scenario due to the lower level of GDP, the increased (direct and indirect) HIV/AIDS-related employment costs faced by companies and wage pressures resulting from the increased skills shortages. As the decline in labour demand exceeds the increase in wages, disposable incomes decline.

As the projected decline in disposable incomes is less than the decline in population, per capita incomes increase, contributing to a shift in income distribution, in turn, benefiting the durable goods and services sectors. Furthermore, the pronounced projected increase in health care spending benefits overall FCE at the expense of non-health care expenditure components and personal savings. *In fact, the results show that total FCE is slightly higher in the AIDS scenario over the period 2002-10*. However, this positive impact reverses noticeably beyond 2010; *over the complete projection period, total real FCE growth is projected to be reduced by 0,3% per annum. The upper-end of the impact range is marginally positive (0,1% growth per annum) and the lower end, -0,5% per annum*.

Consumer spending on durable goods (0,6% to 0,8% lower per annum, 2002-15) and semi-durable goods (0,6% to 1% lower) could be the most vulnerable to the projected shifts in spending in favour of health care products and services and the increase in interest rates. Spending on semi and non-durable goods has a proportionally larger exposure to the black consumer market and is more vulnerable to the demographic impact. Furthermore, the non-health care components of

non-durable goods spending and spending on services could also experience a substantial negative impact. Including spending on health care, real spending on services is higher compared to a no-AIDS scenario (the impact ranging between 0% to 0,5% per annum, 2002-15). It is clear that the aggregated results of the impact on FCE conceal possibly more substantial impacts on specific markets. Further research is required in this regard.

Fixed investment. Whilst capacity utilisation increases in the AIDS scenario and labour costs rise, companies may be intent on increasing investment in machinery, equipment and new technologies, which all suggest upward pressure on fixed investment. However, machinery and equipment demand skilled operators and may not be available to the required extent as the epidemic intensifies. Furthermore, capacity utilisation increases, resulting from the decline in the supply potential of the economy rather than an increase in actual GDP/demand, typically the trigger for increased capital spending. We do not view these two impacts on fixed investment as being symmetrical. *In fact, our econometric simulation reveals a strong adverse impact on real private fixed investment, ranging between 1% and 2% lower growth per annum (2002-15).* This adverse impact results from the lower overall level of economic activity and demand conditions in an AIDS economy, the increase in interest rates and the lower level of corporate profits and savings, *as well as a comparatively smaller national pool of savings (averaging 2% of GDP lower in the baseline AIDS projection).*

Government spending and fiscal policy. The overall impact on the national budget is negative, both on the expenditure side (increased health spending and demand for services) and the income side (lower corporate profits, economic growth and consequently tax revenues). However, this impact is reduced by an assumed small increase in tax rates, as well as cut-backs in non-health care (and non-wage) expenditure, implying a shift in spending between (and possibly within) government departments. Furthermore, the decline in the population reduces the general demand for services, countering the bigger health spend. Our baseline projection favours a 0,6% of GDP increase in the overall tax burden and a 0,2% points deterioration in the budget deficit. The sensitivity analysis revealed that increased deficit financing of the increased health spend will amplify the negative impact on inflation and interest rates.

Trade, the balance of payments and the exchange rate. The overall impact on the balance of payments is fairly limited. Two negative aspects may be noted. *Firstly*, the import intensity of GDP growth is projected to increase, resulting from the high import intensity of spending on health care products, a reduction in the relative cost to import (as the increase in domestic inflation exceeds the increase in imported inflation) and the increased capacity constraints due, in turn, to the economy's reduced supply potential. This adverse impact on the import side is, however, countered by increased exports, which benefit from a real depreciation of the rand. *Secondly*, as the domestic savings effort deteriorates in the AIDS scenario, increased foreign capital flows would be required to plug this gap. However, we argue that the dollar value of capital inflows could be lower in view of the poorer business and economic outlook in the AIDS scenario. The econometric results indicate the overall positive impact on the current account of the balance of payments *(averaging 0,3% of GDP, 2002-15)* is exceeded by the deterioration on the financial account of the balance of payments. The overall balance of payments impact is therefore moderately negative on interest rates and the rand exchange rate.

Overall GDP growth and employment. Whilst the overall impact on GDP is negative, this impact manifests gradually. *Compared to a no-AIDS scenario, the level of real GDP is projected to be 1,5% lower by 2010 and 5,7% lower by 2015. In year-on-year growth terms this translates to declines in the average annual growth rate of 0,1% (2002-05); 0,3% (2006-10); and 0,9% (2011-15). Over the complete projection period, the decline in the average real GDP growth rate is 0,5% per annum. The sensitivity analysis revealed the impact ranges between 0,3% to 0,6% lower real GDP growth per annum, 2002-15.*

Central to the GDP impact, are the HIV/AIDS demographics and the AIDS-related costs to the economy. Employment levels are negatively affected by the cost-raising impacts of the epidemic noted above; combined with higher interest rates, this explains the bulk of the decline in actual

GDP compared to a no-AIDS scenario. The decline in GDP from these sources is countered by the (net) increase in HIV/AIDS-related health expenditure by households and the government. Furthermore, companies strive to maintain output levels and could succeed in increasing the output per worker. In the end, the decline in GDP (5,7% by 2015) is significantly less than the decline in the overall population (18%), which suggests that per capita GDP increases. Over the complete projection period, real per capita GDP growth is on average 0,9% higher per annum.

Conclusion

While the economic impact of HIV/AIDS is negative, we are far from witnessing a doomsday scenario. The negative impact on real GDP growth is gradual and the economy could continue to register 3% average real GDP growth (or better) over the next 10 to 15 years; inflation could still average around 7% (in line with the past 5-6 years); real interest rates may only be marginally higher; the current account deficit could average below 2% of GDP and the budget deficit below 3% of GDP. The point here is that the impact lies in comparisons with the possible outcome in the absence of HIV/AIDS, something that we will never really know.

Having said that, the results clearly show that the macro-economic impact of the HIV/AIDS epidemic cannot be ignored. A particular feature of the overall results is the negative financial impact, which has negative feedback effects on economic growth and job creation; this impact is exacerbated by the negative impact on savings, in turn, having negative implications for fixed investment and SA's balance of payments constraint on economic growth. Furthermore, the macro results may conceal more substantial negative impacts at a more disaggregated level. There could clearly be losing sectors, apart from those sectors benefiting (e.g. health care, funeral services, etc.). Further research is required in this regard.

Finally, the macro-economic impact numbers convey little, if anything, of the human suffering and adverse social impacts likely to accompany such an exponential increase in mortality and sickness as is currently being projected by the actuarial scientists.

Summary table: Macro-economic impact of HIV/AIDS in South Africa: 2002 to 2015

(AIDS-inclusive figures in parenthesis)	2002-05 % p.a.	2006-10 % p.a.	2011-15 % p.a.	Average 2002-15 % p.a.	Impact range 2002-15 % points p.a.
Real expenditure on GDP					
FCE growth	3.1 *(3.1)*	3.4 *(3.4)*	3.8 *(3.1)*	3.5 *(3.2)*	0.1% to -0.5%
Govt consumption expenditure	1.8 *(1.9)*	1.8 *(1.8)*	2.4 *(2.0)*	2.0 *(1.9)*	0.2% to -0.2%
GDFI growth	6.4 *(5.4)*	6.3 *(5.1)*	5.1 *(3.7)*	5.9 *(4.7)*	-1.0% to -1.8%
GDE growth	3.5 *(3.3)*	3.9 *(3.7)*	4.4 *(3.6)*	4.0 *(3.5)*	-0.4% to -0.7%
Exports	5.5 *(5.9)*	5.9 *(6.1)*	4.5 *(4.5)*	5.3 *(5.5)*	0.5% to -0.1%
Imports	7.0 *(6.8)*	6.9 *(7.3)*	5.5 *(5.7)*	6.4 *(6.6)*	0.0% to 0.6%
GDP growth	3.2 *(3.1)*	3.7 *(3.3)*	4.1 *(3.2)*	3.7 *(3.2)*	-0.3% to -0.6%
Formal sector employment	1.2 *(1.2)*	1.9 *(1.3)*	2.1 *(1.0)*	1.7 *(1.1)*	-0.5% to -0.7%
Unemployment**	43.1 *(41.3)*	42.5 *(38.0)*	40.6 *(31.6)*	42.0 *(36.7)*	-5.2% to -6.2%
PPI inflation	5.4 *(6.8)*	5.0 *(7.4)*	4.2 *(7.1)*	4.8 *(7.1)*	1.9% to 3.3%
Prime overdraft interest rate	14.4 *(15.8)*	12.2 *(15.1)*	10.7 *(14.8)*	12.3 *(15.2)*	2.4% to 4.7%
Nominal effective rand (% p.a.)	-4.5 *(-6.0)*	-3.7 *(-6.2)*	-2.5 *(-5.5)*	-3.5 *(-5.9)*	-2.0% to -3.6%
Current account balance as % of GDP	-1.8 *(-1.7)*	-2.0 *(-1.8)*	-2.3 *(-1.8)*	-2.0 *(-1.8)*	0.2% to 0.4%
Domestic savings as % of GDP	15.6 *(14.9)*	18.1 *(16.2)*	21.2 *(18.2)*	18.5 *(16.5)*	-1.3% to -5.9%
Budget deficit as % of GDP	-1.8 *(-1.6)*	-0.9 *(-1.0)*	0.0 *(-0.4)*	-0.8 *(-1.0)*	0.1% to -3.1%
Total population growth	1.6 *(0.9)*	1.5 *(0.2)*	1.5 *(-0.3)*	1.5 *(0.2)*	-1.3%
Total labour force growth	1.7 *(0.9)*	1.8 *(0.1)*	1.7 *(-0.5)*	1.7 *(0.1)*	-1.6%
Potential GDP growth	3.6 *(3.0)*	4.0 *(2.6)*	4.2 *(2.2)*	4.0 *(2.6)*	-1.4% to -1.8%
Real per capita GDP growth	1.6 *(2.2)*	2.1 *(3.2)*	2.6 *(3.5)*	2.1 *(3.0)*	1.0% to 0.7%

*** Defined as the "% of the total labour force outside the formal sector".*

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THE MACRO-ECONOMIC IMPACT OF HIV/AIDS IN SOUTH AFRICA

The evidence of a serious HIV/AIDS epidemic in South Africa is accumulating by the day. The local trajectory of the epidemic is such that SA is currently in the early stages of an exponential increase in the number of AIDS-related deaths expected over the next 5 to 10 years. In a previous Research Note (see *HIV/AIDS and the South African economy*, June 2000), the point was made that the human and social impact of the epidemic is likely to be much more serious than the broad economic impact. Alternatively, the demographic impact is likely to be larger than the impact on economic production as unemployed resources replace the loss of labour due to AIDS and to the extent that the cost of combating the disease is financed from expenditure shifts. *The objective of the current report is to quantify the possible macro-economic impact of the HIV/AIDS epidemic in South Africa*.

As noted previously, many major imponderables face the researcher attempting to model the economic impact. Fully aware of these, we opted to test different assumptions and consider different sets of demographic data available in South Africa. Our baseline scenario could be described as a worst-case demographic scenario to the extent that we do not allow for behavioural changes and large-scale government interventions, both of which appear to have the potential to change the long-term course of the epidemic. In addition, however, we adopt a specific structure of assumptions, allowing for variation, regarding the direct and indirect costs tied to the epidemic and the way in which these are financed. This has a very specific bearing on the econometric simulation of the impact and enabled us to generate range projections of the key macro-economic variables, apart from the favoured baseline projection. A few remarks are in order at this point in time:

- As noted in the previous BER research note, our model projections are subject to the famous Lucas critique, i.e. behavioural and structural change could render the projections obsolete as we go along. However, as the epidemic matures, actuarial scientists' grasp of the epidemic improves, which increases the certainty of their demographic projections, particularly over the coming 5 to 10 years due to the deadly link between HIV infection and AIDS[2]. While more certain demographics provide a more solid platform, this still leaves the economic modeller to grapple with an array of assumptions regarding the way in which families, communities, business and government will absorb the impact of the pandemic.

[2] Key advances have been made in the latest HIV/AIDS study by the Actuarial Society of South Africa (ASSA2000); see the accompanying box. An assessment and projections of prevalence by labour force skills, which is central to an analysis of the economic impact of HIV/AIDS, however, remains problematic due to a lack of suitable data.

- Given the array of behavioural assumptions we had to work with, this study should be seen as a macro-economic sensitivity analysis, rather than claiming to have produced accurate long-term forecasts of reality under an AIDS scenario. In other words, the results should be seen in conjunction with the assumptions we adopt.

Before the alternative assumptions are discussed, attention focuses on the demographics; this section will summarise the key results highlighted in the previous report (June 2000) and expand somewhat in the light of new information which has since emerged. The discussion on the demographic impact of HIV/AIDS is followed by a detailed exposition of the economic impact channels we have identified and the assumptions adopted in this regard. Maximum reference is provided to the assumptions adopted in other studies and - as noted above - we opted to test alternative assumptions apart from the baseline. In the final section of the report the overall results are discussed in detail; *inter alia* the impact on economic growth, household consumption expenditure (including its composition over the next 10 to 15 years), fixed investment, trade, the balance of payments, the rand exchange rate, inflation and interest rates, as well as fiscal policy.

THE DEMOGRAPHIC IMPACT OF HIV/AIDS

In the previous research note, detailed attention was paid to the demographic impact of HIV/AIDS, based on the Actuarial Society of South Africa's (ASSA) modelling of the epidemic. Since then ASSA has updated and refined their model, incorporating the latest information on the epidemic[3]. We opted to incorporate both the latest ASSA demographic projections, as well as those of the Doyle-Metropolitan model[4] into our econometric simulations. The ASSA demographic projections[5] are generally considered to be a less conservative - albeit a possibly more realistic - projection of the HIV/AIDS epidemic in SA *(see the accompanying box comparing the two models)*.

[3] See the forthcoming paper: Dorrington, R: *The demographic impact of HIV/AIDS in South Africa by province, race and class*, Centre for Actuarial Research, University of Cape Town, August 2001.

[4] See Abt Associates & Aids Research Unit Metropolitan Life: *Demographic impacts of HIV/AIDS in South Africa*, A study prepared for the Department of Finance South Africa, June 2000.

[5] One version of the ASSA2000 suite of models, modelling the provinces independently, still has to be calibrated against the most recent Department of Health Demographic and Health Survey (2000) data of antenatal care clinic attendees (see Dorrington: 2001). The ASSA2000 demographic projections referred to in this study relates to the "full version" of the model, modelling the four racial groups in SA *(see the accompanying box)*. We do not report the econometric results based on the ASSA demographic parameters at this stage, awaiting the final ASSA2000 results and possible further research regarding HIV/AIDS prevalence according the labour force skills.

As noted previously, the demographic projections should not be regarded as accurate forecasts of the reality. This is due to the myriad assumptions needed, the remaining gaps in HIV/AIDS data and - most importantly - the possibility of significant intervention and/or behavioural change in future as the epidemic onslaught erupts in full force, possibly altering its course. Having said that, considerable effort is made by the modellers to calibrate their models to reproduce past data as best as possible. Furthermore, due to the considerable lag between the HIV and the AIDS epidemics, the mortality consequences of the exponential increase in HIV prevalence in SA over the 1990s are more or less matter-of-fact over the coming decade.

There also appears to be agreement amongst researchers that an effective vaccine is unlikely to be developed within the next 8 to 10 years. Even existing successful anti-retroviral therapy (ARV), which prolongs the life expectancy of infected individuals, is unlikely to be implemented in SA on a large scale due to financial and infrastructure constraints (Abt Associates, June 2000). *Finally*, predictions of the number of AIDS deaths made in the early 1990s are now being realised (Metropolitan ARU, Business Day, 7 August 2001). In short, there seems to be a close correlation between the available empirical information and what the researchers are telling us. This is enough of a platform to proceed in analysing the economic impact.

The demographic imperatives are critical to the economic impact of the HIV/AIDS epidemic, both in terms of how the economy's production potential is affected and the cost implications of combating the disease. A number of key demographic dimensions of the epidemic, in view of the specific profile of the SA population, are particularly relevant to the economic impact.

Salient features of SA's HIV/AIDS demographics

The broad characteristics of the HIV/AIDS situation in SA were discussed in the previous BER research note on the topic (June 2000). These are summarised below, including new information, which has since emerged. Thereafter the key demographic projections contained in the Abt/Metropolitan study are discussed, including reference to the ASSA2000 results where necessary.

SA's two HIV/AIDS models

Whilst a number of demographers have constructed population projections including the impact of HIV/AIDS (IFR, 2000; BMR, 1999), only two recognised HIV/AIDS models exist in South Africa, which attempt to project the demographic impact of the epidemic by both modelling the spread of HIV/AIDS and accounting for the demographic imperatives. The one model, developed by the Actuarial Society of SA (ASSA), actually originated from the other model, i.e. the Doyle-Metropolitan model, proposed by Doyle and Millar in 1990. The crux of both these models is the notion that the epidemic moves through the population via the sexual interaction between and within 4 defined risk groups:

⇒ commercial sex workers and their clients;

⇒ people with a high incidence of sexually transmitted diseases (STD's), which substantially increases the probability of HIV transmission;

⇒ people with normal HIV risk; and

⇒ people not at risk of being infected.

Both models therefore focus on heterosexual transmission of infection only, which is by far the most common in SA; other modes of transmission (homosexual sex, intravenous drug abuse, contact with blood or blood products) account for a very small proportion of all infections. The way the models operate is by injecting a small number of infected males and females from outside into the high-risk group, which then multiply between people in this and the other risk groups. Depending on the methods, assumptions and the various input parameters (e.g. probabilities of infection, relative fertility rates, the median term to death of an HIV+ person, the rate of perinatal infection, etc.), projections of the epidemic will differ. Whilst these aspects differ between the two models, particularly in the way sexual behaviour is modelled, both models are calibrated to fit known HIV data, which means the model results correspond with actual HIV/AIDS statistics. For this purpose antenatal-care (ANC) clinic data on the HIV prevalence of attending pregnant women serve as the most reliable reference. However, the ASSA2000 model has also been calibrated to fit the latest (1999/2000) mortality data released by the Department of Home Affairs. *The key approaches/ assumptions contained in the two sets of HIV/AIDS demographic projections considered in the present study are highlighted below.*

Abt/Metropolitan ARU assumptions

A study on the demographic impact of HIV/AIDS in SA (June 2000), conducted by Abt Associates and the Metropolitan Aids Research Unit (ARU) for the Department of Finance, relied on the Doyle model. The Doyle model is proprietary to Metropolitan Life and is described as a "*… model combining features of a macro-simulation model and a micro-simulation programme*." The idea is to model the epidemic on a micro level, i.e. sub-epidemics in sub-population groups (with unique age, gender and racial profiles) and then to aggregate to the provincial, regional or national level. Combined with the macro features of the model, reliable medium- to long-term projections can be generated. Key approaches/ assumptions used in the Abt/Metropolitan study, include:

- The model was calibrated to reflect the underlying profile of the SA population and available epidemiological data on HIV/AIDS from SA and other countries.
- Independent provincial projections were compiled and within each province separate projections were made for each race, age and gender group.
- The shape of the epidemic curve within different population groups is assumed the same for each province, however, the starting time of the epidemic is different between provinces estimated from the ANC clinic HIV prevalence data. In a "worst-case scenario", the future course of the epidemic in each province is assumed to follow that of KwaZulu-Natal (KZN) having the most longstanding and probably most accurately

ASSA2000 assumptions

The ASSA model started out as a simplified spreadsheet version of the Doyle model, however, is currently acknowledged as having overtaken it in terms of sophistication. The original version (ASSA500) modelled a hypothetical black population, but has been updated and refined on two occasions, i.e. ASSA600 constructed in 1998 and the latest version, ASSA2000. Apart from incorporating the latest epidemiological information, key advances in the later versions include: allowance for migration; modelling the racial and provincial population groups separately; disaggregating the 'contagion matrix' into more measurable and controllable sexual behaviour patterns (in turn facilitating analysis of interventions/behavioural change); an improved fit to the ANC survey data as well as calibrating the model to the most recent estimates of mortality; and a number of other refinements. ASSA2000 actually consists of a suite of models. The provincial projections are still subject to finalisation. The ASSA projections referred to in this study pertain to the "full version" of the model, modelling the 4 racial groups and for which results have been released; key assumptions include:

- A significant result from the ASSA2000 study is the fact that the shape of the epidemic appears not to be the same for all the provinces. KwaZulu-Natal, the Western and Northern Cape and the Northern Province appear to experience decidedly different epidemics (e.g. contrary to the assumptions in the Abt/Metropolitan study).

measured epidemic in SA. In this scenario, HIV prevalence of black women attending antenatal clinics in KZN is projected to peak at 40% around 2010.

- National and provincial populations were derived from the 1996 census; skill level profiles were based on the 1996 census and 1995/97 OHS's.
- Mortality and fertility rates were derived from Dorrington and Sadie, Udjo and Dorrington respectively; future non-HIV mortality rates were assumed to remain constant and fertility rates to continue declining over time.
- Incubation period: a median of 8,5 years; median life expectancy of AIDS victim, one year; the survival times of infected people vary with age.
- No allowance was made for significant interventions and/or behavioural change that could alter the course of the epidemic. However, a "best-case scenario" was prepared, in which the sexual behavioural parameters in the model were altered; these projections were not used in the present study of the economic impact.
- Mother-to-child HIV transmission rate of 30%;
- Fertility of HIV+ women 30% lower than for uninfected women, however differentiating in terms of age.
- No allowance was made for migration.
- The base population was derived from a re-estimation of the 1996 census population (Dorrington, 1999), which is regarded as being too low; this is different to the Abt/Metropolitan study.
- The proportions in the risk groups vary by population group and province; on average these are as follows: the high risk group 1%; the group with high STD incidence, 20%; the normal HIV risk group 30% and the remainder (49%) not at risk of infection.
- Non-HIV mortality and fertility rates (1985-99) were set in line with the re-estimation of the 1996 census population (Dorrington, 1999); after 1999 rates trended, logistically, to the ultimate rates provided by the US Census Bureau.
- The median term to death for an infected person was set at 11 years for ages 24 and below; 10 years for ages above 24.
- Allowance was made for migration, which accelerated sharply over the early 1990s, however, levelling-off since 1996 and projected to trend to zero over 30 years.
- Figures for condom usage per population group were obtained from the Department of Health's Demographic and Health Survey (1999) and applied to derive usage figures per risk group.
- Probabilities of HIV transmission for the higher risk groups are chosen so as to maximise model fit; in the ASSA600 model the probability of becoming HIV infected in any particular year ranged from above 80% for the high-risk group to zero for the group not at risk.

Population growth & size. Given the current estimated size of the HIV infected population in SA of between 4-6 million and the almost 100% probability that an infected individual (with a median life expectancy of around 10 years) will die, the epidemic's implications for population size and growth are pretty stark. According to ASSA estimates of the impact on mortality, the probability that a 15-year old will not reach the age of 60 increases from 30% to 75% due to HIV/AIDS. Put differently, this implies that around 45% of adults in the country will ultimately become infected with the HIV virus! (Dorrington, 2001).

Both the ASSA and Abt/Metropolitan projections indicate that the total growth in the SA population could amount to a mere 1,5 million people between 2000 and 2015, i.e. more or less 10 million people short compared to a no-AIDS projection *(see charts 1 & 2)*. The more detailed projections are discussed below *(see table 1)*.

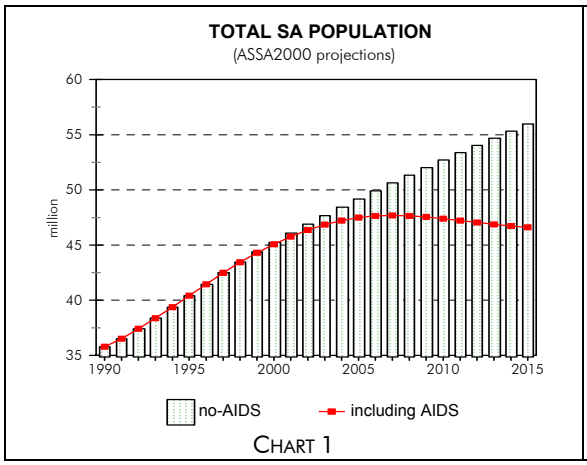

CHART 1

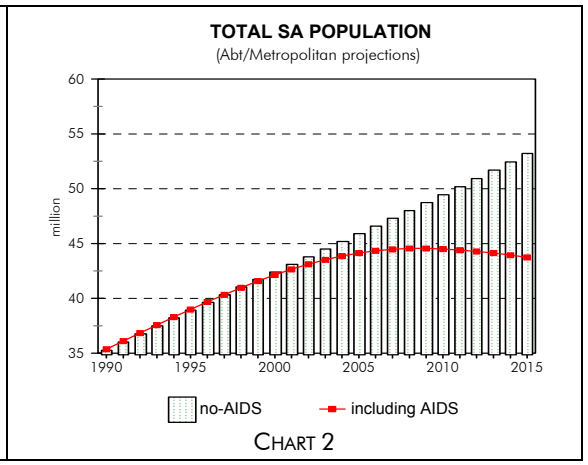

CHART 2

Age & gender: The epidemic has a disproportional impact on the working age population, particularly the ages 20 to 50. According to Abt/Metropolitan, the addition to SA's labour force (estimated at 14,4 million in 2000) could amount to a mere 420 000 people between 2000 and 2015 due to the impact of HIV/AIDS. For men, peak prevalence occurs in the ages 20 to 45, i.e. the prime productive years. HIV prevalence is, relatively, 10-20% higher for women compared to men[6] and peaks at younger ages, between 15 and 35, i.e. the fertile and - to some extent - productive years; the negative impact on fertility obviously has further negative implications for population growth. The main impact of AIDS and AIDS deaths is expected in the 30 to 40-year age group.

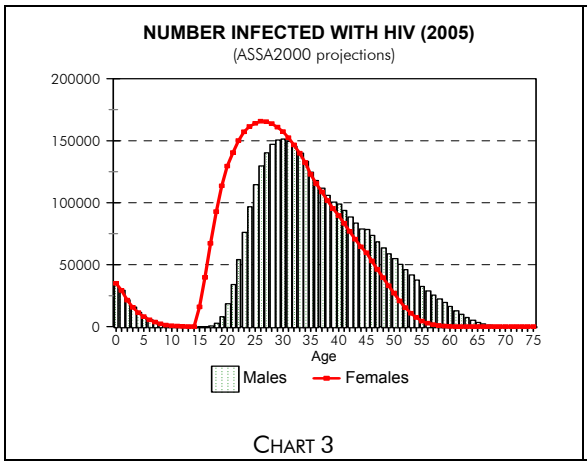

CHART 3

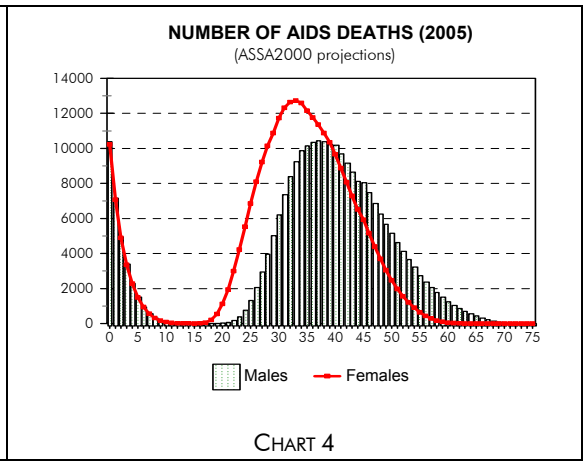

CHART 4

Finally, infant mortality is projected to double by 2010 due to a 30-40% chance of vertical mother-to-child HIV transmission (through birth or breast-feeding). The latest ASSA projections show that the number of surviving maternal orphans (under the age of 15) are

[6] Dorrington (2001) cites data showing little difference in HIV prevalence amongst employed men and women in the age band 18 to 39 for 2000. Generally, infection levels are lower for the employed versus the unemployed.

projected to grow from 360 000 (mid-2000) to close to 3 million by 2010 (Dorrington, 2001); Abt/Metropolitan's estimates are slightly more conservative.

Race: Racial prevalence is heavily skewed, with blacks generally having much higher infection levels compared to whites, asians and coloureds. The latter mentioned population groups are under represented in the ANC survey data, however, insurance data and data collected from the private sector indicate that the higher job grades have prevalence of between 2,5% and 3% (Dorrington, 2001). This data was taken into account in fitting the epidemic curves for the white and asian population groups to the available ANC survey data in the ASSA2000 study[7]. Based on race-specific assumptions (e.g. sexual behaviour, probabilities of transmission, mortality, fertility, migration, etc.), the ASSA2000 model projects prevalence rates to peak at 3,24% (2011) for the white population group, 4,8% (2010) for asians, 6% (2010) for coloureds and 19,5% (2006) for blacks. Given the size of the black population group, it is clear that the HIV/AIDS population is and could remain predominantly black in SA.

In addition to the black population group sharing the African experience, this group also represents the previously disadvantaged in SA, suffering the most under the apartheid system. Apartheid wrecked black family life, dislocated black people, enforced a system of migrant labour, entrenched poverty and stifled the process of skills development for this group, all factors which tend to exacerbate the spread of the disease.

Skills and income: While strong evidence exists in some African countries that infection levels increase in line with socio-economic status, the balance of evidence in SA tends to reflect the opposite (Abt/Metropolitan, June 2000; Dorrington, 2001); lower skilled (and income) people tend to have higher prevalence than the higher skilled (and better paid). This does not reflect racial factors only. Dorrington highlights the fact that the available information shows a particular steep downward gradient in infection levels as we move from the semi-skilled job categories to middle and senior management level amongst blacks; in fact, it appears that HIV prevalence could be independent of race at senior management level.

According to the Abt/Metropolitan study, 7,2% of the highly skilled workers were HIV positive in 2000; 12,1% of skilled workers and 14,3% of semi- and unskilled workers *(see footnote 11 for the skills classification)*. Furthermore, the unemployed reveal up to 30-50% higher infection levels compared to the employed, partly related to the large share of the young

[7] Dorrington (2001) points out that, apart from the case for the black population group, the epidemic curves fitted for the white, asian and coloured population groups are less than satisfactory due to the scarcity of data.

and females amongst the unemployed. More detailed projections are discussed and provided below *(see table 3)*.

It needs to be emphasised that these aggregated figures could conceal important sectoral deviations from the average. Certain economic sectors are known to have above-average infection levels, due to the nature of the work and/or the demographic profiles of the workforces, e.g. mining, transport, construction, tourism and entertainment.

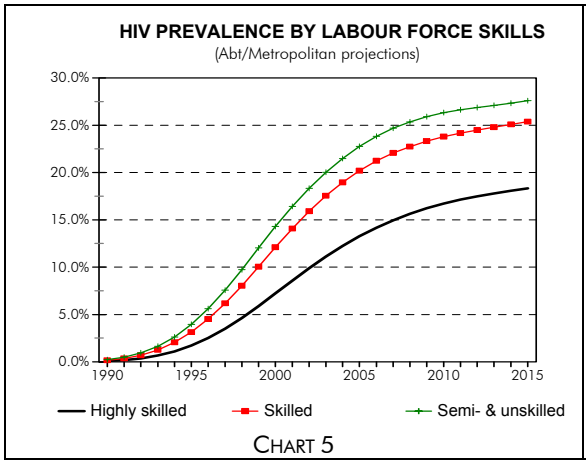

CHART 5

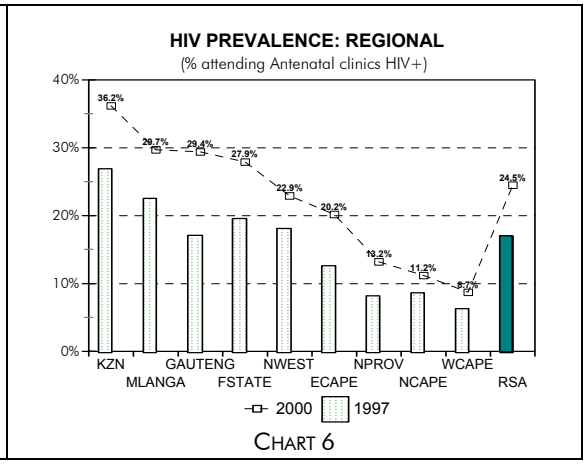

CHART 6

Regional: The provinces with the highest prevalence are KwaZulu-Natal (36,2% of pregnant women attending ANC clinics in 2000), Mpumalanga (29,7%), Gauteng (29,4%) and Free State (27,9%); the Northern Cape (11,2%) and the Western Cape (8,7%) have the lowest prevalence. Whilst it was previously assumed that all the provinces have a similar epidemic curve (only with different starting points), the latest information and analysis indicate that four provinces could have decidedly different epidemics (revealing different patterns compared to each other and that of the country as a whole), namely KwaZulu-Natal, the Northern Province, the Northern Cape and the Western Cape. The latter mentioned three provinces, in particular, are expected to experience milder epidemics with ANC prevalence projected to plateau at around 18% compared to 40% in KwaZulu-Natal (Dorrington, 2001). *Finally*, prevalence in urban areas tends to exceed that of rural areas, albeit that SA's well-developed transport infrastructure tends to reduce these differences[8].

[8] Dorrington (2001) discovered a possible upward bias in the pre-1998 ANC survey data due to the fact that the centres were predominantly based in urban areas. From 1998, the Department of Health introduced a new protocol and the number of rural centres increased. The upward bias in the ANC survey data seemed to have disappeared in the 1999 and 2000 surveys as the number of rural centres increased and the urban-rural difference in prevalence levels receded.

Projections to 2015.

Whilst the salient features of SA's HIV/AIDS demographics were discussed in relation to age, gender, race and province above, the projections of these sub-populations do not receive detailed attention below. Key to the econometric model input at this stage is, *firstly*, the projected overall population size and infection levels; and - more importantly - the projected labour force and infection levels by skills category. These are discussed below.

General population. Estimates of the current HIV positive population vary. According to the Abt/Metropolitan study, the number is 3,8 million people (at the start of this year); the ASSA estimate is 5,9 million (mid-year)[9]. Alternatively, between 9% and 13% of the total population in SA is currently infected with the HIV virus, having increased from almost zero in 1990[10]. These prevalence rates are projected to increase further; according to the Abt/Metropolitan study, to 15,1% by 2015 (or 6,6 million people), the increase levelling off from around 2008. Chart 7 shows how the ASSA2000 epidemic curve differs from that of Abt/Metropolitan; HIV prevalence increases sharply, peaking at 16,2% in 2006 (i.e. 7,7 million people) and declining to 13,5% (6,2 million people) by 2015.

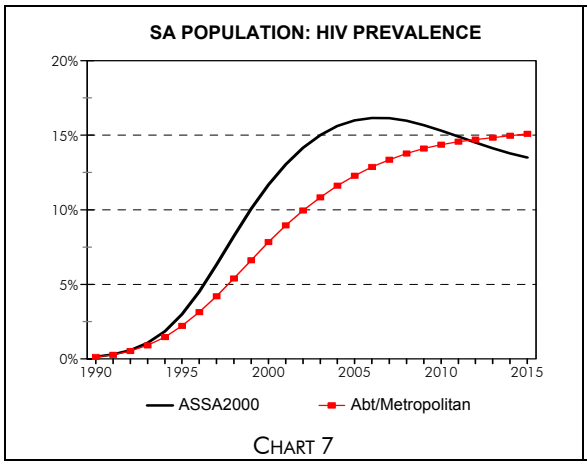

CHART 7

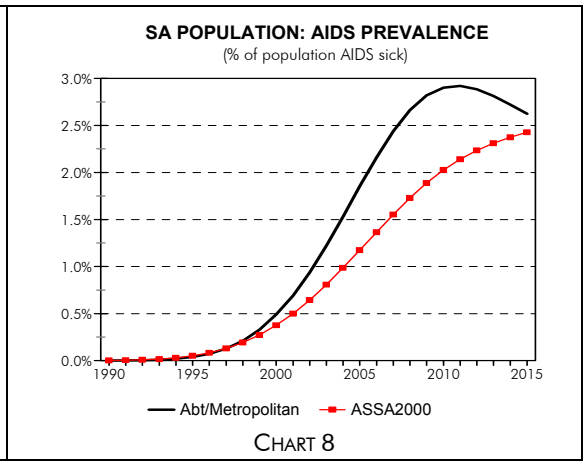

CHART 8

The AIDS epidemic lags that of HIV *(see chart 9)*; Abt/Metropolitan projects the number of people suffering from full-blown AIDS to increase from 158 250 in 2000 to 518 000 by 2005 and 1,06 million by 2015; the corresponding ASSA2000 numbers are 879 000 (2005) and 1,2 million (2015) respectively. According to ASSA, AIDS prevalence is projected to peak in 2011 (2,9% of the population), five years later than the peak in HIV prevalence.

[9] This compares to the Department of Health's official estimate of 4,7 million people being HIV infected in 2000.

[10] It should be noted that the two models' population estimates for 2001 also differ.

Table 1: The impact of HIV/AIDS on SA's general population: 2000 to 2015

	Population (millions)		Infected with HIV		AIDS deaths	AIDS sick	
	no-AIDS	Incl. AIDS	Number	%		Number	%
2000	42,4	42,1	3 299 817	7,8%	121 311	158 247	0,4%
2005	45,9	44,1	5 422 496	12,3%	371 209	518 058	1,2%
2010	49,5	44,5	6 393 424	14,4%	613 884	901 394	2,0%
2015	53,2	43,7	6 602 904	15,1%	708 880	1 061 704	2,4%

Source: Abt Associates/ Aids Research Unit Metropolitan Life (June 2000)

From an estimated 121 000 AIDS deaths in 2000, this number is projected to increase sharply over the coming years, to 371 000 in 2005, 614 000 in 2010 and 709 000 in 2015 (Abt/Metropolitan, June 2000). Not all people with AIDS die in any particular year, which explains the lower number of deaths compared with the number of AIDS sick in any particular year.

Due to the negative impact of HIV/AIDS on mortality and fertility, Abt/Metropolitan projects the population growth rate to decline from 1,35% in 2000 to zero in 2009 and then to -0,46% in 2015. From an estimated 42,1 million in 2000, the SA population is projected to peak at 44,5 million in 2009, declining slightly to 43,7 million by 2015 *(see table 1)*. According to ASSA, the population peaks in 2007, also declining slightly thereafter.

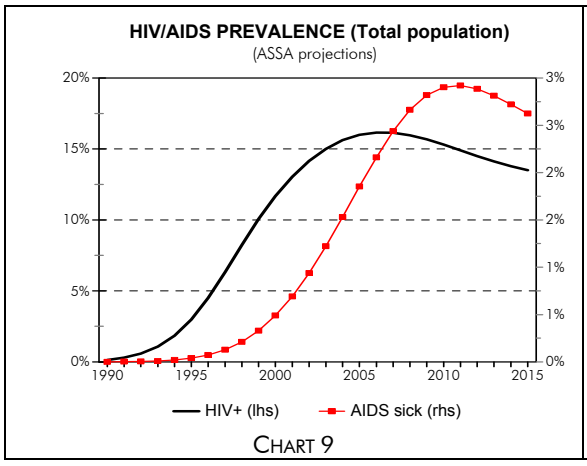

CHART 9

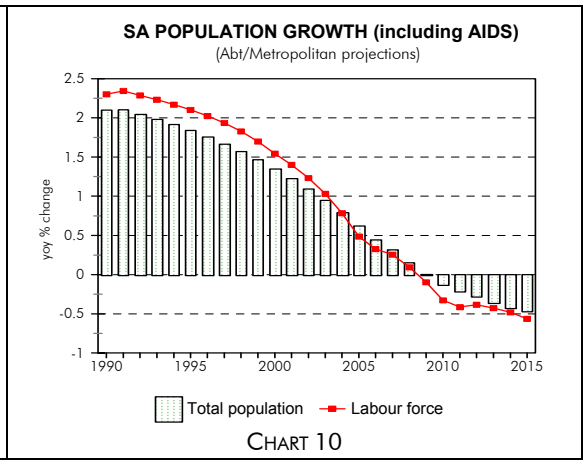

CHART 10

Labour force by skills[11]. Table 2 above shows the structure of the SA labour force as estimated at the time of the 1996 census. The table shows that more than 60% of the SA labour force comprises semi- and unskilled labour, 28% skilled labour and 10% highly skilled

[11] The skill categories are defined according to the 1996 census classification. Highly skilled occupations include professional, semi-professional and technical occupations; managerial, executive and administrative occupations; certain transport occupations (e.g. pilot, navigator). Skilled occupations include clerical, service and sales occupations; farmers, farm manager; artisan, apprentice and related occupations; production foreman, production advisor. All other occupations are defined as either semi- or unskilled.

labour *(see footnote 11 for the skills classification)*. A large proportion of the semi- and unskilled labour force is unemployed (41%) known to be at higher risk of being infected by the HIV virus. Furthermore, 7-8% of the various skills groups are employed in the informal sector. Of the formally employed, 17% occupy highly skilled jobs; 38% skilled and 45% semi- and unskilled jobs.

Abt/Metropolitan (June 2000) draws the attention to the fact that a very small "reserve pool" of highly skilled and - to a lesser extent - skilled workers exist in SA; quite the opposite is true regarding the semi- and unskilled labour force. These characteristics of the labour force are pertinent in view of the economic consequences of the AIDS epidemic.

Table 2: The structure of SA's labour force (1996)[1]

	Highly skilled		Skilled		Semi & unskilled		TOTAL
Economically active	number	%	number	%	number	%	Number
Formally employed	1 300 009	92,1	2 899 334	76,5	3 509 890	40,9	7 709 233
Informally employed	100 177	7,1	289 901	7,7	710 223	8,3	1 100 301
Unemployed	11 148	0,8	598 083	15,8	4 366 238	50,8	4 975 469
TOTAL labour force	1 411 334	100	3 787 318	100	8 586 351	100	13 785 003
Composition (%)	10,2%		27,5%		62,3%		100%
Economically inactive[2]							11 319 353
Potential manpower[3]							25 104 356

[1] See footnote 11 for a classification of the three defined skills groups. 2: Mainly students, the disabled, retired people and housewives (ages 15-64). 3: Population aged 15 to 64 (i.e. 62% of the total; 34% of the population was under 15 years of age and 4% 65 and older in 1996).
Source: Statistics SA: Census 1996; Abt Associates/ Aids Research Unit Metropolitan Life (June 2000)

Table 3 shows that all skill categories are affected by the HIV/AIDS epidemic. For highly skilled workers prevalence is projected to increase from 7,2% in 2000 to a peak of 18,3% in 2015, the increase tapering off over the last part of the projection period. This is a high infection rate, implying that close to 1-in-5 highly skilled workers could eventually become infected.

One factor explaining this high prevalence is the fact that this group includes a large number of nurses and teachers and both professions having a large black component. To the extent that the racial HIV profile exaggerates the skills HIV profile (the downward gradient in blacks' prevalence levels up the skills ladder was noted above), an upward bias could be present in the projected prevalence of highly skilled workers[12]. From a sectoral perspective,

[12] The skills HIV profiles were derived from overlaying the available 1996 census data with age, gender and racial HIV profiles per province; the historical skills data, which served as input into the Abt/Metropolitan (June 2000) study, were supplied by Dr C van der Merwe of Quantec. However, an analysis of primary prevalence data according to socio-economic (or skills) group and by sector is required before the final word can be spoken in this

however, this may be a more accurate reflection of prevalence levels in the highly-skilled government sector, explaining the projections; in this case, prevalence is likely to be lower in the non-government sector than those shown for highly-skilled workers in table 3 below.

HIV prevalence for skilled and unskilled workers is projected to increase from 12,1% and 14,3% respectively in 2000 to 25,4% and 27,6% in 2015. Not shown in table 3, is prevalence for the unemployed, projected to increase to well above 30% due to a predominantly young, black and female profile.

Table 3: The impact of HIV/AIDS on SA's labour force: 2000 to 2015

	Labour force (millions)		HIV prevalence (%)			AIDS prevalence (%)		
	no-AIDS	Incl. AIDS	highly skilled	Skilled	semi- & unskilled[1]	highly skilled	skilled	semi- & unskilled[1]
2000	14,5	14,4	7,2%	12,1%	14,3%	0,3%	0,5%	0,6%
2005	15,8	15,1	13,3%	20,2%	22,8%	1,4%	1,9%	2,2%
2010	17,2	15,1	16,7%	23,8%	26,3%	2,7%	3,5%	3,9%
2015	18,7	14,8	18,3%	25,4%	27,6%	3,5%	4,2%	4,7%

[1] Including jobs not classified in the 1996 census; see footnote 11 for the skill classification.
Source: Abt Associates/ Aids Research Unit Metropolitan Life (June 2000)

Corresponding to the projected HIV profile, the shares of the skills groups suffering from AIDS reflect the same gradient between the skills categories. Compared to 2,7% of the highly skilled labour force projected to suffer from AIDS by 2010, this share could be 3,5% and 3,9% in the case of the skilled and unskilled labour forces respectively.

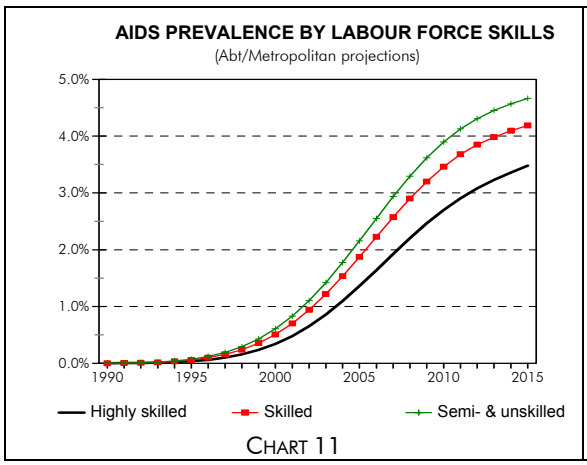

CHART 11

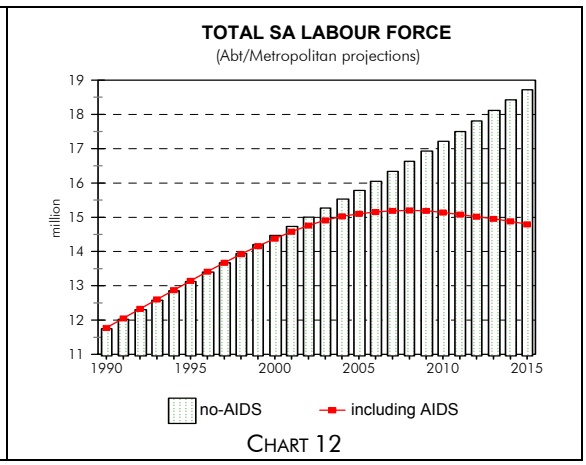

CHART 12

In all, the total labour force is projected to be close to 21% lower by 2015 compared to a no-AIDS scenario (chart 12), the overall size of the labour force remaining almost stagnant over the next 14 years *(see table 3)*. The Abt/Metropolitan projections show that the difference

regard. It is clear that more research is necessary; high-skills prevalence levels is a key issue regarding the macro-economic impact of HIV/AIDS.

between an AIDS-inclusive and no-AIDS labour force by 2015 could be 16,8% in the case of highly skilled workers, 19,3 % for skilled and 22,2% for semi- and unskilled workers.

THE MACRO-ECONOMIC IMPACT CHANNELS AND THE KEY ASSUMPTIONS

For the purpose of the econometric modelling of the macro impact, we decided to combine the highly skilled and skilled labour forces (and employed). A distinct feature of the SA labour force is the relatively small "reserve pool" of skilled people, compared to the huge pool of unemployed semi- and unskilled workers. As noted above, this factor has an important bearing on the economic impact of HIV/AIDS; whilst semi- and unskilled workers can relatively easily be replaced at low cost, this is decidedly not the case for skilled and highly skilled workers. Furthermore, prevalence is also lower for the skilled and highly skilled workers compared to the unskilled. Combining the two skilled categories was thought not to materially affect the modelling results; however it is important to differentiate between the medium- and high skilled labour force (and employed) on the one hand and the semi- and unskilled labour force (and employed) on the other.

The macro-econometric simulation exercise to model the impact of HIV/AIDS is a complex one. We approached this problem identifying key macro-economic impact channels, in turn, analysing the impact of each of these independently after making the necessary assumptions and then to combine the model for final (aggregated) simulation results. Five broad economic impact channels, some containing more detail, were identified:

- A lower overall population and labour force, affecting both the production side (the economy's production potential) and the expenditure side of the economy (final household consumption, residential fixed investment and the demand for government services).
- Direct costs to the private business sector, e.g. increased contributions by firms to their employees' pension, life, disability and medical benefit schemes.
- Indirect costs to the private business sector, e.g. firms having to face the costs associated with increased absenteeism, training, recruitment, etc. Reduced labour, as well as multi-factor productivity, could be another indirect cost to firms due to the impact of the epidemic.
- Higher government expenditure due to the increased direct and indirect costs (similar to the case for business as noted above), the increased demand for public sector health services and the orphan legacy of the HIV/AIDS epidemic.
- *Finally*, households are likely to face additional out-of-pocket spending on health care products and services (i.e. costs not covered by medical schemes), as well as for funeral services.

Each of these economic impact channels is discussed below, including the assumptions we made to facilitate the analysis.

LOWER POPULATION AND LABOUR FORCE DUE TO LOWER FERTILITY AND AIDS DEATHS

An overriding impact of the HIV/AIDS epidemic is the absolute decline in the population size compared to a no-AIDS scenario. The previous section highlighted the salient features of this demographic impact; the population growth rate is projected to decline dramatically over the coming decade; the working age population is more vulnerable, women are more vulnerable than men and at younger ages; infection levels are higher for the unskilled than for the skilled and blacks are disproportionately affected; and the epidemic is different in the various provinces, with KwaZulu-Natal having the most advanced and possibly the most serious epidemic, closely followed by Mpumalanga, Gauteng and the Free State.

The impact on population growth is dramatic to say the least and even more so for the working age population. One has to assess how much of this demographic impact will be transferred to the economy. The lower population and labour force have implications for both the production and the expenditure sides of the economy *(see below)*. However, before these are discussed, attention first focuses on some assumptions and the approach we adopted to gauge the direct impact on final household consumption expenditure (FCE), accounting for the income distribution profile of households. Private residential fixed investment and the demand for government services are also directly exposed to the lower population due to HIV/AIDS.

Assumptions: final expenditure components of GDP

The lower population number has direct implications for three important final expenditure categories, namely FCE, government consumption expenditure and private residential fixed investment. The HIV/AIDS impact on private residential fixed investment was modelled by including a population variable in the econometric function; considering the fact that the working age population could remain almost stagnant over the coming 10 to 15 years, the impact on residential fixed investment could be substantial[13]. Regarding government consumption expenditure, it is to be expected that, apart from the sharp increase in the demand for health services due to HIV/AIDS, the lower population number implies a reduced overall demand for government services, which should impact negatively on government

[13] The non-black population was used as the demographic variable; this provided a better model fit compared to the total population and accounts for the fact that a large proportion of AIDS deaths is unlikely to directly spill over to declines in residential investment, particularly in the private sector. This implicitly assumes that AIDS mortality amongst home-owning blacks is similar to that of non-blacks, which could be a reasonable assumption.

employment. As government employment (and final consumption) is exogenous in the model, we had to make an assumption on the impact due to the lower population. The decline in government employment was set at 50% of the decline in the non-government labour force (differentiated between the two skills categories), assuming that half of the government workers lost due to AIDS is replaced from unemployed and other sources[14]. The increase in the demand for public sector health services, on the other hand, is discussed below *(see page 24)*.

Regarding the impact of the lower population on FCE, the following issues are of note:

- One has to account for a positive per capita income effect, as the decline in incomes is likely to be less serious than the decline in the population due to AIDS. In the unskilled categories of labour (which are disproportionately infected), a worker lost due to AIDS could, in particular, be replaced more easily and at a lower cost from unemployed resources. This implies that economic production and income is not fully exposed to the impact of the deceased worker. (We return to the costs accompanying the replacement of workers lost due to AIDS – *see page 22 below*.)
- Furthermore, the assets of the deceased could be liquidated and shared by the surviving family members/relations, which should counter the negative impact on spending power (albeit a possible negative impact on savings). This factor will be more pertinent but not restricted to the wealthier consumers/higher income earners.
- *Thirdly*, higher HIV infection levels among lower income earners suggest a less than proportional decline in spending power due to AIDS deaths in these income groups. Conversely, AIDS deaths within the higher income groups could have a disproportional negative impact on FCE; furthermore an analysis of spending patterns indicates that higher-income consumers tend to consume higher value-added products and services.

We accounted for these factors in the following way. Consumption functions were constructed for each of the four main components of FCE, driven mainly by various after-tax income variables and interest rates. In the econometric model, household consumption is therefore dependent on income rather than demographic variables, which distorted the economic impact when included as explanatory variables in the consumption functions. Whilst the consumption functions (indirectly) accounted for the demographic impact via a reduced wage bill (in turn related to a lower labour force and employment levels), the reduction in consumption levels tied to deaths amongst the "unemployed" (or extended family dependants)

[14] The government wage bill contributes around 60% of total government consumption expenditure.

remained unaccounted for. Furthermore, as noted above, the income distribution of the deceased had to be taken into account. The following method was applied:

- *Firstly*, no-AIDS projections of the four main FCE components were made using the aforementioned consumption functions in the BER econometric model. Then the FCE components were disaggregated into its racial components using racial FCE data supplied by Quantec (2001) for the period 1970-2000. The historic racial household expenditure structure (assumed to reflect a no-AIDS consumption pattern) was extrapolated into the future, making some adjustments for the latter part of the forecast period.
- *Secondly*, for each population group, the deviation between the AIDS and no-AIDS projected populations were calculated and weighted for each year using racial income distribution data (produced by the SA Advertising Foundation, 1998). For this part of the impact, we therefore implicitly assumed income distribution patterns to remain unchanged over the projection period[15].
- *Thirdly*, AIDS inclusive projections of the racially disaggregated sub-components of FCE were calculated by applying the income-weighted deviations between the AIDS and no-AIDS population groups and then aggregating the resulting FCE projections by population group. The percentage deviation between the AIDS and no-AIDS projections of real household expenditure on non-durable and semi-durable goods was higher due to the greater exposure of these sectors to black consumers. However, the higher share of blacks in the lower income groups countered this factor, reducing the differential impact between the four main components of FCE.
- *Finally,* the absolute differences between the AIDS and no-AIDS projections of the FCE components, adjusted for the unemployed share of the labour force, entered the model as add factors in the respective consumption functions.

Whilst not fully accounting for possible changes in the income distribution pattern as a result of the AIDS epidemic, this analysis indicated a rather muted impact on overall FCE, the deviation between the AIDS and no-AIDS projections of the major FCE components ranging between 2%-2,5% in real terms by 2015. This is a conservative assumption (of the impact on FCE from the lower population *per se*) and excludes the impact on FCE from lower disposable

[15] This is an unrealistic assumption as the income distribution under an AIDS scenario is expected to change. Modelling the impact of the lower population number compared to a no-AIDS scenario on income distribution patterns (using WEFA's Social Accounting Matrix), the ING BARINGS/WEFA study (October 2000) showed that the share of higher-income households increase while that of lower-income households decline over time as a result of the epidemic. The durable goods and services sectors benefit from the per capita increase in average incomes.

income, in turn related to lower employment levels due to the epidemic; this impact was simulated endogenously in the model and is discussed in more detail below.

Macro-economic effects

- Potential GDP[16], which is determined by the supply of labour, capital and technology, will be substantially lower due to the adverse impact of HIV/AIDS on the labour force[17]. Similarly, actual GDP will also be lower as a result of lower levels of employment. However, since the adverse impact of the epidemic on the labour force, and hence potential output, outweighs the negative impact on actual output, the gap between actual and potential GDP declines. This implies an increase in capacity utilization in the economy, which puts upward pressure on prices. Given the government's monetary policy of inflation targeting, this exerts upward pressure on interest rates, which constrains domestic demand and investment.
- Our model results indicate that HIV/AIDS would reduce the supply of available workers to such an extent that skilled and unskilled unemployment rates would decline, putting upward pressure on wage rates. Higher wage rates, in turn, reduce the demand for labour.[18] Since the drop in employment more than counters the increase in wages, aggregate household income declines. As personal disposable income is the most important determinant of private consumption expenditure, lower consumer income translates into lower consumer spending.
- Apart from this wage/employment induced impact on consumption expenditure, the impact tied to the reduction in the absolute number of consumers due to AIDS (and the associated assumptions) were discussed above; likewise regarding the lower demand for housing and government services and other government spending (e.g. pensions, education and welfare spending). Opposed to the impact from a lower population, government will experience an increase in demand for its health care services due to HIV/AIDS – *see page 24*.

[16] Potential GDP gives an indication of an economy's production potential or *production possibility frontier*. In the BER econometric model, potential GDP is calculated with a Cobb-Douglas production function as the maximum output obtainable with the supply of labour (differentiating between skilled and unskilled labour), the non-government fixed capital stock and total factor productivity. This concept of the potential GDP as the level of aggregate output achievable with the maximum utilisation of production factors has to be distinguished from the more modern formulation being closely related to the trend GDP growth rate.

[17] The coefficients in the production function are such that a change in the skilled labour supply has a significantly stronger impact on potential GDP compared to the impact of a change in the unskilled labour supply.

[18] Our analysis indicated that the increase in wages for skilled workers (and hence the decline in skilled employment) would be more pronounced than that for unskilled workers, as skilled wages are more sensitive to changes in unemployment rates (i.e. the availability of workers) than unskilled wages.

In all, the negative effects of a smaller population and labour force on final consumption expenditure, investment and government consumption expenditure is enough to ensure a substantially lower GDP than could have been possible in the absence of HIV/AIDS.

DIRECT COSTS OF HIV/AIDS TO THE PRIVATE SECTOR

Assumptions

AIDS related illnesses and deaths of managers, employees and their family members will have a significant impact on business. It is expected that companies will need to increase their contributions to pension, life, disability and medical benefits on account of the AIDS epidemic. While it is certain that the AIDS epidemic will lead to an increase in the cost of providing benefits for most companies, it is difficult to determine the magnitude of these direct costs to companies over an extended period of time. The reason for this is that some companies will attempt to shift a large proportion or even or all of the increased benefit costs to employees. Should companies succeed in restructuring their risk benefits so that employees carry a larger share of the responsibility, a proportion of the direct costs of HIV/AIDS will be absorbed by employees who will have to increase their own benefit contributions (and hence reduce their personal savings or expenditure on other consumer products and services), accept lower benefits or opt out of schemes altogether.

The AIDS Research Unit of the Metropolitan Group projected that the cost of an average set of employee benefits could double by 2005 and triple by 2010. Metropolitan estimated that, where companies have the full responsibility for the provision of benefits, these direct cost increases could add approximately 15% to the (no-AIDS) salary and wage costs of an average manufacturing company by 2005 and around 30% by 2010 (Quattek, 2000, 11-12). In May 2001, Stephen Kramer (the manager of Metropolitan's AIDS Research Unit) noted that, based on current *expected* employee benefit structures, these direct cost increases could be lower. He suggested that direct cost increases could add 10% to salary and wage costs by 2005 and around 20% by 2010.[19] We decided to exclude semi- and unskilled labour from the direct cost calculations, as it is likely that many of these workers are not covered by medical and other benefits.[20] Since HIV/AIDS prevalence is lower for the skilled and highly skilled

[19] Amalgamated Beverage Industries (a company that bottles and distributes soft drinks in southern Africa) recently estimated that about 4% of their current salary expenses relate to HIV/AIDS costs such as contributions to pension funds, medical aid and funeral benefits, as well as recruitment and training costs. They projected that 8% (12%) of their salary expenses would go towards HIV/AIDS related costs by 2005 (2010) (Deutche Securities, 2000: 9).

[20] Only about 20% of South Africans are currently covered by employment-related health insurance (Abt Associates 2001: 16).

groups and it is conceivable that the cost of AIDS drugs and treatment could decline substantially, we proposed to use a more conservative estimate than that of Metropolitan - we assumed that, if companies were to have the full responsibility for the provision of benefits, direct costs would add around 5% to the (no-AIDS) remuneration costs of skilled and highly skilled employees by 2005 and 10% by 2010.[21] [22] It was assumed that 60% of the direct costs increases would be related to increases in the cost of medical benefits, while the other 40% of the cost increases would be related to increases in the cost of providing pension, life and disability benefits.

We assumed that companies would carry 50% of the direct (employee benefit) costs increases due to HIV/AIDS[23]. It was assumed that companies would pass 50% of their share of the wage cost increases on to its customers through price increases (producer price inflation), while the remaining 50% of their share of the cost increases be absorbed through a reduction in their operating surpluses (lower company profits).[24] Extra spending on direct AIDS-related costs by companies is balanced by an equal increase in private consumption expenditure.

Since it was assumed that companies would carry only 50% of the increases in the costs of employee benefits, employees would have to be responsible for the other half. In this respect it was assumed that households would finance 50% of their share of the direct costs from personal savings and the other half by reducing their expenditure on a number of consumer products and services.

Presumably, close to the full amount of the contributions by employers and employees to employees' pension, life, disability and medical benefits will eventually be paid out to employees and will be used to contract a range of products and services. We assumed that

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[21] AIDS prevalence rates in the skilled and highly skilled labour force were used to interpolate between 2001 and 2010. The additional cost was kept constant (at 10%) after 2010. This pattern corresponds to that of the epidemic; initially we will experience an escalating cost impact as AIDS prevalence increases, however, when the epidemic plateaus, AIDS-related costs should also stabilise.

[22] Our assumption that direct costs would add around 5% to the (no-AIDS) remuneration costs of skilled employees by 2005 implies that the wage (including benefits) of an average skilled worker (i.e. the total skilled wage & salary bill per worker per year) will be about R4 500 higher in real terms (2001 prices) by 2005 in the AIDS scenario compared to the no-AIDS scenario. Alternatively, should companies agree to carry all of the direct costs, extra benefit contributions by firms would amount to roughly R22 500 (in real terms; 2001 prices) per annum per HIV/AIDS infected worker in the skilled category. From this perspective, our assumption does not appear to be too conservative. The direct cost assumption was increased by 50% (i.e. 7,5% (15%) of the skilled wage bill by 2005 (10)) and used as an alternative in the sensitivity analysis discussed below *(see page 38)*.

[23] This implies a 2,5% increase in the skilled and highly skilled wage rate by 2005 and 5% by 2010. The SARB includes employers' contributions to pension, life, disability and medical benefits in their calculation of the compensation of employees in the national accounts. Higher contributions by employers therefore translate into higher remuneration (i.e. wage income) for employees.

60% of the extra direct costs to employers and employees due to HIV/AIDS would be spent on health-related products and services, while the other 40% would be spent by households in the normal fashion (i.e. on health-related and other goods and services). It was assumed that, initially, 40% of the *health spending* would go towards health products such as HIV/AIDS drugs (implying an increase in consumer spending on non-durable goods) and 60% towards medical care (implying an increase in consumer spending on services). However, since we expect the cost of HIV/AIDS drugs to decline in the future, it was assumed that the share of health spending that goes towards non-durable goods would gradually decline to 25% in 2010.

Macro-economic effects

- Higher contributions by employers to medical and other employee benefit schemes translate into higher wages for skilled employees. This reduces the demand for skilled labour, however, since the wage increase more than counters the decline in skilled employment, the aggregate wage bill (and hence household income) still increases. Total consumption expenditure is stimulated by the rise in consumer income. Spending on non-durable goods (e.g. AIDS medicine/drugs) and services (e.g. medical care) gain the most, as the largest part of the increase in the skilled wage rate stems from the disbursement of medical benefits. Although spending on durable and semi-durable goods also benefit from the increase in household income, this is countered by a shift in consumption expenditure, as it is assumed that households finance 50% of the increase in their benefit contributions by reducing their non-health care expenditure. Similarly, personal savings suffer from the increase in benefit contributions by households.

- Since we assumed that firms would be able to pass 50% of their share of the direct cost increases on to customers through price increases, producer price inflation is significantly higher. Given the government's inflation targets, this exerts upward pressure on interest rates. Corporate savings and investment also suffer, as a proportion of the higher wage bill is financed out of the operating surpluses of companies.
- The rise in consumer demand for medical care leads to an increase in imports, as a significant proportion of health care products and services are generally imported. In turn, exports should benefit from the real depreciation of the rand exchange rate – the exchange rate depreciates due to a worsening inflation differential and a rise in the current account

[24] ING Barings assumed that companies would carry two-thirds of the wage cost increases, of which 50% would be passed on to customers through price increases (Quattek, 2000: 12).

deficit. However, since the increase in imports outweighs the rise in exports, the trade balance deteriorates in the AIDS scenario.

In all, the AIDS-induced increase in final consumption expenditure (which constitutes more than 50% of GDP) is just enough to counter the decline in investment and the worsening trade balance, so that GDP increases slightly.

INDIRECT COSTS OF HIV/AIDS TO THE PRIVATE SECTOR

Assumptions

In addition to direct cost increases, indirect costs to companies may also rise. These costs include recruitment and training costs; the cost of increased labour turnover; lost skills; worker absenteeism due to illness or compassionate leave for workers to attend funerals and to care for sick family members; lower labour productivity due to physical disability, stress and reduced morale caused by the illness or death of friends, fellow employees and relatives; legal fees and time spent on negotiations between labour and management; as well as the costs involved in ensuring occupational health and safety standards (Laubscher, 2000: 11-13; Quattek, 2000: 11-12).

AIDS related illnesses and deaths of managers and other employees may also reduce overall productivity - or *total factor productivity*. Total factor productivity refers to "*efficiency improvements (or declines), which are not attributable solely to one or other of the two factor inputs (labour and capital), but rather to their combination in production*" (Parker *et al*, 2000: 17). Absenteeism, delays in finding replacement workers, disruption of teams, the loss of experience and skills and adjustment problems will increase the possibility of idle machinery and slow down production, thereby reducing the productivity with which capital and labour combine in the production process; this impact on firms' productivity is on top of the impact on labour productivity *per se*.

Some indirect costs are difficult to quantify and often accumulate for a long time before companies recognise their significance. Our assumption with regard to the indirect costs to the private sector is threefold:

- *Firstly*, we assumed a 40% reduction in the productivity of both skilled and unskilled workers sick with AIDS. This mainly affects the potential GDP, as the "effective" labour force is reduced due to the impact of AIDS on labour productivity. A reduction in labour productivity also reduces the demand for skilled and unskilled labour.

- *Secondly*, we explored the impact of a gradual reduction in the rate of total factor productivity growth to about 79% of what it could have been without AIDS - this 21% reduction in the rate of total factor productivity growth is based on the 21% reduction in the total labour force due to AIDS.[25]
- *Thirdly*, like ING Barings, we assumed that AIDS-induced indirect costs would increase employment costs to companies. Metropolitan estimated that indirect costs could add 10% to the remuneration costs of an average manufacturing company by 2005 and around 15% by 2010 (Quattek, 2000: 12). Since we already accounted for some of the indirect costs by reducing the effective labour force, we opted for a more conservative indirect cost estimate - we assumed that indirect costs would add around 5% to the (no-AIDS) remuneration costs of unskilled employees by 2005 and 7,5% by 2010. As some of these indirect costs are tied to increased economic activity and possibly employment (e.g. associated with recruitment and training), we added 20% of the indirect costs back in the form of increased employment. This should ameliorate the negative impact on GDP.

The aggregate indirect costs (calculated as a percentage of the remuneration of employees) to companies reliant upon skilled labour could be lower than the indirect costs of employing unskilled labour due to the lower HIV/AIDS prevalence among the skilled labour group[26]. Furthermore, skilled labour is more likely to be covered by health insurance, which would render HIV/AIDS drugs and medical care more affordable. The right kind of medical care (e.g. anti-retroviral treatment) may well prolong the life of an HIV infected employee, keeping the worker healthier, and hence more productive, for a longer period of time. It was therefore assumed that indirect costs would add only 2,5% to (no-AIDS) remuneration costs of skilled employees by 2005 and 5% by 2010.

We assumed that companies would be responsible for all of the indirect costs due to HIV/AIDS. It was assumed that companies would pass 50% of the costs on to its customers through price increases (producer price inflation), while the remainder would be absorbed through a reduction in their operating surpluses (lower company profits).

[25] The impact of HIV/AIDS on overall productivity is especially difficult to quantify and has been absent in many of the earlier macro-econometric analyses (e.g. the ING Barings study). Arndt and Lewis (2000: 10) did include this impact channel and linked their reduction in total factor productivity growth to the AIDS death rate for unskilled labour. According to their estimates, the rate of total factor productivity growth could be 50% lower by 2010 than would have been possible in the absence of AIDS (Arndt and Lewis, 2000: 9).

[26] The indirect cost per skilled worker infected by HIV/AIDS could, however, be larger than that for an unskilled worker, assuming skilled workers' contribution to production is higher than for unskilled workers.

Macro-economic effects

By reducing the effective labour force and total factor productivity, HIV/AIDS will have an adverse impact on the economy's production potential. Actual GDP will also be lower due to the negative impact of indirect costs to companies on consumption expenditure and investment. Consumption expenditure and fixed investment will be adversely affected as lower labour productivity and other indirect employment costs lead to a decline in the demand for skilled and unskilled labour, thereby reducing wage income and consumer spending. Furthermore, it was assumed that companies would finance indirect cost increases by increasing their selling prices and through lower operating surpluses. Therefore, analogous to the direct cost effects, this will put upward pressure on prices and interest rates and lead to a reduction in corporate savings and investment. Lower company profits will also have negative repercussions for the government's budget deficit, as lower private sector profits will translate into lower government revenue from corporate tax.[27]

HIGHER GOVERNMENT EXPENDITURE

Assumptions

Direct and Indirect Costs of HIV/AIDS to Government as an Employer. Increased morbidity and mortality among government employees will bring about substantial direct and indirect costs for the government as an employer. Like private sector companies, the government will need to increase its contributions to pension, life, disability and medical benefits of its employees on account of the AIDS epidemic. As in the case of direct costs to the private sector, we assumed that only skilled and highly skilled employees are covered by medical and other benefits. Our assumptions with regard to the size and the distribution of the direct (employee benefit) costs are also analogous to our direct cost assumption for the private sector. It was assumed that the direct costs would amount to about 5% of the (no-AIDS) remuneration costs of skilled and highly skilled government employees by 2005 and 10% by 2010. We assumed that the government would carry 50% of the direct cost increases due to HIV/AIDS and that employees would have to be responsible for the other half. Our assumption with regard to how households finance their share of cost increases and how the benefit disbursements would be divided between the four main consumption expenditure categories is analogous to the direct cost assumption for the private sector *(see page 19)*.

[27] Since it was assumed that companies are responsible for all of the indirect costs increases (as apposed to only 50% of the direct cost increases), AIDS induced indirect firm costs impact more negatively on government tax revenues than direct firm costs.

With regard to the size of the indirect costs to government as an employer, we make the same assumption as for the indirect costs to the private sector. We assumed that indirect costs would amount to about 2,5% (5%) of the no-AIDS remuneration costs of skilled (unskilled) employees by 2005 and 5% (7,5%) by 2010. Whereas the extra direct costs increased the wages of skilled government employees, it was assumed that the AIDS-induced indirect costs increased government expenditure. As was the case for the private sector indirect costs, we added 20% of the indirect costs back in the form of increased government employment, which softens the negative impact on GDP. Furthermore, given the tight fiscal deficit targets, we assumed that the government would cut back its non-wage consumption expenditure to such an extent that government consumption expenditure would only increase by 50% of the indirect costs[28].

Higher Public Health Care Expenditure. One of the most visible consequences of the epidemic will be an increase in the number of people seeking medical care. Since only ±20% of South Africa's population is covered by employment-related and other private medical schemes, the vast majority of HIV/AIDS victims will look towards publicly funded hospitals for medical care (Abt Associates, April 2001: 16). Public hospitals are funded out of general tax revenue and essentially provide medical services free of charge. The financial strain on the public health sector will be severe, not only as a result of the sheer number of people seeking health care, but also because health care for AIDS patients is more expensive than for most other conditions.

According to Ainsworth and Over, AIDS treatment costs generally lie between two and four times per capita income (Parker *et al*, 2000: 15).[29] The SARB estimated per capita GDP in South Africa to be R20 000 in 2000, which puts treatment costs between R40 000 and R80 000 according to Ainsworth and Over's rule of thumb (*SARB Quarterly Bulletin*, June 2001). According to ING Barings, more conservative estimates suggest that the current average annual cost to the *public sector* of treating an AIDS patient is between R3 000 and R4 500 (Quattek, 2000: 16).

Our analysis explores the impact of providing public health care at a cost of R16 900 per full-blown AIDS case. This is based on Abt Associates' estimate of the average cost of care per AIDS-infected person per year in the public sector *(see table 4)*.

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[28] In the absence of better information, the crowding-out effects of this expenditure increase on non-health departmental budgets, e.g. education, have not been considered.

[29] An estimate by the World Bank suggests that on average, the cost of AIDS treatment is roughly equal to 2,7 times the per capita GDP (Haacker, 2001:5).

Table 4: Average cost of care per infected person per year by stage and sector[30]

	Public Sector			Private Sector		
	Inpatient	Outpatient	Total	Inpatient	Outpatient	Total
Stage 1 and 2	R 700	R 600	R 1 300	R 1 600	R 1 400	R 3 000
Stage 3	R 5 200	R 1 100	R 6 300	R 11 800	R 2 400	R 14 200
Stage 4	R 15 500	R 1 400	R 16 900	R 35 100	R 3 200	R 38 300

Source: Abt Associates, April 2001: 16

We made the assumption that 75% of all the AIDS victims who are not employed in the skilled and highly skilled sectors (i.e. the economically inactive population, the unemployed and semi- and unskilled employees) would look towards publicly funded hospitals for medical care.[31] This amounted to roughly R6 billion of extra public sector spending on health care (in real terms; 2001 prices) by the year 2005 and R11,7 billion by 2010.[32] It was assumed that 60% of this extra health expenditure would be used to employ more doctors, nurses and other health workers and the remaining 40% would go towards other government health expenditure. In order to account for the budget constraints of the government, it was assumed that the government would finance 50% of the extra health expenditure by cutting back spending in other departments or within the health department.

Welfare expenditure for orphans. One of the most tragic consequences of the HIV/AIDS epidemic is the growth in the number of children who will lose one or more parent to AIDS; Abt/Metropolitan projects the number of maternal orphans under the age of 15 to increase from the current ±250 000 to close to 1 million in 2005 and 2,5 million by 2010[33]. Given that welfare grants for orphaned children are statutory entitlements, a quadrupling in the number of orphans over the next four years is bound to have a significant impact on government welfare expenditure.

[30] It should be noted that neither the public nor the private sector cost estimates include anti-retroviral therapy.

[31] In other words, 25% of the AIDS victims who are not employed in the skilled or highly skilled sectors (e.g. children and housewives) will not rely on free medical services at public hospitals. These individuals either receive financial support and care from family members or friends, or they are able to afford medical services at private hospitals, either because they have health insurance via a parent or spouse's insurance or because they are able to finance the AIDS induced medical costs from savings and by cutting back spending on non-essential products and services.

[32] ING Barings assumed that government would have to provide medical care for all AIDS victims in South Africa, except those who are a part of the skilled and highly skilled labour force. They assumed that government would spend only R3 750 per full-blown AIDS case. This amounted to roughly R3,5 billion of extra public sector spending on health care by the year 2005 and R4 billion by 2010. (Quattek, 2000: 16-17).

[33] Dorrington's (ASSA2000) estimate and projection is more liberal, projecting the total number of maternal AIDS orphans to increase from 360 000 (estimated by mid-2000) to close to 3 million by 2010.

Our analysis explores the impact of providing foster care grants at a cost of R570 per orphan per month. We assumed that only about 30% of foster parents would actually turn to government for financial assistance, as many potential caregivers would not want to go through the administrative process or may fear that they would not get approved as foster parents if they do go through the official channels to become foster parents. Our estimates indicated that this would lead to roughly R2,9 billion of extra welfare spending on orphans (constant 2001 prices) by the year 2010.

Macro-economic effects

- Higher contributions by the government to medical and other employee benefit schemes will translate into higher wages for skilled government employees, leading to an increase in the government wage bill. Higher wage income will stimulate aggregate consumption expenditure - consumer spending on non-durable goods and services in particular will gain from the disbursement of medical benefits. However, spending on semi-durable and durable goods, as well as personal savings, will suffer, as skilled government employees finance their higher benefit contributions by reducing their savings and non-health care expenditure.
- Direct and indirect employment costs to the government, as well as higher public health and welfare expenditure, will lead to an increase in the budget deficit (or a lower budget surplus) and will exacerbate the public sector borrowing requirement. As mentioned earlier, AIDS related costs will also create pressure on the government's fiscal position from another front – lower government tax revenues. Increased direct and indirect costs related to HIV/AIDS will reduce private sector profits and hence, lower corporate taxes, which will have negative repercussions for the budget deficit.
- Given the resolve that the government has shown in sticking to its fiscal deficit target, it is unlikely that government will allow the budget deficit to get out of hand. It was therefore assumed that personal and corporate tax rates will be about 0,5% and 3.0% higher on average between 2001 and 2015 than would have been possible without AIDS. Higher taxes will generate extra revenue to fund the additional AIDS related expenditure and will reduce the impact of increasing employment costs and higher government health expenditure on the budget deficit.

INCREASED OUT-OF-POCKET HOUSEHOLD SPENDING

Total health care expenditure in SA (currently around R60 billion annually, split 40%/60% between the public and the private sectors respectively) could increase substantially

due to HIV/AIDS (according to calculations by Abt Associates; see Hensher, 2001). Apart from the increased spending on health care products and services tied to the disbursement of medical benefits in terms of employees' medical funds (which we accounted for in our assumptions regarding the direct costs faced by companies and the government), consumers are likely to face additional out-of-pocket health care spending as a result of the epidemic. Consumers will have to finance health care costs not covered by medical funds and/or access to state hospitals.

We accounted for these costs in that the total direct medical HIV/AIDS-related firm and government costs (in net terms) plus the (net) out-of-pocket HIV/AIDS-related health care spending of consumers more or less add up to Abt Associates' estimate of the total HIV/AIDS-related increase in health care expenditure noted above. Similar to the direct cost assumptions, it was assumed that 50% of the out-of-pocket household spending will be financed from savings and the remainder from cutting back on non-health care expenditure; the key difference being that wages do not increase as is the case for the direct cost assumptions.

This out-of-pocket spending will have a positive impact on the non-durable goods (including medication) and services (including health care) components of FCE and therefore on GDP and contribute to a shift in consumer spending, impacting adversely on non-health care spending.

THE MACRO-ECONOMIC IMPACT: OVERALL RESULTS

From the analysis above, it is clear that the basis of the economic impact of HIV/AIDS lies *first and foremost* in the demographics; and, *secondly* in the costs of combating the disease. However, in understanding the economic impact, it is important to highlight the following:

- Whilst the population (and labour force) size is reduced by 18% (21%) respectively compared to a no-AIDS scenario by 2015, the decline in economic production, employment and incomes is substantially less.
  - ⇒ The economic impact is softened by fact that labour losses can be replaced from unemployed sources; our econometric simulation shows that both the skilled and unskilled unemployment rates decline, albeit that this decline is restricted by a concomitant decline in the demand for labour.
  - ⇒ Furthermore, companies strive to maintain production levels, possibly implementing more productive technologies and increasing the economic production per worker; and
  - ⇒ Surviving household incomes could be augmented from insurance payouts, the liquidation of the deceased's assets, etc., lessening the impact on spending levels; however, this will ultimately have a negative impact on GDP due to lower national savings and/or wealth.
- The flip side of the cost pressures arising from the epidemic (directly and - to a lesser extent - indirectly, for both the public and private sectors) is spending in the economy, possibly leading to an increase in GDP. For instance, the increased risk benefit costs borne by companies (and/or employees) also represent additional income to employees[34], eventually translating into increased spending (mainly, but not exclusively, on health care products and services). Another example is increased company expenses on recruitment and training, which benefit the agencies involved and imply heightened levels of economic activity. Furthermore, implicit in these examples, could be a shift in spending (e.g. households cutting back on non-health care spending), which does not necessarily represent a loss in GDP. The following issues should, however, be noted:
  - ⇒ GDP will ultimately be negatively affected by a shift in spending from more to less productive avenues, particularly to the extent that companies (and government) cut back on capital spending.

⇒ As households strive to maintain living standards, increased health care spending can be financed from savings, possibly activating passive money balances and boosting GDP in the first round. However, the reduced supply of savings in the economy has negative implications for fixed investment and economic growth over the longer term.

⇒ *Finally*, to the extent that the cost pressures translate into higher prices, upward pressure on interest rates could result, in turn, constraining household and fixed investment expenditure.

With this in mind, the overall macro-economic impact results are discussed in more detail below.

INFLATION AND INTEREST RATES

One of the key econometric results is the impact on inflation and therefore interest rates. A number of channels contribute to the higher inflation outcome:

- The HIV/AIDS related (direct and indirect) costs experienced by companies; the impact on prices will be worse the larger share of the increase in costs is successfully passed onto consumers. International competitive forces could limit firms' ability to pass these costs on to the consumer level, however, it is conceivable that some of the cost increase will be recouped in this manner.
- Increased pressure on countrywide salary and wage rates, particularly in the skilled categories of labour. The HIV/AIDS epidemic exacerbates the existing skills shortage in SA; whilst immigrants could reduce this gap as companies strive to maintain production levels, salaries will have to be attractive in foreign currency terms.
- Tied to the former, a narrower GDP gap (i.e. the difference between potential and actual GDP), contributing to upward pressure on prices as the utilisation of the country's productive forces increases. This happens, as the fall in potential GDP is larger than the decline in the actual GDP.
- The fiscus is also likely to be worse off due to the HIV/AIDS epidemic. Whilst the econometric results show that the impact is not major (under the specific assumptions we adopt), the higher budget deficit and average tax burden compared to a no-AIDS scenario can contribute to the inflationary bias of the epidemic.

[34] Some company pay packages are structured in such a way that 100% of this cost increase will be absorbed by the employee, implying a shift in spending and/or a possible reduction in savings.

In all, producer price inflation is projected to be 2,3% points higher on average over the projection period (2002-15), the deviation increasing from 1,4% points (2002/05) to 2,3% points (2006-10). The projected increase in consumer inflation is slightly larger. Assuming a policy of inflation targeting remains in place, monetary policy will have to be tightened to counter the inflationary consequences of the epidemic. Furthermore, due to a deterioration in the national savings and overall balance of payments position *(see below)*, additional pressure could result on interest rates. Prime overdraft interest rates are therefore projected to be 2,9% points above that of a no-AIDS scenario over the projection period; this deviation rising from 1,4% points (2002/05) to 3% points (2006-10). The increase in the nominal prime rate is higher than the increase in inflation, implying a small increase in real prime overdraft rates compared to a no-AIDS scenario *(see table 5)*. The higher level of interest rates has a negative bearing on the interest rate sensitive expenditure components of GDP, particularly private fixed investment *(see below)*.

Table 5: The impact on inflation and interest rates

	CPI inflation		PPI inflation		Prime overdraft int. rate	
	level[1]	diffs[2]	level[1]	diffs[2]	nominal[2]	real[2]
2002-05	6,8%	1,6	6,8%	1,4	1,4	0,0
2006-10	7,7%	2,6	7,4%	2,3	3,0	0,6
2010-15	8,3%	3,3	7,1%	2,9	4,1	1,2
2002-15	7,6%	2,6	7,1%	2,3	2,9	0,6

[1] *Inflation rate in the AIDS scenario;* [2] *Average % point difference between AIDS and no-AIDS scenarios.*

The exact size of the impact on inflation and interest rates may be overstated in our static model projections (e.g. considering the dynamics of international competition). However, a conclusion to be drawn from our analysis is that the HIV/AIDS epidemic is likely to have adverse financial repercussions for SA, which will in turn have negative feedback effects on economic growth.

FINAL HOUSEHOLD CONSUMPTION EXPENDITURE

The overall impact on FCE is negative as should be expected in a country where the total population declines by around 10 million compared to a no-AIDS scenario. However, the impact on this sector is not that straightforward. As was discussed above, a number of opposing forces determine the net impact on FCE.

- The lower population has an overall negative impact on FCE. However, due to the fact that incomes decline by substantially less than the total population, per capita disposable

income increases in the AIDS scenario, which limits the negative impact on FCE; alternatively the income-weighted decline in population is less pronounced.

- The demand for labour, i.e. employment, is lower compared to the no-AIDS scenario, affecting disposable incomes and therefore consumer spending. The demand for labour declines due to the lower level of economic activity in the first place. However, upward pressure on wage rates as particularly skilled labour shortages intensify due to AIDS, the increased direct costs (i.e. risk benefit contributions) faced by the private sector and government and lower labour productivity and indirect employment costs exacerbate the decline in the demand for labour. The overall net impact on disposable income is therefore negative as the decline in employment levels exceeds the increase in wages[35].
- The negative impact on FCE as a result of the lower level of disposable incomes is lessened to the extent that consumers activate savings in an attempt to maintain living standards. Furthermore, as was discussed in the previous section, the liquidation of financial and fixed assets, insurance payouts, etc. could augment incomes. While this will boost FCE in the first round, the longer-term impact on fixed investment and growth is negative.
- The higher level of inflation and interest rates contribute to lower FCE compared to a no-AIDS scenario, particularly in the case of the interest rate sensitive components of FCE (e.g. durable goods spending).

Beyond these impacts on FCE, important shifts in consumer spending are likely to result due to the epidemic. *Firstly*, as per capita incomes increase in the AIDS scenario, the distribution of income will change as a larger share of the population will fall in higher income categories, whilst the share of the population in the lower income categories declines. Our calculations indicate that the durable goods and services sector benefit as a result. *Secondly*, due to the substantial increase in spending on health care products and services in the AIDS scenario consumers are likely to cut back on other categories of spending. All the major components of FCE will be negatively affected by these cutbacks. However, non-durable goods spending (including spending on medication) and the services sector (including spending on health care services) benefit from the increased health spend. In fact, spending on services is higher in the AIDS scenario compared to the no-AIDS scenario. Table 6 shows the impact on the major components of FCE.

[35] The partial analysis of the impact of higher direct costs to companies showed that the decline in employment was smaller than the increase in wage costs, resulting in a net addition to FCE and GDP growth. However, when all the impact channels are considered, this positive net impact is reversed.

A notable feature of these results is the fact that total FCE is slightly higher in the AIDS scenario over the period 2002-2010. This is explained by the increased consumer spending on health care products and services (classified as non-durable goods and services spending)[36], the activation of personal savings *(see the final column in table 6)* and the positive employment effects associated with the government and companies' efforts to combat the epidemic. Consumer spending on semi-durable goods is projected to be the most vulnerable; this component is adversely affected by the shift in spending in favour of health care products and services, the increase in interest rates and this sector's proportionally larger exposure to the black consumer market. Spending on durable goods is also adversely affected, particularly vulnerable to the HIV/AIDS-related shifts in spending and increases in interest rates. Furthermore, the non-health care components of non-durable goods spending and spending on services (not shown in table 6) could also experience a substantial negative impact. It is clear from table 6 that the aggregated results of the impact on FCE conceal possibly much more substantial impacts on specific markets.

Table 6: The impact on final household consumption expenditure (FCE)[1]

	Durables	Semi-durables	Non-durables	Services	Total FCE	Savings[2]
2002	-1,0	-0,7	0,3	1,5	0,5	-0,5
2005	-3,1	-2,4	-0,1	3,0	0,7	-0,8
2010	-5,7	-5,4	-1,6	6,3	0,8	-1,5
2015	-7,9	-9,8	-6,3	3,5	-2,8	-0,2

[1] *% difference in constant price levels of AIDS and no-AIDS scenarios; not yoy growth rate differentials.*
[2] *% points difference in the personal savings ratio (expressed as a % of disposable income) between an AIDS and no-AIDS scenario.*

FIXED INVESTMENT

The simulation results indicate that the impact on fixed investment expenditure could be very negative. As the supply potential of the economy is negatively affected by the AIDS epidemic, demand levels will have to adjust to a new equilibrium, including the level of fixed investment. This results from a number of negative influences:

- The lower overall level of economic activity, reflected in lower levels of demand in the economy.
- The higher level of interest rates.
- Lower corporate profits and savings, as well as a smaller pool of national savings, which will adversely impact on fixed investment.

[36] This positive impact wears off over the final 5-year period (2011-15), when the direct AIDS-related costs experienced by the government and companies are projected to stabilise, in line with the projected trajectory of the epidemic.

Whilst capacity utilisation increases in the AIDS scenario and labour costs rise, companies may be intent increasing investment in machinery, equipment and new technologies, which all suggest upward pressure on fixed investment. This aspect, however, did not feature strongly in our econometric simulation. It was difficult to formulate an assumption on increased capital intensity due to AIDS; machinery and equipment require skilled operators, which may not be available to the required extent as the epidemic intensifies. Furthermore, whilst capacity utilisation increases, this happens as the supply potential of the economy declines, rather than due to increased actual GDP/demand, typically the trigger for increased capital spending. The question is whether the impact on fixed investment is symmetrical when the increase in capacity utilisation is caused by a decline in the supply potential as opposed to an increase in actual GDP.

Table 7 shows a substantial decline in private fixed investment compared to a no-AIDS scenario. The small net addition to the total population over the next 10 to 15 years as a result of the AIDS epidemic, as well as the higher level of interest rates explain the pronounced weakening of private residential fixed investment (projected to decline by 10% by 2010 compared to a no-AIDS scenario). Public sector fixed investment (i.e. the government and the parastatals) could also be influenced, however, for the purpose of the present study a zero impact was assumed.

Table 7: The impact on fixed investment (GDFI)

	Private residential[1]	Private (excl. residential)[1]	Total private[1]	Total GDFI[1]	Total GDFI (% of GDP)[2]		National savings (% of GDP)[2]	
					level	diffs	level	diffs
2002	-1,3	-0,6	-0,7	-0,5	17,4	-0,2	14,8	-0,4
2005	-4,4	-5,0	-5,0	-3,7	18,4	-0,7	15,2	-0,9
2010	-9,8	-11,8	-11,6	-8,9	20,1	-1,6	16,7	-2,7
2015	-15,2	-19,2	-18,9	-14,5	20,6	-2,1	19,2	-3,1

[1] *% difference in constant price levels of AIDS and no-AIDS scenarios; not yoy growth rate differentials.*

[2] *Percentage points; the "level" columns indicate ratios in the AIDS scenario; the "diffs" columns indicate the deviation from the no-AIDS scenario.*

Table 7 shows that total fixed investment as a % of GDP is 1,6% points lower by 2010 compared to a no-AIDS scenario, in symphony with the deterioration in national savings. Whilst foreign savings could augment the domestic savings shortfall, it is not clear whether these capital inflows will materialise to the required extent should the domestic fixed investment and economic growth performance remain unsatisfactory. The impact on private fixed investment could therefore be substantial, to some extent reflecting the shift in spending, from more to less productive avenues, due to the impact of the HIV/AIDS epidemic. The level of

total private fixed investment is projected to decline by 9% by 2010 compared to a no-AIDS scenario; this translates to an average reduction in the projected real growth rate of around 1,2% per annum over the period 2002-10 *(see Appendix)*.

GOVERNMENT SPENDING AND FISCAL POLICY

The AIDS epidemic is likely to impact negatively on the national budget. *On the expenditure side of the budget*, the direct (higher risk benefit contributions) and indirect employment costs related to the epidemic boost government expenditure. Furthermore, the demand for health care services increase sharply as those not covered by medical funds turn to state hospitals; and, finally, welfare grants increase due to the sharp increase in the number of surviving maternal orphans. *On the income side*, tax revenues are adversely affected by the lower overall level of economic activity and the deterioration in corporate profits compared to a no-AIDS scenario.

The macro-economic impact will depend on how government decides to absorb this impact. Our assumptions were motivated in the previous section. According to these, the negative impact on the budget deficit will be reduced by a small increase in tax rates, as well as cut-backs in non-health care (and non-wage) expenditure, implying a shift in spending between (and possibly within) government departments[37]. The overall increase in government expenditure has a stimulatory effect on GDP growth, however, the higher public sector borrowing requirement adds to the higher level of inflation and interest rates, in turn, constraining GDP growth.

Table 8: The impact on the balance of payments and the fiscus[1]

	Current account balance (% of GDP)		Govt consumption expenditure (% of GDP)		Total taxes (% of GDP)		Budget deficit (% of GDP)	
	level	diffs	level	Diffs	level	diffs	level	diffs
2002-05	-1,7	0,0	16,6	0,0	26,5	0,4	-1,6	-0,2
2006-10	-1,8	0,2	15,7	0,2	25,9	0,5	-1,0	0,1
2011-15	-1,8	0,6	14,6	0,5	24,9	0,8	-0,4	0,5
2002-15	-1,8	0,3	15,6	0,2	25,7	0,6	-1,0	0,1

[1] *Percentage points; the "level" columns indicate ratios in the AIDS scenario; the "diffs" columns indicate the deviation from the no-AIDS scenario.*

[37] We did not analyse any dynamic effects possibly tied to cutbacks in some categories of government expenditure; for instance, cutbacks in the education budget could have serious negative long-term economic repercussions.

TRADE, THE BALANCE OF PAYMENTS AND THE EXCHANGE RATE

The overall impact on the balance of payments is mixed. The trade account is negatively affected in terms of import and export volumes. While exports could benefit from a small real depreciation in the trade weighted rand exchange rate and the more sluggish domestic market conditions compared to the no-AIDS scenario, upward pressure on imports predominates. Despite the decline in real domestic expenditure compared to a no-AIDS scenario, import demand increases:

- *Firstly*, due to the increased import intensity of domestic expenditure, in turn, tied to the HIV/AIDS-induced increase in spending on health products, which are mainly imported.
- *Secondly,* the relative cost to import declines in the AIDS scenario as the increase in domestic inflation exceeds the increase in imported inflation.
- *Finally,* while the decline in the country's supply potential may not stimulate fixed investment expenditure (symmetrically compared to an increase in actual GDP), increased capacity utilisation could contribute to increased imports, implying an increased import intensity of GDP growth.

However, the impact is not major – the increase in import volumes compared to a no-AIDS scenario is only slightly higher than the increase in export volumes. Furthermore, the nominal depreciation of the rand (slightly more than the deterioration in SA's inflation differential with its major trading partners) has a bigger (positive) impact on the export price deflator than the (negative) impact has on the import price deflator. This exchange rate-induced improvement in the terms of trade counterbalances the deterioration on the trade account. Table 8 below shows that, expressed as a % of GDP, the current account balance actually improves somewhat, by 0,2% points compared to a no-AIDS scenario over the period 2006-10 and 0,6% points over the period 2010-15.

The impact on the financial account could be negative. Faced with a poorer domestic savings effort as a result of the HIV/AIDS epidemic *(see table 7),* SA needs increased foreign capital inflows to plug this gap. However, it is difficult to assume such an outcome in view of the weaker economic outlook in the AIDS scenario. Our assumption was to keep the projected rand value of capital inflows (exogenous to the model) unchanged between the AIDS and no-AIDS scenarios, which implies a decline in the dollar value of capital inflows compared to a no-AIDS scenario. The negative impact on the financial account of the balance of payments exceeds the marginal improvement on the current account discussed above. Consequently, the deterioration in the overall balance of payments contributes to upward

pressure on interest rates and explains the marginal decline in the real effective rand compared to a no-AIDS scenario.

In national account terms, the current account gap is equal to the gap between savings and investment. One would expect a poorer national savings effort to impact negatively on the current account balance. This would indeed be the case should fixed investment remain unchanged; however, our econometric simulation shows that the decline in fixed investment compared to a no-AIDS scenario is quite strong. Apart from lower savings, the decline in the GDP and the higher level of interest rates explain the reaction of fixed investment. In fact, the decline in investment is slightly more than the decline in savings, mirroring the slight improvement in the current account balance (i.e. 0,3% of GDP).

OVERALL GDP GROWTH AND EMPLOYMENT

Overall GDP is negatively affected by the HIV/AIDS epidemic. However, the impact appears to manifest gradually. Compared to a no-AIDS scenario, the level of real GDP is projected to be 1,5% lower by 2010 and 5,7% lower by 2015. In year-on-year growth terms this translates to declines in the average annual growth rate of 0,1% (2002-05); 0,3% (2006-10); and 0,9% (2011-15). Over the complete projection period, the decline in the average real GDP growth rate is 0,5% per annum *(see the Appendix)*.

As noted above, central to the GDP impact, are the HIV/AIDS demographics and the AIDS-related costs to the economy.

- AIDS has a significant negative impact on the production potential of the economy, related to the decline in the labour force (compared to a no-AIDS scenario), the decline in labour productivity and total factor productivity. The gap between potential and actual GDP narrows, i.e. capacity utilisation increases in the AIDS scenario. The outcome of this is upward pressure on prices, which result from higher wage rates (particularly due to increased skilled labour shortages) and the lower GDP gap (or increased capacity utilisation). Higher wage rates reduce the demand for labour (i.e. employment) and the higher level of inflation leads to higher interest rates; lower employment and higher interest rates (compared to a no-AIDS scenario), in turn, constrain GDP growth.
- The second key channel of the AIDS impact on economic growth, namely the AIDS-related costs, also result in upward pressure on prices as companies pass some of these cost increases onto consumers via higher product prices. Higher inflation is likely to spill over into higher interest rates. Apart from the increase in interest rates, the (direct and indirect)

AIDS-related costs raise employment costs, which impacts negatively on employment; combined with the higher level of inflation and interest rates, this contributes to lower GDP growth (compared to a no-AIDS scenario).

In all, lower employment levels and higher interest rates explain the bulk of the decline in actual GDP compared to a no-AIDS scenario. The decline in GDP from these sources is countered by the (net) increase in HIV/AIDS-related health expenditure by households and government. Furthermore, companies strive to maintain output levels and could succeed in increasing the output per worker. In the end, the decline in GDP (6% by 2015) is significantly less than the decline in the overall population (18%), which suggests that per capita GDP increases; over the complete projection period, real per capita GDP growth is on average 0,9% higher per annum.

Table 9: The impact on real GDP growth and employment

	Real GDP[1]	Real GDE[1]	Formal sector employment[1]		Unemployment rate (%)[2]		Poten-tial GDP[1]	GDP per capita[1]
			skilled	unskilled	level	diffs		
2002	0,4	0,4	0,4	2,0	41,8	-1,1	-1,1	2,1
2005	0,1	-0,2	-0,4	2,5	40,7	-2,5	-3,2	4,2
2010	-1,5	-1,3	-3,8	1,1	35,8	-6,2	-9,8	9,7
2015	-5,7	-5,1	-9,8	-3,3	28,7	-10,9	-17,9	14,8

[1] *% difference in constant price levels of AIDS and no-AIDS scenarios; not yoy growth rate differentials.*

[2] *"Level" defined as "percent of labour force outside the formal sector" in the AIDS scenario; "diffs" is percentage points difference compared to no-AIDS scenario.*

A MACRO-ECONOMIC SENSITIVITY ANALYSIS

The econometric results discussed above should be seen in relation to the specific assumptions we adopted in our baseline AIDS-inclusive economic scenario. However, being aware of the uncertainties involved, we decided to conduct a macro-economic sensitivity analysis in order to gain a better understanding of the sensitivities related to the economic impact of HIV/AIDS. For this purpose, a number of the baseline assumptions *(see the second part of the paper, page 14)* were altered and the econometric outcome evaluated[38]. The objective was to test realistic alternative assumptions. Before we highlight some of the key results, the alternative assumptions are briefly stated below.

[38] It needs to be emphasized that we did not adopt alternative demographic or epidemiological inputs/assumptions for this part of the exercise. The sensitivity analysis therefore only relates to alternative economic behavioural assumptions. Different demographic parameters are obviously another important source of alternative AIDS-inclusive economic scenarios, however, time constraints disallowed such an analysis.

- Higher direct and indirect costs. For various reasons we adopted conservative assumptions regarding the direct and indirect costs faced by government and the private sector as a result of the HIV/AIDS epidemic *(see pages 19 to 27)*. Our alternative assumption was to increase these costs by 50%, both for the government and private firms.[39]
- Companies shoulder less of the direct (employee benefit) cost increase. In our baseline scenario we argued that companies would come under substantial pressure to absorb part (50%) of the direct costs accompanying the spreading HIV/AIDS epidemic; these costs will not always be easy to bypass given the socio-political dynamics tied to the pandemic. However, our alternative assumption allows for companies being more successful in their bid to avoid these costs, they carrying only 25% of the direct (employee benefit) costs increases; and employees carrying the other 75%.
- Households finance a smaller proportion of their share of the cost increases through savings. Our alternative assumption is that households would finance 25% of their share of the direct costs from personal savings (compared to 50% in the baseline) and the other 75% (50%) by cutting back on non-health care products and services.
- Government does not substitute away from spending in other departments to finance indirect cost increases or higher health spending, i.e. HIV/AIDS-related spending is added onto government consumption expenditure.
- No increase in personal and corporate taxes (as we argue in the baseline government would do to limit the impact on the budget deficit), i.e. the additional government spending is financed via a higher budget deficit (or lower surplus).
- Finally, a larger negative impact on multi-factor productivity. It is difficult to quantify an assumption in this regard. The alternative assumption was therefore designed to cover a fairly broad spectrum of possible multi-factor productivity outcomes.

The methodology, which we applied, was to simulate each of these alternative assumptions individually and then to evaluate the results. For a list of key macro-economic variables *(see table 10)*, a lower and upper range impact was then calculated for the complete projection period, i.e. 2002-15. The upper and lower ranges were calculated such that the range would cover the full spectrum of possible outcomes, provided any combination of the alternative assumptions. This was possible as most of the impacts work in a linear fashion.

[39] For instance, in our baseline AIDS-scenario we assumed that, if companies were to have the full responsibility for the provision of benefits, direct costs would add around 5% to the (no-AIDS) remuneration costs of skilled and highly skilled employees by 2005 and 10% by 2010. Our alternative assumptions are that direct costs would add around 7,5% (15%) to the wage costs of skilled and highly skilled employees by 2005 (2010). Similar adjustments were made to the other direct and indirect costs assumptions for the government and private firms.

Table 10: Macro-economic impact of HIV/AIDS - A sensitivity analysis[1]

	BER baseline AIDS scenario	Impact range 2002-15 % points p.a.
Real GDP growth	-0,47	-0,33 to -0,63
Real GDP growth per capita	0,9	1,0 to 0,7
Potential GDP growth	-1,4	-1,4 to -1,8
Formal sector employment	-0,6	-0,5 to -0,7
PPI inflation	2,3	1,9 to 3,3
Prime overdraft rate (nominal)	2,9	2,4 to 4,7
Prime overdraft rate (real)	0,6	0,4 to 1,4
Total real FCE growth	-0,3	0,1 to -0,5
Durable goods	-0,6	-0,6 to -0,8
Semi-durable goods	-0,8	-0,6 to -1,0
Non-durable goods	-0,5	-0,1 to -0,9
Services	0,2	0,5 to 0,0
Total real GDFI growth	-1,2	-1,0 to -1,8
GDFI (as % of GDP)	-1,3	-1,0 to -2,4
Gross domestic savings ratio	-2,0	-1,3 to -5,9
Real government consumption	-0,1	0,2 to -0,2
Total taxes (as % of GDP)	0,6	0,0 to 0,9
Budget deficit (as % of GDP)	-0,1	0,1 to -3,1
Current account balance (as % of GDP)	0,3	0,2 to 0,4
Nominal effective rand	-2,4	-2,0 to -3,6
Real effective rand	-0,1	0,1 to -0,4

[1] *Average annual differentials between an AIDS and a no-AIDS scenario; figures pertain to the average impact over the complete projection period, i.e. 2002-15.*

Table 10 shows that the negative impact on overall real GDP growth ranges from 0,33% to 0,63% per annum (2002-15). Both final household and government consumption are positively influenced in the "best-case" scenario; however, this is mainly related to spending on health care products and services. The decline in the real growth of spending on durable and semi-durable goods, ranging between 0,6% to 0,8% and 1% per annum respectively, is substantial. As noted before, the adverse impact on non-health related spending categories in the non-durable goods and services sectors could be similar (if not more severe in the case of non-durable goods), however, further analysis is required to assess these disaggregated impacts.

The negative impact on fixed investment is also substantial, ranging from 1% to 2% per annum in terms of real growth. Similarly, the impact on inflation (1,9% to 3,3%) and interest rates (2,4% to 4,7%) is pronounced, even at the lower ranges. The econometric simulations show that a smaller negative impact on real GDP is accompanied by a higher

inflation outcome *(and vica versa)*, as capacity constraints are more (less) acute in the AIDS scenario. Furthermore, increased deficit financing of the HIV/AIDS-related costs would exacerbate the inflation impact. *Finally*, the impact on the balance of payments seems to be fairly limited. While the nominal depreciation of the currency could be substantially more compared to a no-AIDS scenario, this is more or less in line with the deterioration in inflation, resulting in relatively small changes in the real effective rand exchange rate.

CONCLUSION

The AIDS-inclusive and no-AIDS macro-economic projections, based on this study, are provided in the Appendix. These numbers are instructive and provide important information on the possible quantified impact of the HIV/AIDS epidemic on the broader economy. In conclusion, however, we would like to focus attention on the direction and content of these impacts, rather than the point estimates themselves.

- *Firstly*, the overall economic impact is negative. Economic growth is weaker, accompanied by lower productivity, weaker job creation and spending levels in the economy; inflation and interest rates are higher; the national savings performance weakens; the balance of payments is worse off and the currency is weaker. Having said that, we are far from witnessing a doomsday scenario. Given the demographic parameters, our analysis shows the negative impact on real GDP growth is gradual and ranges on average from 0,3% to 0,6%, suggesting the economy could continue to register 3% average real GDP growth over the next 10 to 15 years *(see the Appendix)*; inflation could still average around 7% (in line with the past 5-6 years); real interest rates may only be marginally higher; the current account deficit could average below 2% of GDP and the budget deficit below 3% of GDP. The point here is that the impact lies in comparisons with the possible outcome in the absence of HIV/AIDS, something that we will never really know.
- *Secondly,* while not being alarmist, the results clearly show the macro-economic impact of the HIV/AIDS epidemic cannot be ignored. A particular feature of the overall results is the negative financial impact, i.e. on inflation and interest rates, which have negative feedback effects on economic growth and job creation. This is tied to the costs associated with combating the epidemic and the capacity constraints resulting from the substantial negative impact on the economy's productive potential. Furthermore, the negative impact on savings is also pronounced, having negative implications for fixed investment and SA's balance of payments constraint on economic growth. The results show that the average

real growth in fixed investment could be between 1% and 2% lower per annum over the following 10 to 15 years due to the HIV/AIDS epidemic.

- *Thirdly,* the macro results may conceal more substantial negative impacts at a more disaggregated level. This is clear from the impact on key final expenditure components, e.g. household spending on durable and semi-durable goods and presumably the non-health related categories of non-durable goods spending, as well as private residential fixed investment. There could clearly be losing sectors, apart from the sectors benefiting (e.g. health care, funeral services, etc.). Further research is required to come to grips with these disaggregated impacts and shifts in spending likely to accompany the epidemic.
- *Finally,* as noted above, the negative impact on GDP is less than the projected decline in population, resulting in higher per capita GDP levels and growth. This result could have significant distributional consequences, however, may be construed by some as evidence of a "better-off" economic situation in an AIDS scenario; this is far from the truth. Our no-AIDS projections attest to this; while a smaller population provides an opportunity for improved developmental planning, the AIDS epidemic is likely to be a heavy drain on resources bedevilling such efforts. For one, life expectancy (being a key measure of a country's developmental status) is projected to plummet. Furthermore, the macro-economic impact numbers convey little, if anything, of the human suffering and adverse social impacts likely to accompany such an exponential increase in mortality and sickness as currently being projected by the actuarial scientists.

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APPENDIX: MACRO-ECONOMIC PROJECTIONS, 2002-2015

(AIDS-inclusive figures in parenthesis)	2002-05 % p.a.	2006-10 % p.a.	2011-15 % p.a.	Average 2002-15 % p.a.	Impact range 2002-15 % points p.a.
Demographics					
Total population growth	1.6 *(0.9)*	1.5 *(0.2)*	1.5 *(-0.3)*	1.5 *(0.2)*	-1.3%
Total labour force growth	1.7 *(0.9)*	1.8 *(0.1)*	1.7 *(-0.5)*	1.7 *(0.1)*	-1.6%
Growth & employment					
Real GDP growth	3.2 *(3.1)*	3.7 *(3.3)*	4.1 *(3.2)*	3.7 *(3.2)*	-0.3% to -0.6%
Real GDE growth	3.5 *(3.3)*	3.9 *(3.7)*	4.4 *(3.6)*	4.0 *(3.5)*	-0.4% to -0.7%
Potential GDP growth	3.6 *(3.0)*	4.0 *(2.6)*	4.2 *(2.2)*	4.0 *(2.6)*	-1.4% to -1.8%
Real per capita GDP growth	1.6 *(2.2)*	2.1 *(3.2)*	2.6 *(3.5)*	2.1 *(3.0)*	1.0% to 0.7%
Formal sector employment	1.2 *(1.2)*	1.9 *(1.3)*	2.1 *(1.0)*	1.7 *(1.1)*	-0.5% to -0.7%
Unemployment**	43.1 *(41.3)*	42.5 *(38.0)*	40.6 *(31.6)*	42.0 *(36.7)*	-5.2% to -6.2%
Consumer sector					
Total FCE	3.1 *(3.1)*	3.4 *(3.4)*	3.8 *(3.1)*	3.5 *(3.2)*	0.1% to -0.5%
Durable goods	6.2 *(5.4)*	8.1 *(7.5)*	7.9 *(7.4)*	7.5 *(6.8)*	-0.6% to -0.8%
Semi-durable goods	3.5 *(2.8)*	4.6 *(3.9)*	4.3 *(3.3)*	4.2 *(3.4)*	-0.6% to -1.0%
Non-durable goods	2.3 *(2.1)*	1.2 *(0.8)*	1.6 *(0.7)*	1.7 *(1.1)*	-0.1% to -0.9%
Services	3.2 *(3.7)*	4.0 *(4.7)*	4.3 *(3.8)*	3.9 *(4.1)*	0.5% to 0.0%
Real personal disposable income	3.4 *(3.2)*	3.7 *(3.6)*	4.1 *(3.6)*	3.8 *(3.5)*	-0.1% to -0.4%
Personal savings ratio	0.9 *(0.2)*	2.6 *(1.3)*	3.5 *(2.8)*	2.4 *(1.5)*	2.6% to -5.7%
Fixed investment & saving					
Private residential GDFI	3.4 *(2.2)*	3.3 *(2.1)*	3.1 *(1.8)*	3.3 *(2.0)*	-1.1% to -1.5%
Total GDFI	6.4 *(5.4)*	6.3 *(5.1)*	5.1 *(3.7)*	5.9 *(4.7)*	-1.0% to -1.8%
GDFI as % of GDP	18.4 *(17.9)*	21.0 *(19.7)*	22.5 *(20.5)*	20.8 *(19.5)*	-1.0% to -2.4%
Domestic savings as % of GDP	15.6 *(14.9)*	18.1 *(16.2)*	21.2 *(18.2)*	18.5 *(16.5)*	-1.3% to -5.9%
Inflation & interest rates					
CPI inflation	5.1 *(6.8)*	5.1 *(7.7)*	5.0 *(8.3)*	5.1 *(7.6)*	2.2% to 3.8%
PPI inflation	5.4 *(6.8)*	5.0 *(7.4)*	4.2 *(7.1)*	4.8 *(7.1)*	1.9% to 3.3%
Prime overdraft interest rate	14.4 *(15.8)*	12.2 *(15.1)*	10.7 *(14.8)*	12.3 *(15.2)*	2.4% to 4.7%
Real prime rate	9.0 *(9.0)*	7.1 *(7.8)*	6.5 *(7.7)*	7.4 *(8.1)*	0.4% to 1.4%
Bop & exchange rate					
Real exports	5.5 *(5.9)*	5.9 *(6.1)*	4.5 *(4.5)*	5.3 *(5.5)*	0.5% to -0.1%
Real imports	7.0 *(6.8)*	6.9 *(7.3)*	5.5 *(5.7)*	6.4 *(6.6)*	0.0% to 0.6%
Current account balance as % of GDP	-1.8 *(-1.7)*	-2.0 *(-1.8)*	-2.3 *(-1.8)*	-2.0 *(-1.8)*	0.2% to 0.4%
Nominal effective rand (% p.a.)	-4.5 *(-6.0)*	-3.7 *(-6.2)*	-2.5 *(-5.5)*	-3.5 *(-5.9)*	-2.0% to -3.6%
Real effective rand (% p.a.)	-1.6 *(-1.7)*	-0.9 *(-1.0)*	0.4 *(0.4)*	-0.6 *(-0.7)*	0.1% to -0.4%
The fiscus					
Real govt consumption expenditure	1.8 *(1.9)*	1.8 *(1.8)*	2.4 *(2.0)*	2.0 *(1.9)*	0.2% to -0.2%
as % of GDP	16.6 *(16.6)*	15.5 *(15.7)*	14.2 *(14.6)*	15.3 *(15.6)*	0.8% to 0.1%
Total taxes as % of GDP	26.2 *(26.5)*	25.4 *(25.9)*	24.0 *(24.8)*	25.1 *(25.7)*	0.0% to 0.9%
Budget deficit as % of GDP	-1.8 *(-1.6)*	-0.9 *(-1.0)*	0.0 *(-0.4)*	-0.8 *(-1.0)*	0.1% to -3.1%

*** Defined as the "% of the total labour force outside the formal sector".*

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