THE HIV/AIDS PANDEMIC IN SOUTH AFRICA: SECTORAL IMPACTS AND UNEMPLOYMENT

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Abstract: South Africa is currently confronting an HIV/AIDS crisis. HIV prevalence in the population is currently estimated at about 13 per cent with that number projected to increase over the next five years or so. Given the massive scale of the problem and the concentration of effects on adults of prime working age, the pandemic is expected to sharply influence a host of economic and non-economic variables. While the pandemic will certainly influence the rate of economic growth, structural changes are also likely to be one of the primary economic hallmarks of the AIDS pandemic.

This paper builds on the work of Arndt and Lewis (2000) who estimated the aggregate macroeconomic impacts of the HIV/AIDS pandemic in South Africa using a computable general equilibrium (CGE) approach. They found that, despite dramatically lower rates of growth of the unskilled labor pool relative to the ‘no AIDS’ trend, estimated unemployment rates for unskilled labor in their base ‘AIDS’ scenario increased absolutely over most of the upcoming decade and are essentially the same (slightly higher in fact) as the rates estimated for a fictional ‘no AIDS’ scenario. In this paper, we seek to further investigate the interactions between unemployment and AIDS using the basic modeling approach set forth in Arndt and Lewis.

Before projecting the impacts of the pandemic on unemployment, recently compiled historical data on employment, unemployment, and remuneration are presented. The unemployment problem is, rather, an employment problem; and it is concentrated primarily in the unskilled and semi-skilled labour category. Job creation performance over the past three decades in this category has been dismal with total employment (formal sector and informal sector) of unskilled and semi-skilled labourers in 1999 at only 92 per cent of the level present in 1970.

In a country with an extraordinarily complex historical legacy such as South Africa, it is impossible to attribute this disastrous job creation performance to any single factor. Nevertheless, large differences in remuneration trends across labor classes and standard economic theory point to these trends as major contributing factors. By 1999, real remuneration per unskilled and semi-skilled worker had grown to 250 per cent of the 1970 level while remuneration for other

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categories had remained essentially flat. Based on these data, the neoclassical conclusion that unskilled and semi-skilled labor has been systematically pricing itself out of the market seems practically unavoidable. Employment growth has, given slow economic growth rates, gone hand in hand with wage moderation as in the highly skilled and skilled segments. In contrast, employment compression has been associated with substantial real remuneration growth as in the unskilled and semi-skilled segment.

With this historical background in mind, we turn to examining the interactions between the AIDS pandemic and unemployment using a CGE approach. In the model, the unskilled and semi-skilled wage is fixed relative to the producer price index. As a result, employment levels by activity are the equilibrating variables. We find that, even though the pandemic is projected to drive growth rates in the supply of unskilled and semi-skilled labour to around zero, our analysis indicates that the pandemic will also depress labour demand leaving the unemployment rate, in our base ‘AIDS’ scenario, essentially unchanged compared with a fictional ‘no AIDS’ scenario. The pandemic depresses labour demand through three effects.

- Declines in the rate of overall economic growth.
- Pronounced declines in sectors that supply investment commodities, particularly the Construction and Equipment sectors. These two sectors happen to use unskilled and semi-skilled labour intensively and together account for a significant share (16.3 per cent) of total payments to this category of labour.
- Beyond this investment demand effect (brought on by reduced savings), AIDS induced morbidity effects on unskilled and semi-skilled workers tend to depress output relatively more in sectors that use unskilled and semi-skilled labour intensively with further negative implications for employment.

Countering these three effects will be key to palliating the negative economic consequences of the pandemic and reducing unemployment rates. To reduce the unemployment problem, South Africa must have rapid overall economic growth ideally with sectors that use unskilled and semi-skilled labour intensively leading the way. Results indicate that a policy of real wage moderation (or even modest decline) presents a straightforward option for bolstering overall economic growth. A wage moderation policy also provides a particularly large stimulus for sectors that use unskilled and semi-skilled labour intensively with further positive implications for employment. Copyright © 2001 John Wiley & Sons, Ltd.

# 1 INTRODUCTION

South Africa is currently confronting an HIV/AIDS crisis. HIV prevalence in the population is currently estimated at about 13 per cent with that number projected to increase over the next five years or so. The implications of the pandemic will be profound for millions of families as the primary family wage earners and/or caretakers fall sick, require care, and eventually die. The pandemic will, without doubt, place extraordinary pressure on institutions that confront its direct effects, such as the health care system for the care of those living with AIDS and social services/systems (broadly defined) for the care of dependents of AIDS victims.

There is also fairly wide agreement that implications will not be confined to the households and institutions in the direct path of the pandemic. This consensus stems
mainly from the massive scale of the problem. It is probably fair to say that any change 
that reduces the population growth rate from around two per cent to zero in the space of a 
decade, as the pandemic is projected to do, could be expected to sharply influence a host of 
economic and non-economic variables. Since the pandemic brings about this reduction in 
population growth mainly by killing individuals of prime working age, there is legitimate 
concern over economic impacts.

While the pandemic will certainly influence rates of economic growth, structural 
changes are also likely to be one of the primary economic hallmarks of the AIDS 
pandemic in South Africa. At a minimum, the onset of the pandemic implies major 
departures from past trends in rates of accumulation of factors of production (e.g. skilled 
and unskilled labour) and changes in consumption patterns of government and households 
(e.g. more health care spending) with at least some of these consumption pattern changes 
financed by switching from investment to current expenditure. These changes will interact 
with policy and existing economic structure causing the economy to evolve structurally in 
a manner that is likely to be quite different from the path in the absence of the pandemic.

This paper seeks to build on the work of Arndt and Lewis (2000; henceforth A + L) who 
estimated the aggregate macroeconomic impacts of the HIV/AIDS pandemic in South 
Africa using a computable general equilibrium (CGE) approach. A + L sought primarily to 
estimate impacts on gross domestic product (GDP) and absorption. However, in their 
analysis, A + L also found that, despite dramatically lower rates of growth of the unskilled 
labour pool relative to the ‘no AIDS’ trend, estimated unemployment rates for unskilled 
labour in their base ‘AIDS’ scenario increased absolutely over most of the upcoming 
decade and are essentially the same (slightly higher in fact) as the rates estimated for a 
fictional ‘no AIDS’ scenario.

Here, we seek to further investigate the interactions between unemployment and AIDS 
using the basic modelling approach set forth in A + L. The paper is structured as follows. 
Section 2 provides an historical perspective of the unemployment problem in South Africa 
based on recently compiled data. Sections 3, 4, and 5 draw heavily from A + L in order to 
provide the context for a focus on the unemployment issue. In particular, Section 3 
describes the modelling approach employed to simulate the economic implications of the 
AIDS pandemic. Section 4 provides the primary assumptions underlying the ‘AIDS’ and 
‘no AIDS’ scenarios and Section 5 presents basic macroeconomic results. Section 6 
analyses the sectoral implications of the pandemic, the implications of these changes in the 
structure of production for unemployment, and the sensitivity of the overall outcome to the 
rate of growth of wages for unskilled and semi-skilled labour. Section 7 concludes and 
discusses policy implications.

2 UNEMPLOYMENT IN HISTORICAL PERSPECTIVE

New data on unemployment rates by skill class are presented in Figure 1.1 The data show 
that, for all classes of labour, unemployment rates were quite low in the early 1970s. 
However, since 1976, unemployment rates for unskilled and semi-skilled labour have 
increased essentially monotonically. In 1995, this unemployment rate surpassed the mind-
bogglingly high level of 50 per cent and continued to climb for the remaining four years of 
available data. In contrast, the unemployment rate for highly skilled workers has been

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1The data series were derived from official South African statistical sources by Quan tec Research.
negligible throughout the period. The rate for skilled labour began to climb more recently and has attained a fairly significant level.

The unemployment data in Figure 1 are based on a definition of the economically active population employed by Statistics South Africa. Broader definitions of unemployment, which are more generous in the definition of actively and unsuccessfully seeking employment, would give even higher unemployment rates while narrower definitions than the one employed would give lower rates. However, given the unemployment rates obtained by any reasonable measure, debate over the true magnitude of the unemployment rate is, for all practical purposes, moot. By any definition, the unemployment rate among unskilled and semi-skilled workers is now ridiculously high, and it has been increasing for nearly a quarter century.

Figure 2 gives further insight into the unemployment problem in South Africa. It is, rather, an employment problem. Job creation performance over the past three decades in
the unskilled and semi-skilled labour category has been dismal. Total employment (formal sector and informal sector) of unskilled and semi-skilled labourers in 1999 was only 92 per cent of the level present in 1970. While the number of jobs in the informal sector quadrupled between 1970 and 1999, the formal sector has been marked by massive job shedding. Formal sector employment of unskilled and semi-skilled labourers in 1999 was only three million compared with four million employed in 1970. The formal employment peak occurred in 1981 at 4.4 million jobs. Between 1981 and 1999, the level of formal sector employment declined in every year but three losing a total of 1.3 million jobs in the space of less than two decades. The trend towards reductions in formal sector employment of unskilled and semi-skilled labour is evidently firmly in place and shows no sign of abating.

In short, formal sector employment failed to grow as rapidly as the unskilled and semi-skilled labour force in the 1970s and declined essentially throughout the 1980s and 1990s while labour supply continued to expand. In contrast, employment in the highly skilled and skilled labour segments grew respectively by 380 and 200 per cent over the same period.

In a country with an extraordinarily complex historical legacy such as South Africa, it is impossible to attribute this disastrous job creation performance to any single factor. Nevertheless, large differences in remuneration trends across labour classes and standard economic theory point to these trends as major contributing factors. Figure 3 shows real remuneration per employee by labour class since 1970. In 1999, real remuneration per highly skilled worker was at 90 per cent of the 1970 level while real remuneration per skilled worker increased to 110 per cent of the 1970 level. In contrast, real remuneration per unskilled and semi-skilled worker in 1999 had grown to 250 per cent of the 1970 level.

Based on these data, the neoclassical conclusion that unskilled and semi-skilled labour has been systematically pricing itself out of the market seems practically unavoidable. Employment growth has, given slow economic growth rates, gone hand in hand with wage

![Graph](image_url)

**Figure 3.** Real remuneration per employee

*Source: Derived from official South African data by Quantec Research, Pretoria, South Africa*
moderation as in the highly skilled and skilled segments. In contrast, employment compression has been associated with substantial real remuneration growth as in the unskilled and semi-skilled segment.

With these employment and remuneration trends in mind, we turn to the task of looking forward at employment trends in the context of the AIDS pandemic.

3 AIDS AND UNEMPLOYMENT: AN ECONOMY-WIDE APPROACH

We estimate the interactions between the AIDS pandemic and unemployment using a recursive dynamic computable general equilibrium (CGE) model of the South African economy. CGE models have a number of features that make them suitable for examining ‘cross-cutting’ issues such as the impact of AIDS on key economic variables.

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

The model version employed here contains 14 productive sectors, including three service sectors of particular relevance to analysis of HIV/AIDS: medical and health services, social services, and government services. There are five primary factors of production (professional, skilled, and unskilled labour, informal labour, and physical capital), five household categories representing income distribution quintiles, seven different government functional spending categories, and three government investment categories.  

Sectoral production occurs according to a translog production function that determines how capital and labour inputs are combined together in generating value added.  The value added aggregate is then combined with intermediate (material) inputs to produce output

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2The basic model data is derived from a 1997 Social Accounting Matrix estimated by WEFA, a South African consulting firm. The WEFA SAM is in fact more disaggregated, including 45 productive sectors, and a household structure differentiated by deciles (with the upper decile further broken down into five groups). But for modeling purposes, we have chosen to use a more aggregated version of their original data.

3The translog production function is a more flexible specification than the standard (non-nested) CES production relationship often specified in such models, in that it allows for different elasticities of substitution between input pairs (e.g. between capital and skilled labour, and capital and unskilled labour). This is important in the South African context because of the enormous differences in factor utilization (ranging from high unemployment among unskilled labour to full employment of professional labour) and historic trends in factor use.
according to a fixed coefficients technology. Profit-maximization by producers is assumed, implying that each factor is demanded so that marginal revenue product equals marginal cost.⁴

Given the focus on unemployment, the treatment of labour markets is crucial. The wage, employment, and unemployment trends illustrated in Figures 1, 2, and 3 indicate that markets for unskilled and semi-skilled labour function poorly. Fallon and Lucas (1998) discuss these and other labour market failures. They find that institutional factors, such as labour unions, wage bargaining councils, and labour legislation, have combined to create a relatively rigid wage for unskilled and semi-skilled workers that is set well above market clearing levels.

In the simulations, wages for unskilled and semi-skilled, as well as skilled and informal, labour are assumed to be set institutionally. In particular, wages for these classes of labour are fixed relative to the producer price index.⁵ Producers effectively face a completely elastic supply curve for these types of labour, allowing them to vary employment levels at a fixed wage as needed to match marginal revenue and marginal cost. Total employment for each skill type with a fixed wage is thus endogenously determined as the sum of all the sectoral demands; unemployment in each labour class is simply the difference between total labour supply and total employment. There is no feedback specified from the level of unemployment to the wage-setting mechanism, so that wages are not responsive to changing unemployment levels.

The productivity with which factors combine to produce output in each sector can be affected in two ways: first, the overall productivity can be changed (corresponding to a change in total factor productivity, or TFP) to reflect conditions in which the general productivity of existing technologies is enhanced or reduced (i.e., with the same bundle of labour and capital inputs, less output is produced), and second, the contribution of specific factor inputs (such as labour) can be affected, implying that the effectiveness of each input unit is reduced (i.e., even though there are 100 workers, the effective input is equivalent to only 95 healthy workers).

On the demand side, the South Africa model maintains the standard CGE assumption that domestic goods are imperfect substitutes for traded goods (both exports and imports). Sectoral exports are assumed different from output sold domestically, and are combined using a constant elasticity of transformation (CET) function to form domestic output. This treatment captures explicit differences between exports and domestic goods (such as quality), as well as other barriers preventing costless reallocation of output between the export and domestic markets (such as market penetration costs). Hence, the price of the good on domestic markets need not equal the domestic price of exports, which is determined by the world price, the exchange rate, and exogenous export subsidies. Producers maximize revenue from selling to the two markets, so that the ratio of exports to domestic sales is a function of the price ratio.

As with exports, sectoral imports and domestically produced goods are imperfect substitutes in both intermediate and final uses. Demanders of imports minimize the cost of acquiring a ‘composite’ good, defined as a CES aggregation of imports and domestic

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⁴However, factors need not receive a uniform wage or ‘rental’ (for capital) across sectors; sectoral factor market distortions are imposed that fix the ratio of the sectoral return to a factor relative to the economywide average return for that factor.

⁵In all simulations, the consumer and producer price indices diverge very little with consumer prices increasing slightly relative to producer prices.
demand. Substitution elasticities can vary by sector, with lower elasticities reflecting greater differences between the domestic and imported good. Retaining the small country assumption, the supply of imports is assumed infinitely elastic at a price fixed by world market conditions. The domestic price of the imported good is determined by the world price times the exchange rate, plus any tariffs. The assumption of cost minimizing behaviour by demanders implies that the sectoral desired ratio of imports to domestic goods is a function of their price ratio.

Five household categories (based on income distribution quintiles) are distinguished in the model, along with government and corporate accounts. Each group receives income from a variety of sources and has explicit behavioural rules governing savings and expenditure behavior. Firms receive the returns to capital, pay corporate taxes, and receive transfers (from government and the rest of the world). The remainder is divided between corporate savings and household dividends.

Factor income for each of the labour types is distributed to the households using fixed shares, as are corporate dividends. Households are taxed at a fixed rate, and may also receive transfers from the government; they save a fixed fraction of their income (which adds to the pool of domestic savings), with the remaining income spent on consumption.

The government receives tax revenue from import tariffs, export taxes, indirect (excise) taxes, the value added tax, income taxes on corporations and households, and the proceeds from net foreign borrowing. The government spends money on transfers to households and firms, seven different categories of goods and services (including separate health and education), and three types of government investment. The remaining surplus or deficit is added to the available supply of savings in the economy.

Sectoral private consumption is determined through the fixed expenditure shares under the assumption that households have a Cobb–Douglas utility function. Government consumption is also allocated using fixed expenditure shares. Final demand for intermediate goods is the sum of the intermediate demands generated in each producing sector. Investment is allocated using dynamic updating rules discussed in more detail below. Final demand for investment goods is obtained using an activity specific capital coefficients matrix.

Several other features affect simulations with the CGE model. The savings-investment ‘closure’ is savings-driven: in other words, the resources available for investment each year are determined by the sum of savings generated by groups within the economy (households, firms, and government) plus any foreign capital inflow. Government current spending as a share of total absorption (C+I+G) is controlled exogenously. The rule for allocation of government spending across the seven expenditure categories can accommodate various ‘crowding out’ mechanisms – for example, increased spending on health services can come entirely at the expense of other types of spending or through an increase in the government deficit, which crowds out investment. In the base scenario, AIDS-related government expenditure is deficit financed. Net foreign savings are fixed exogenously, and the exchange rate varies to achieve external balance. In common with other CGE models, the model only determines relative prices and the absolute price level must be set exogenously. In our model, the aggregate producer price index is fixed, defining the numeraire.

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6 This characterization of imperfect substitutability was developed by Armington (1969). It has since become a standard feature in numerous applied models; see, for example, Dervis et al. (1982) and Devarajan et al. (1990).
As a recursive dynamic model, the model contains a set of cumulation and updating rules (e.g. investment adds to capital stock, after depreciation; labour force growth by skill category; productivity growth). The purpose of these dynamic equations is to ‘update’ various parameters and variables from one year to the next, and for the most part, the relationships are straightforward.\(^7\) Growth in the total supply of each labour skill category is specified exogenously, and for the informal, unskilled and skilled labour groups (for which inflexible wages leads to unemployment), the growth trajectory of real wages is also provided. Sectoral capital stocks are adjusted each year based on investment, net of depreciation, and investment is assumed to respond to differential sectoral profit rates so as to preserve the rental rate differentials observed in the base year data. Sectoral productivity growth (TFP) is specified exogenously.

Using these simple relationships to update key variables, we can generate a series of growth scenarios, based on different assumptions for key exogenous variables (such as demographics, government spending, and technology). Using actual data, we first run the model forward from 1997 to 2000, providing an opportunity to ‘calibrate’ the model to recent actual performance (i.e. does the model adequately reproduce recent growth?). We then use the model to generate forward projections from 2001–10, based on the assumptions and updating relationships provided.

It is important to emphasize that, at present, we are primarily interested in the differential impact of the HIV/AIDS pandemic. By using the model and varying our assumptions about future trends in key variables (such as wage rates), we can use the CGE model as a simulation laboratory with which to conduct controlled experiments. In particular, we can compare a hypothetical ‘no AIDS’ scenario to a series of more likely ‘AIDS’ scenario. From this vantage point, what matters most is whether our benchmark ‘no AIDS’ scenario is more or less reasonable, rather than whether it is ‘accurate’ or not. In other words, building more detail or feedback into the base ‘no AIDS’ scenario will only matter if we choose to vary these features across experiments: if they are not factors which we believe will depend on AIDS-related variables, then including them should make little difference to the differential among scenarios on which we are focusing.

### 4 ESTIMATING THE MACROECONOMIC IMPACT OF THE PANDEMIC

Box 1 summarizes the key channels incorporated into our base ‘AIDS’ scenario, along with the assumptions made in each case. An appendix provides details on demographic assumptions.

Some more details on the ‘AIDS’ scenario assumptions are worthwhile. With respect to labour productivity, we assume that, due to morbidity and absenteeism, AIDS-afflicted workers are half as productive as remaining workers. AIDS-afflicted workers stay on the job for two years. The labour productivity effect for each skill class in period \(t\) is assumed to be exactly proportional to the AIDS death rate for that skill class in period \(t+1\).

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\(^7\) Note that the model is not ‘dynamic’ in the full economic sense of the word, since there are no multi-period optimizing equations and hence no attempt to ensure intertemporal optimality. The simulations are best thought of as a sequence of ‘lurching equilibria,’ in which within period (static) equilibrium is first attained, then the model ‘lurches’ forward to the next period, and a new (static) equilibrium is found.

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### Box 1. Features of the ‘AIDS’ scenario

<table>
<thead>
<tr>
<th>Effect</th>
<th>Model Assumption</th>
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</thead>
<tbody>
<tr>
<td><strong>Population/labour supply:</strong> AIDS pandemic will slow population growth and have differential impact on growth in labour supply by skill category</td>
<td>Slower growth in population and in labor force by skill categories (taken from ING Barings, 2000; see the appendix)</td>
</tr>
<tr>
<td><strong>Labour productivity:</strong> Incidence of HIV/AIDS among workers will reduce labour productivity, especially with onset of AIDS</td>
<td>Effective labour input for each skill type reduced proportionally with projected AIDS deaths (from ING Barings, 2000) on period hence</td>
</tr>
<tr>
<td><strong>Total factor productivity:</strong> Prevalence of HIV/AIDS lowers overall productivity (due to hiring and training adjustment costs, absenteeism, slower technological adaptation, etc.)</td>
<td>Sectoral TFP growth declines with the onset of the pandemic falling to one half the ‘no AIDS’ rate at the height of the pandemic</td>
</tr>
<tr>
<td><strong>Household spending patterns:</strong> HIV/AIDS affected households will shift spending towards health and related expenditures</td>
<td>AIDS affected households save nothing and increase their share of health services spending to 10–15 per cent of total spending (depending on quintile), at the expense of other (non-food) expenditures</td>
</tr>
<tr>
<td><strong>Government spending:</strong> Spread of AIDS will induce higher government spending on health and social services, either displacing other spending or increasing the deficit</td>
<td>Health share of total government recurrent spending rises from 15 per cent in 1997 to 26 per cent in 2010; non-AIDS related spending remains a constant share of total absorption.</td>
</tr>
</tbody>
</table>

Reductions in TFP growth rates are keyed off of the unskilled labour AIDS death rate. When that rate reaches its maximum value (3.4 deaths per hundred workers in 2010), TFP growth rates in all sectors are halved relative to the ‘no AIDS’ scenario. The AIDS TFP penalty in earlier years depends upon the ratio of the AIDS death rate for that year to the maximum value. So, for example, in 2003, the AIDS death rate for unskilled workers is 1.7 per 100 workers. The TFP growth rate in 2003 is two-thirds the ‘no AIDS’ growth rate \[1.0/(1+1.7/3.4)=0.67\].

It must be emphasized that the TFP declines simulated are, in large measure, hypothetical since very little solid information is available on the implications of AIDS for overall factor productivity growth rates.

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8 It may be worth highlighting the difference between the labour productivity effect and growth in TFP. The labour productivity effect could be viewed as a stock effect. It says that the stock of labour at a point in time is less productive as a function of AIDS death rates at that time. In contrast, the TFP effect could be viewed as a flow effect. It says that the rate of technical progress is reduced as a result of the pandemic.
With respect to government spending, our assumptions on government expenditure amount to a 6.9 per cent annual real increase in government expenditure on health from 1997 to 2010. This rate compares with a real rate of annual expenditure increase (actual expenditure deflated by the CPI) on health recorded for consolidated government accounts for the period 1992 to 1997 of 5.7 per cent (South African Reserve Bank, 1999). Real expenditure increases for social programs (on orphans for example) is assumed to be much lower at 2.7 per cent per annum.

Since the focus is on unemployment, the growth trajectories of real wages are of interest. Real remuneration for unskilled and semi-skilled labour is assumed to grow at a 2 per cent annual rate, which is less than the approximately 3.5 per cent average annual growth rate (calculated as the simple average of annual changes) observed from 1970–99. Real remuneration for skilled labour is assumed to remain constant, which is a somewhat slower growth rate than recent trend. Remuneration for highly skilled labour is set in the market place.

5 Base Case Macroeconomic Results

Figure 4 provides a reference point for the basic characteristics of the ‘no AIDS’ scenario as well as some insight into the bottom line results on the economic implications of the AIDS pandemic. The ‘no AIDS’ scenario postulates relatively low average growth rates during the 1997–99 period (around 2.5 per cent), consistent with South Africa’s performance during this period. ‘No-AIDS’ scenario growth rates accelerate slowly and steadily throughout the simulation period, due primarily to capital deepening and projected increases in the rate of accumulation of professional and skilled labour (which are projected based on historical trends).

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9 Even under a generous health care financing scenario, scarce government health resources will be directed towards treating AIDS and related conditions at the expense of other uses. In other sub-Saharan African countries, AIDS expenditure appears to have severely crowded out of other health expenditures, and there is some evidence of a decline in the health status for non-AIDS afflicted populations (World Bank, 1997).
The ‘AIDS’ scenario offers a very different picture. Growth rates in the late 1990s start off at roughly the same level as the ‘no AIDS’ scenario, due to the (relatively) low incidence of AIDS. However, the growth paths diverge significantly over the simulation period, as the impact of the pandemic becomes more pronounced. GDP growth rates decline from year to year through 2008 (to only around 1 per cent), before rebounding slightly in 2009 and 2010. Differences in real GDP growth rates between the scenarios reach a maximum of 2.6 per cent in 2008.

These differences in growth rates cumulate over time to bring about a substantial divergence in the overall size of the economy. Figure 5 shows that, by 2010, real GDP is about 20 per cent below the level attained in the ‘no AIDS’ scenario. In comparing medium-term performance, such real GDP measures are frequently used as an indicator of aggregate economic welfare. With respect to the AIDS pandemic, there is the broad issue, which we do not address, of whether any GDP or absorption-based indicator can provide an adequate measure of ‘welfare’ in the context of a pandemic that (among other effects) lowers average life expectancy by around 20 years. We do attempt to address a blatant omission in a traditional indicator. In particular, GDP in the ‘AIDS’ scenario contains substantially increased spending on health (both public and private) in order to combat AIDS, which may not represent an ‘improvement’ in welfare relative to the ‘no AIDS’ base. An alternative indicator of welfare might focus exclusively on absorption (C + I + G) excluding AIDS-related government expenditures and private expenditures on food and medical services.\(^\text{10}\) This measure is defined as ‘Absorption2’ in Figure 5. Real spending on this aggregate (deflated by the consumer price index) is 24 per cent lower in the ‘AIDS’ scenario in 2010.

One expects the AIDS pandemic to reduce the overall size of the economy. With fewer factors of production, reduced investment, and lower productivity in the ‘AIDS’ scenario, the size of the economy is bound to be smaller. But while the size of the economy is smaller, the population is lower as well. Per capita GDP might actually rise. A number of analyses have found per capita income largely unchanged in ‘AIDS’ versus ‘no AIDS’ scenario.

\(^\text{10}\) There are other important omissions. Both per capita income and absorption2 entirely ignore AIDS victims and the trauma associated with their deaths.Binswanger (2000) compares the measure of per capita GDP with the measure of birthday cake per child as an indicator of success of a birthday party. If a lunatic enters a birthday party and shoots two guests, success of the party increases by the birthday cake per child measure. Absorption2 is subject to essentially the same criticism.
scenarios. (BIDPA, 2000; ING Barings, 2000; The World Bank, 1997; Bloom and Mahal, 1995; Cuddington, 1993; Kambou et al., 1993).11

In contrast, for South Africa, we find a substantial reduction in GDP and Absorption2 per capita. The exact declines are shown in Figure 6. By 2010, per capita GDP is 8 per cent lower in the ‘AIDS’ scenario compared with the ‘no AIDS’ scenario. Moreover, this per capita GDP decline disproportionately lowers non-health and non-food expenditure: Absorption2 per capita declines by 13 per cent. So, the survivors of the AIDS pandemic are left with a smaller economic ‘pie’, and more of this pie is directed towards health and food expenditure, so that discretionary expenditures decline dramatically.

A + L provide detailed explanations of why these results are more pessimistic than the analyses cited above—a major reason being the now massive scale of the pandemic. This sentiment is echoed by Bloom (2000), a co-author on one of the studies cited above, who states that "the whole economy [in Africa] could unravel what is about to come is ten times worse.”

6 AIDS AND UNEMPLOYMENT

A naive analysis that considered the AIDS pandemic and unemployment might forecast that the unemployment rate should fall at least relative to a ‘no AIDS’ scenario. After all, the growth rate of the unskilled and semi-skilled labour pool is considerably slower in the ‘AIDS’ versus the ‘no AIDS’ scenarios (see the Appendix). By 2010, this labour pool is 17 per cent smaller in the ‘AIDS’ scenario compared to the ‘no AIDS’ scenario. Despite this slower rate of growth in the unskilled and semi-skilled labour pool, unemployment rates for this category of labour differ very little between the ‘AIDS’ and ‘no AIDS’ scenarios. This is shown in Figure 7, which shows projected unemployment rates for unskilled and semi-skilled workers.

Reduced overall economic growth rates are clearly part of the story. While the supply of unskilled and semi-skilled labour is smaller, the aggregate demand for labour is smaller as

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11Economic history provides some support for a mild or even positive impact on per capita GDP based on the experience of the bubonic plague in the middle ages and the influenza pandemic in India in 1918–19. However, neither of these pandemics concentrated on young adults (in fact, young adults were probably more likely to survive) and neither required extended periods of palliative care, both features of the AIDS pandemic. A more appropriate historical analogue might be the African slave trade, which also removed young adults from the population (but did not require extended periods of palliative care).
well due to the smaller size of the economy. The character of growth could also be a part of the story. The huge employment problem in South Africa calls for rapid economic growth, particularly in sectors that use relatively large amounts of unskilled and semi-skilled labour. By this same logic, the implications of the pandemic for employment depend upon both the implications for overall growth and the implications for the character of that growth. If sectors that are particularly large demanders of labour are hit particularly hard by the pandemic, then the implications for employment will be worse than if the pandemic depresses growth more strongly in sectors that use relatively little labour.

Table 1 shows the ratio of real value added by sector between the ‘no AIDS’ and ‘AIDS’ scenarios in 2010 as well as sectoral shares in total value added and two measures of labour use (all shares computed from base year data). Regarding the ratios of value added shown in the first data column of the Table, note that none of the ratios is greater than one implying that output in all sectors is reduced in the ‘AIDS’ compared with the ‘no AIDS’ scenarios. There is also considerable dispersion in these real value added ratios across sectors. Real value added levels for the Construction and Equipment sectors in the ‘AIDS’ scenario are respectively 65 per cent and 69 per cent of the levels attained in the ‘AIDS’ scenario.

Investment demand accounts for 62 per cent and 34 per cent of total demand in the Construction and Equipment sectors respectively. With these high shares of investment demand, these sectors are particularly susceptible to the reduction in savings (increased government budget deficit and reduced household savings rates) brought on by the epidemic. Due to the cumulated effects of the reduction in savings, aggregate real investment in 2010 in the ‘AIDS’ scenario is only 61 per cent of the level attained in the ‘no AIDS’ scenario. In contrast, real value added levels in (private) Medical Services and Government Services (includes public medical spending) are relatively close to the levels attained in the ‘no AIDS’ scenario due primarily to AIDS related medical expenditures.

These differential sectoral impacts have potential implications for employment. We explore these by examining the bottom row of Table 1 labeled ‘Real GDP (actual and weighted)’. As indicated earlier, real GDP in the ‘AIDS’ scenario is 20 per cent lower relative to the ‘no AIDS’ scenario resulting in a real GDP ratio of 0.80. This is shown at the
Table 1. Sectoral impacts of the pandemic

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<tr>
<th>Sector</th>
<th>AIDS/NoAIDS ratio of real value added</th>
<th>Share in total value added</th>
<th>Share in total labour value added</th>
<th>Labour share in sectoral value added</th>
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<tr>
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<td>0.7</td>
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*The ratio of real value added is taken for 2010, which is the final year of the simulation period. All shares are computed from base year (1997) data.

The bottom of the first data column of the Table. The second data column indicates the average of the sectoral ratios weighted by initial (1997) composition of value added weights. This provides an estimate of the ratio of real GDP at factor cost between the two scenarios. The final row of the third data column also contains an average of the sectoral real value added ratios. This time the weights are the shares of sectoral labour use in total labour value added. This measure, at 0.78, is 3.5 per cent below the real GDP at factor cost ratio of 0.81 (shown in the last row of data column two). This differential indicates that output from sectors that are large demanders of labour tends to be relatively more strongly depressed due to the pandemic.

The relationship between the ratio of real value added and sectoral labour use as a share of total labour supply is illustrated graphically in Figure 8 using a scatter plot format. The ratio of real value added is on the horizontal axis and the share of each sector in total labour use is on the vertical axis. As mentioned earlier, Construction has the smallest ratio of real value added at 0.65. It is thus the point in Figure 8 closest to the vertical axis. This point indicates that Construction accounts for approximately 8 per cent of total demand for labour (this can be confirmed in Table 1). Remaining points are analogously placed. Figure 8 also contains the estimated line from a regression where the real value added ratios are the dependent variables and the sectoral shares in total labour use are the independent variables. The slope of the line is negative confirming the tendency for sectors that are larger demanders of labour to be more strongly impacted by the pandemic.

The estimated slope coefficient is, however, not significantly different from zero. Choice of aggregation influences this result. By running a more disaggregate analysis (e.g. generating more observations), one could almost surely obtain a negative and significant estimated coefficient. By the same token, one could also weaken or even eliminate the result by aggregating all of the sectors that tend to be less negatively
impacted by the pandemic into a single large sector, which, purely by virtue of its size, would tend to constitute a large share of total unskilled and semi-skilled labour demand. This would dampen or even eliminate the observed negative relationship between share in total labour demand and sectoral growth performance. However, one can say that, based on this (reasonably sensible) aggregation, sectors that demand a large share of the total unskilled and semi-skilled labour supply, tend to be relatively more strongly affected by the pandemic. This is due in part to depressed investment demand combined with the structural feature that investment sectors, such as Construction and Equipment, tend to be relatively large users of labour. However, other factors, such as the morbidity-induced declines in productivity of unskilled and semi-skilled labour, also appear to play a role. This is explored in Figure 9.

Figure 9 also presents a scatter plot. As in Figure 8, the ratio of real value added for each sector is plotted on the horizontal axis. The vertical axis indicates the share of unskilled and semi-skilled labour value added in total sectoral value added. Referring to Table 1 for
an example, about 39 per cent of total value added in the Mining sector accrues to unskilled and semi-skilled labour. Figure 9 illustrates a rather robust relationship between intensity of unskilled and semi-skilled labour use and declines in output due to AIDS. The larger the intensity of unskilled and semi-skilled labour use relative to other factors of production, the lower is real value added in 2010 relative to the ‘no AIDS’ scenario. The t-statistic on the slope coefficient for the regression line in Figure 9 is significant at the 1 per cent level. The Construction and Equipment sectors use labour intensively (see Table 1). So, depressed investment demand reinforces the relationship in Figure 9. The morbidity effect on productivity of unskilled and semi-skilled labour is the other main driving force.

In summary, due to both the rate of economic growth and the composition of growth under the AIDS epidemic, demand for unskilled and semi-skilled labour is projected to be weak over the coming decade. This AIDS induced slowdown in demand completely offsets the AIDS induced decline in supply. As a result, unemployment rates are essentially the same between the ‘AIDS’ and ‘no AIDS’ scenarios. To ameliorate the unemployment problem, policies to foster more rapid job creation are required.

In light of trends in real remuneration by labour category presented in Section 2, a policy of wage moderation for the unskilled and semi-skilled category is an obvious choice. Under current conditions, wage moderation could be expected to stimulate growth and to concentrate that growth in sectors that use unskilled and semi-skilled labour intensively (as a share of sectoral value added). Wage moderation stimulates growth by enhancing employment. Since the opportunity cost of moving an individual from unemployment to work is (by definition) zero, employment growth translates directly into real GDP growth. This increase in growth stimulates investment, which further enhances growth over time. For obvious reasons, wage moderation also favours sectors that use labour intensively. Thus, both the rate and compositional quality of growth should be improved through a policy of wage moderation.

Figures 10 and 11 illustrate the impacts of alternative wage policies for the unskilled and semi-skilled labour category on GDP growth and unemployment respectively. As mentioned earlier, the base case assumes a rate of real remuneration growth for unskilled
and semi-skilled labour of 2 per cent per annum – a rate well below the average of 3.5 per cent recorded over the past three decades. Alternative rates of 1 per cent, 0 per cent, and minus 1 per cent are illustrated in the Figures.

Figure 10 illustrates that assumptions about trends in real remuneration have a significant impact on rates of GDP growth. If real remuneration remains constant over the simulation period, GDP growth performance improves by about 0.5 percentage points annually relative to the ‘no AIDS’ base. If real wages decline at a rate of 1 per cent per year, annual growth performance improves by nearly a full percentage point. The improved growth rate comes about first through higher employment and then through the cumulative effect of increased investment (induced by the higher employment rates).

Differentials in unemployment rates across the scenarios illustrate the improved employment performance associated with reduced rates of growth of real remuneration. (supply of unskilled and semi-skilled labour is the same across all of the scenarios). This is shown in Figure 11. A constant level of real remuneration leads eventually to a gradually declining unemployment rate. Annual reductions of 1 per cent in real remuneration (to a level in 2010 about 14 per cent below the level in 1997) generates a fairly steep decline in the unemployment rate. This reductions-in-real-remuneration scenario leads to an unemployment rate in 2010 that is 17 percentage points below the level in the base case; nevertheless, despite these reductions, the unemployment rate remains high at 41 per cent.12

Real wage moderation leads to both more rapid growth and improved quality of growth from an employment perspective. Figure 12 uses a scatter plot analysis to compare the base case ‘AIDS’ scenario (real remuneration growth of 2 per cent per annum for unskilled semi-skilled labour) with an ‘AIDS’ scenario and no change in real remuneration over the simulation period. The ratios of real value added are plotted on the horizontal axis and the share of unskilled and semi-skilled labour in sectoral value added is plotted on the vertical

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12Recall that the analytical focus is on differentials across scenarios. We report this unemployment level, as opposed to differential, mainly to point out that annual real wage declines of 1 per cent paired with tepid economic growth will not be sufficient to eliminate the employment problem over the space of a decade. We believe this is a robust levels result.
axis. This time the regression line is positively sloped (the slope coefficient is significantly different from zero). Wage moderation both enhances growth (all value added ratios are greater than one) and favours sectors that use labour intensively (positive slope of the regression line).

The distributional implications of a policy of wage moderation (or even decline), compared with the historical trend of rising real wages, are not self-evident. While households without unemployed members would (*ceteris paribus*) prefer to see real wages rise, households with unemployed members stand to benefit from increased employment. New techniques, relying on very substantial household detail, could be employed to rigorously sort through these conflicting effects.\(^\text{13}\) In the context of the current model, the real value of total factor payments to unskilled and semi-skilled labour is a possible indicator. This measure stays essentially constant across the various wage scenarios. Factor payment declines due to reduced real remuneration growth rates are completely offset by payments to the newly employed.\(^\text{14}\)

### 7 CONCLUSIONS

A persistent feature of the South African economy in the last three decades has been very poor job creation performance for unskilled and semi-skilled labour combined with a fairly rapid increase in the supply of this same category of labour. An enormous unemployment problem has resulted from these two trends. Recently compiled data and standard economic theory point to rapid growth in real remuneration for unskilled and semi-skilled workers as a major contributor to the poor job creation performance, particularly in the formal sector.

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\(^\text{13}\) Embedding very detailed representations of households within CGE models is now possible and forms an important area of future research.

\(^\text{14}\) Recall that the production technology is translog in value added. In the formulation, substitution elasticities differ markedly across factor pairs and differ markedly from one. Consequently, this real value of factor payments result does not stem from a Cobb-Douglass or Cobb-Douglas like production relationship.
While the HIV/AIDS pandemic can be expected to significantly alter levels and trends for a host of economic variables, our analysis indicates that the pandemic, taken alone, might not materially affect the unemployment rate. Even though the pandemic is projected to drive growth rates in the supply of unskilled and semi-skilled labour to around zero, our analysis indicates that the pandemic will also depress labour demand leaving the unemployment rate, in our base ‘AIDS’ scenario, essentially unchanged compared with a fictional ‘no AIDS’ scenario. The pandemic depresses labour demand through three effects.

- Declines in the rate of overall economic growth.
- Pronounced declines in sectors that supply investment commodities, particularly the Construction and Equipment sectors. These two sectors happen to use unskilled and semi-skilled labour intensively and together account for a significant share (16.3 per cent) of total payments to this category of labour.
- Beyond this investment demand effect (brought on by reduced savings), AIDS induced morbidity effects on unskilled and semi-skilled workers tend to depress output relatively more in sectors that use unskilled and semi-skilled labour intensively with further negative implications for employment.

Countering these three effects will be key to palliating the negative economic consequences of the pandemic and reducing unemployment rates. To reduce the unemployment problem, South Africa must have rapid overall economic growth ideally with sectors that use unskilled and semi-skilled labour intensively leading the way. A policy of real wage moderation (or even modest decline) presents a straightforward option for bolstering overall economic growth and giving a particularly large stimulus for sectors that use unskilled and semi-skilled labour intensively.

ACKNOWLEDGEMENTS

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REFERENCES


### APPENDIX

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Source: ING Barings (2000) for years 2000-2010. Figures for 1998 and 1999 were obtained by extrapolation.
Figure A1. Population. Source: ING Barings (2000)