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

Channing Arndt
Assistant Professor
Department of Agricultural Economics
Purdue University

Jeffrey D. Lewis
Lead Economist, South Africa
The World Bank

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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% 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 labor 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 laborers in 1999 at only 92% 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% of the 1970 level while remuneration for other 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. Even though the pandemic is projected to drive growth rates in the supply of unskilled and semi-skilled labor to around zero, our analysis indicates that the pandemic will also depress labor demand leaving the

unemployment rate, in our base "AIDS" scenario, essentially unchanged compared to a fictional "no AIDS" scenario. The pandemic depresses labor 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 labor intensively and together account for a significant share (16.3%) of total payments to this category of labor.

- 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 labor 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 labor 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 labor intensively with further positive implications for employment.

THE HIV/AIDS PANDEMIC IN SOUTH AFRICA:
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1. Introduction

South Africa is currently confronting an HIV/AIDS crisis. HIV prevalence in the population is currently estimated at about 13% 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 percent 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 labor) 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 (2001; 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 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.

Here, we seek to further investigate the interactions between unemployment and AIDS using the basic modeling approach set forth in A+L. The paper is structured as

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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 modeling 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 analyzes 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 labor. 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 labor, unemployment rates were quite low in the early 1970s. However, since 1976, unemployment rates for unskilled and semi-skilled labor have increased essentially monotonically. In 1995, the unemployment rate, according to this data, surpassed the mind-bogglingly high level of 50% and continued to climb for the remaining four years of available data. In contrast, the unemployment rate for highly skilled workers has been negligible throughout the period. The rate for skilled labor began to climb more recently and has attained a fairly significant level.

The data in Figure 1 are based on a "narrow" definition of unemployment. 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 1 ABOUT HERE

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 labor category has been dismal. Total employment (formal sector and informal sector) of unskilled and semi-skilled laborers in 1999 was only 92% 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 laborers 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

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[1] The data series were derived from official South African statistical sources by Quantec Research.

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employment of unskilled and semi-skilled labor is evidently firmly in place and shows no sign of abating.

FIGURE 2 ABOUT HERE

In short, formal sector employment failed to grow as rapidly as the unskilled and semi-skilled labor force in the 1970s and declined essentially throughout the 1980s and 1990s while labor supply continued to expand. In contrast, employment in the highly skilled and skilled labor segments grew respectively by 380 and 200 percent 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 labor classes and standard economic theory point to these trends as major contributing factors. Figure 3 shows real remuneration per employee by labor class since 1970. In 1999, real remuneration per highly skilled worker was at 90% of the 1970 level while real remuneration per skilled worker increased to 110% of the 1970 level. In contrast, real remuneration per unskilled and semi-skilled worker in 1999 had grown to 250% of the 1970 level.

FIGURE 3 ABOUT HERE

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 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 labor, 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

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Matrix, or SAM), which requires (among other things) that key behavioral 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 fourteen 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 labor, informal labor, and physical capital), five household categories representing income distribution quintiles, seven different government functional spending categories, and three government investment categories.[2]

Sectoral production occurs according to a translog production function that determines how capital and labor inputs are combined together in generating value added.[3] The value added aggregate is then combined with intermediate (material) inputs to produce output 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. However, 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. 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 labor and capital inputs, less output is produced), and second, the contribution of *specific* factor inputs (such as labor) 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 workers).

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[2] The 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.

[3] The 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 labor, and capital and unskilled labor). This is important in the South African context because of the enormous differences in factor utilization (ranging from high unemployment among unskilled labor to full employment of professional labor) and historic trends in factor use.

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 demand.[4] 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 behavior 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 behavioral 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 labor 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.

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[4] 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, de Melo, and Robinson (1982) and Devarajan, Lewis, and Robinson (1990).

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*.

As a recursive dynamic model, the model contains a set of cumulation and updating rules (e.g. investment adds to capital stock, after depreciation; labor 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.[5] Growth in the total supply of each labor skill category is specified exogenously, and for the informal, unskilled and skilled labor 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 2001-2010, based on the assumptions and updating relationships provided.

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[5] 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.

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.

Box 1: Features of the "AIDS" scenario

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

Some more details on the "AIDS" scenario assumptions are worthwhile. With respect to labor 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 labor 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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Reductions in TFP growth rates are keyed off of the unskilled labor 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 $[1.0/(1+1.7/3.4)=0.67]$.[6] 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.

With respect to government spending, our assumptions on government expenditure amount to a 6.9 percent 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 percent (South African Reserve Bank, 1999).[7] Real expenditure increases for social programs (on orphans for example) is assumed to be much lower at 2.7 percent per annum.

Since the focus is on unemployment, the growth trajectories of real wages are of interest. Real remuneration for unskilled and semi-skilled labor is assumed to grow at a 2% annual rate, which is less than the approximately 3.5% average annual growth rate (calculated as the simple average of annual changes) observed from 1970-1999. Real remuneration for skilled labor is assumed to remain constant, which is a somewhat slower growth rate than recent trend. Remuneration for highly skilled labor 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 1997-1999 period (around 2.5 percent), consistent with South Africa's performance during this period. "No-AIDS" scenario growth rates accelerate slowly and

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[6] It may be worth highlighting the difference between the labor productivity effect and growth in TFP. The labor productivity effect could be viewed as a stock effect. It says that the stock of labor 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.

[7] 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).

steadily throughout the simulation period, due primarily to capital deepening and projected increases in the rate of accumulation of professional and skilled labor (which are projected based on historical trends).

FIGURE 4 – INSERT ABOUT HERE

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 percent), before rebounding slightly in 2009 and 2010. *Differences* in real GDP growth rates between the scenarios reach a maximum of 2.6 percent 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 percent 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.[8] This measure is defined as "Absorption2" in Figure 5. Real spending on this aggregate (deflated by the consumer price index) is 24 percent lower in the "AIDS" scenario in 2010.

Figure 5 – INSERT ABOUT HERE

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"

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[8] 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.

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" scenarios. (BIDPA 2000; ING Barings 2000; The World Bank 1998; Bloom and Mahal 1995; Cuddington 1993; Kambou, Devarajan, and Over 1993).[9]

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 percent 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 percent. 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.

FIGURE 6 – INSERT ABOUT HERE

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 labor pool is considerably slower in the "AIDS" versus the "no AIDS" scenarios (see appendix). By 2010, this labor pool is 17% smaller in the "AIDS" scenario compared to the "no AIDS" scenario. Despite this slower rate of growth in the unskilled and semi-skilled labor pool, unemployment rates for this category of labor 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.

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[9] Economic 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).

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

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 labor 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 to 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% and 69% of the levels attained in the "AIDS" scenario.

Investment demand accounts for 62% and 34% 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% 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% lower relative to the "no AIDS" scenario resulting in a real GDP ratio of 0.80. This is shown at 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 labor use in total labor value added. This measure, at 0.78, is 3.5% 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 labor tends to be relatively more strongly depressed due to the pandemic.

The relationship between the ratio of real value added and sectoral labor use as a share of total labor 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 labor 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% of total demand for labor (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 labor use are the independent variables. The slope of the line is negative confirming the tendency for sectors that are larger demanders of labor 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 labor demand. This would dampen or even eliminate the observed negative relationship between share in total labor 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 labor 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 labor. However, other factors, such as the morbidity-induced declines in productivity of unskilled and semi-skilled labor, 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 labor value added in total sectoral value added. Referring to Table 1 for an example, about 39% of total value added in the Mining sector accrues to unskilled and semi-skilled labor. Figure 9 illustrates a rather robust relationship between intensity of unskilled and semi-skilled labor use and declines in output due to AIDS. The larger the intensity of unskilled and semi-skilled labor 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% level. The Construction and Equipment sectors use labor intensively (see Table 1). So, depressed investment demand reinforces the relationship in Figure 9. The morbidity effect on productivity of unskilled and semi-skilled labor 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 labor 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 labor 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 labor 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 favors sectors that use labor 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 labor 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 labor of 2% per annum—a rate well below the average of 3.5% recorded over the past three decades. Alternative rates of 1%, 0%, and minus 1% 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 relative to the "no AIDS" base. If real wages decline at a rate of 1% per year, 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 labor 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% in real remuneration (to a level in 2010 about 14% 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%.[10]

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 annum for unskilled semi-skilled labor) 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 labor in sectoral value added is plotted on the vertical axis. This time the regression line is positively sloped (the slope

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[10] Recall 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% 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.

coefficient is significantly different from zero). Wage moderation both enhances growth (all value added ratios are greater than one) and favors sectors that use labor 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 (ceterus 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.[11] In the context of the current model, the real value of total factor payments to unskilled and semi-skilled labor 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.

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 labor combined with fairly rapid increase in the supply of this same category of labor. 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.

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 labor to around zero, our analysis indicates that the pandemic will also depress labor demand leaving the unemployment rate, in our base "AIDS" scenario, essentially unchanged compared to a fictional "no AIDS" scenario. The pandemic depresses labor 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 labor intensively and together account for a significant share (16.3%) of total payments to this category of labor.

- Beyond this investment demand effect (brought on by reduced savings), AIDS induced morbidity effects on unskilled and semi-skilled workers tend to depress

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[11] Embedding very detailed representations of households within CGE models is now possible and forms an important area of future research.

output relatively more in sectors that use unskilled and semi-skilled labor 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 labor 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 labor intensively.

Table 1: Sectoral impacts of the pandemic.[a]

| Sector	AIDS/NoAIDS ratio of real value added	Share in total value added	Share in total labor value added	Labor share in sectoral value added
Agriculture	0.83	0.043	0.060	0.239
Mines	0.73	0.067	0.152	0.391
Food Processing	0.82	0.036	0.039	0.191
Consumption Goods	0.76	0.020	0.056	0.486
Intermediates	0.78	0.106	0.103	0.167
Equipment	0.69	0.046	0.081	0.299
Elec., Gas, Water	0.79	0.033	0.030	0.157
Construction	0.65	0.031	0.082	0.450
Trade	0.79	0.139	0.094	0.116
Transport	0.80	0.082	0.098	0.207
Business services	0.80	0.184	0.041	0.039
Medical services	0.90	0.019	0.003	0.032
Social services	0.80	0.032	0.068	0.363
Government	0.92	0.162	0.091	0.097
Simple Average	0.79	0.071	0.071	0.231
Real GDP ratio (actual and weighted)	0.80	0.81	0.78	NA

[a] 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.
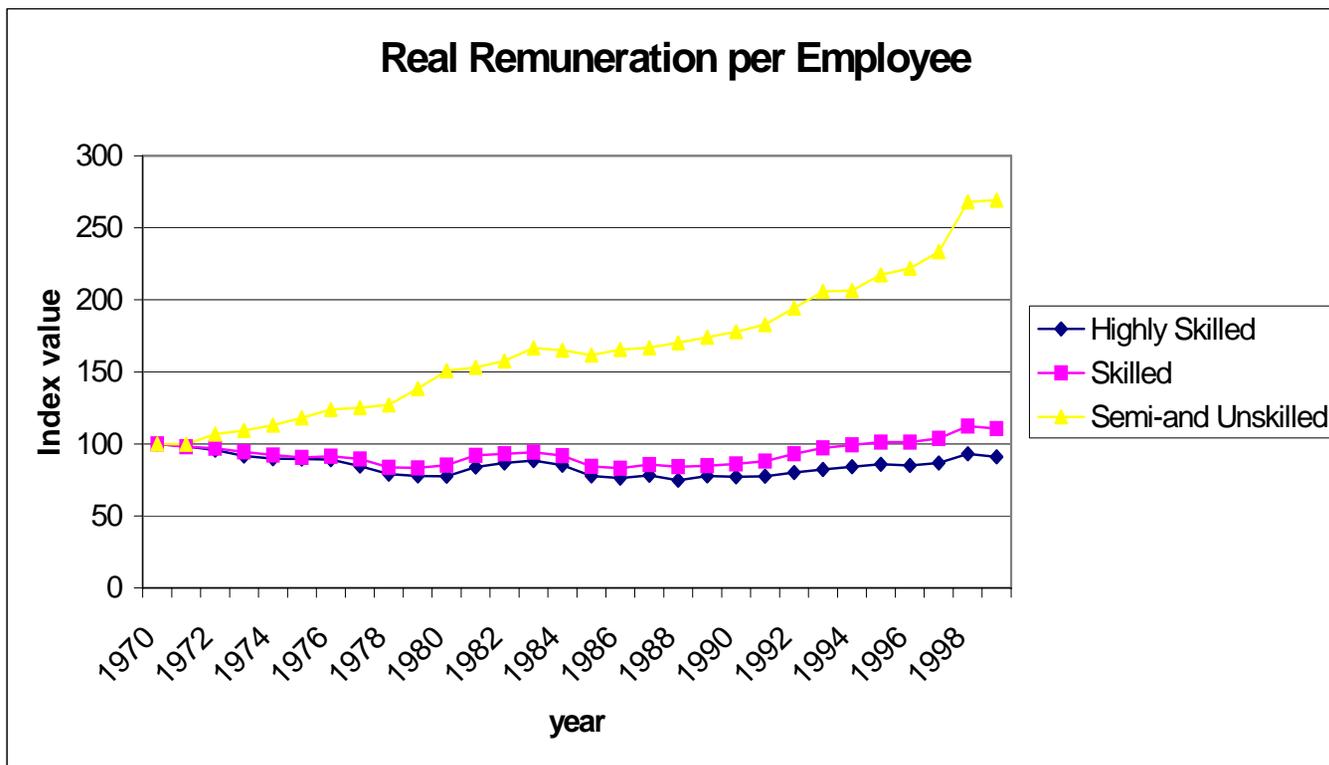
Figure 1
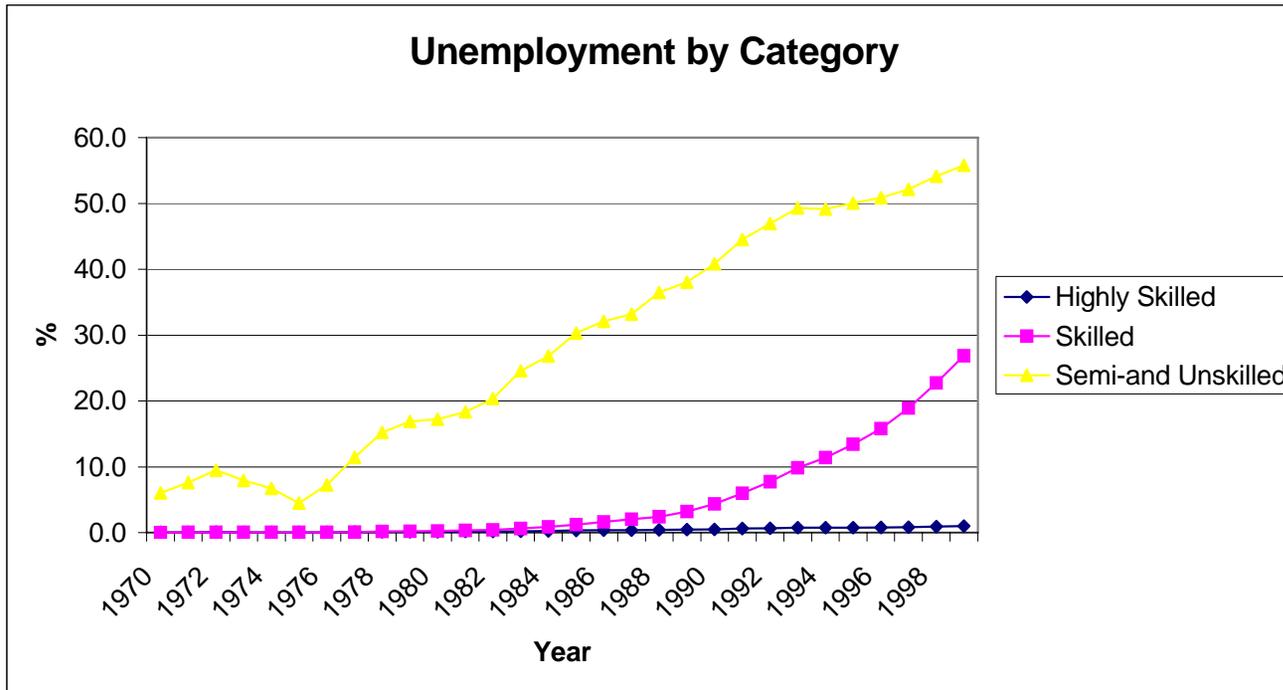
Unemployment by Category

Source: Derived from official South African data by Quantec Research, Pretoria, South Africa.
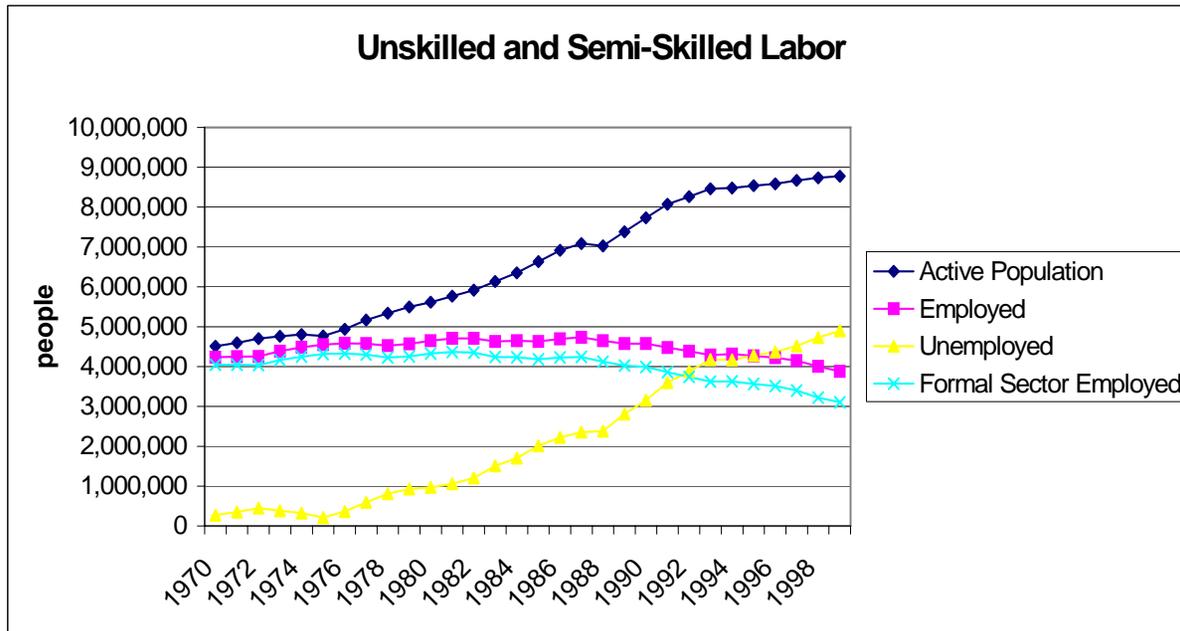
Figure 2

Source: Derived from official South African data by Quantec Research, Pretoria, South Africa.

Figure 3

Source: Derived from official South African data by Quantec Research, Pretoria, South Africa.
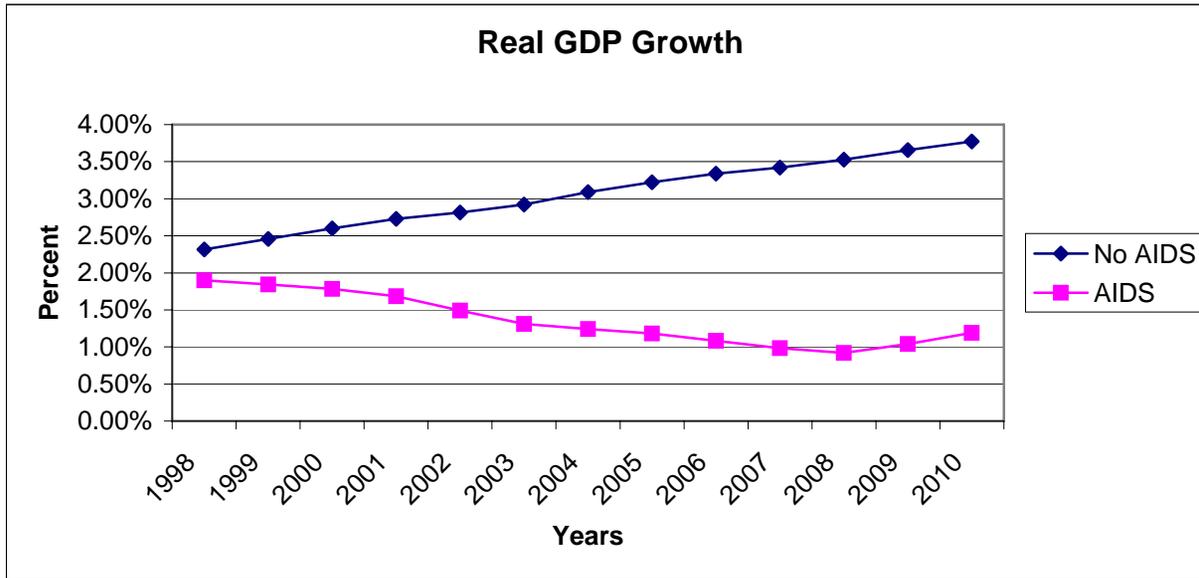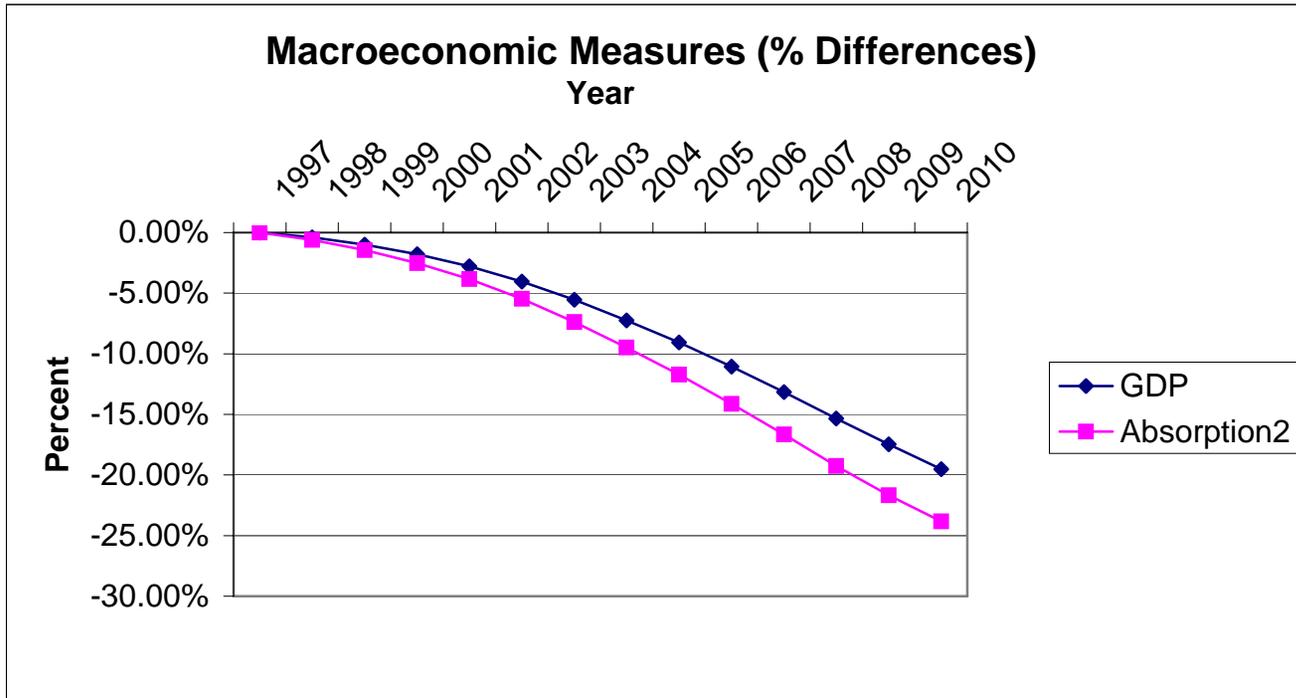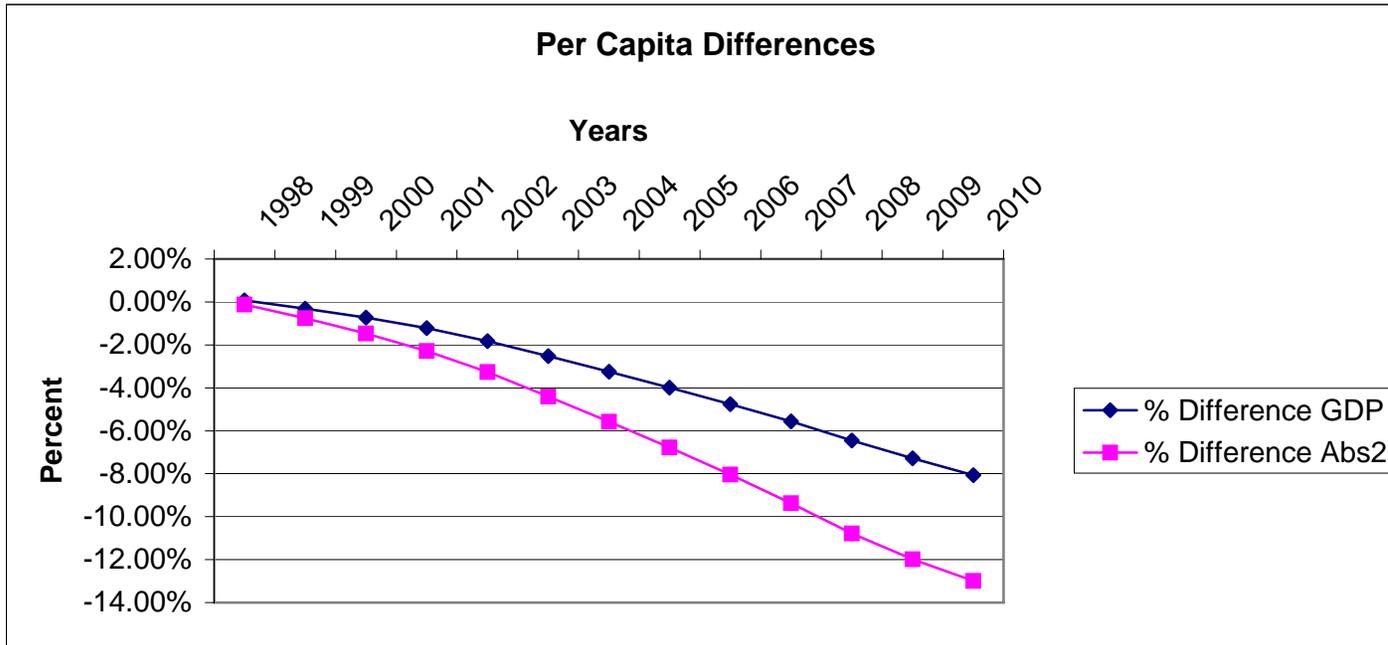
Figure 4

Real GDP Growth

Figure 5

Figure showing "Macroeconomic Measures (% Differences)" plotting GDP and Absorption2 against Year (1997–2010), with Percent on the y-axis.

Figure 6

Per Capita Differences

Figure 7

Unemployment Rate - Semi and Unskilled Workers

Figure 8

Share of Unskilled Labor Use and Relative Expansion

Figure 9

Share of Unskilled Labor in Value Added and Relative Expansion

Figure 10

Figure 11

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Figure 12

AIDS Scenarios Wage Moderation and Base
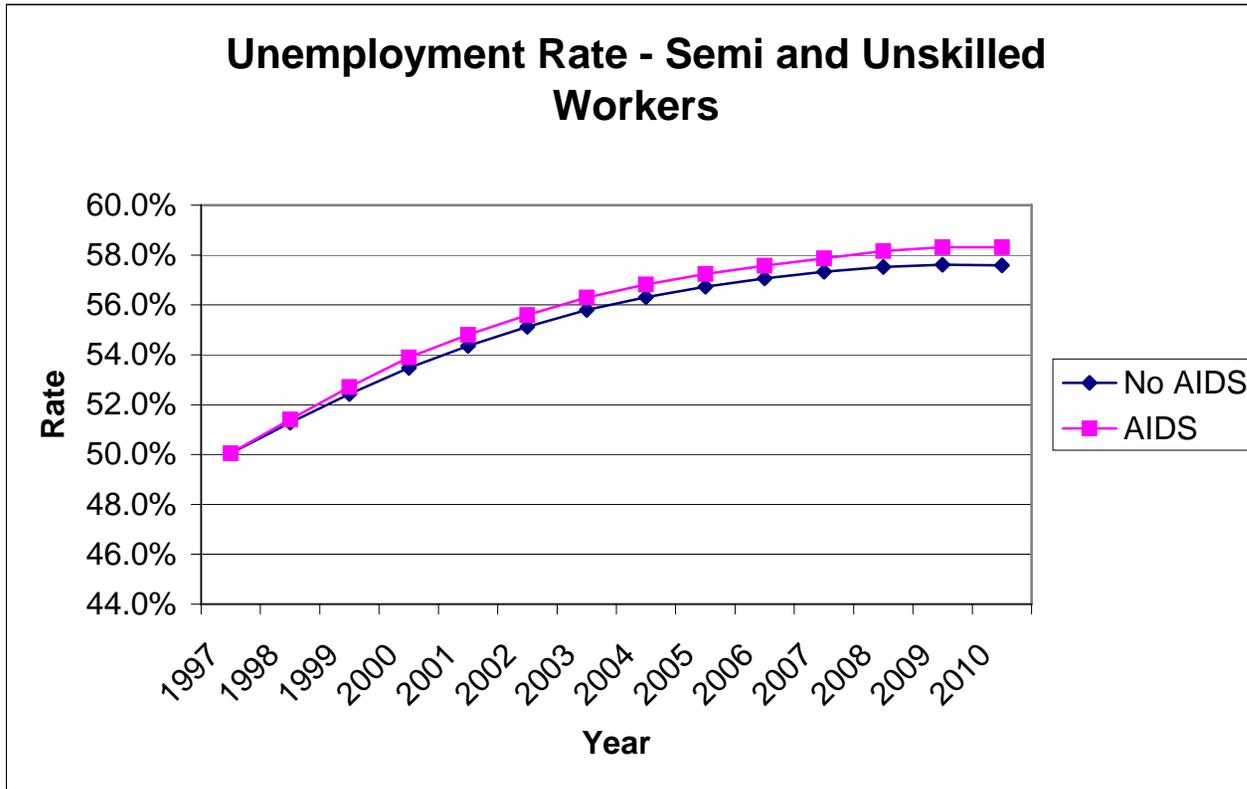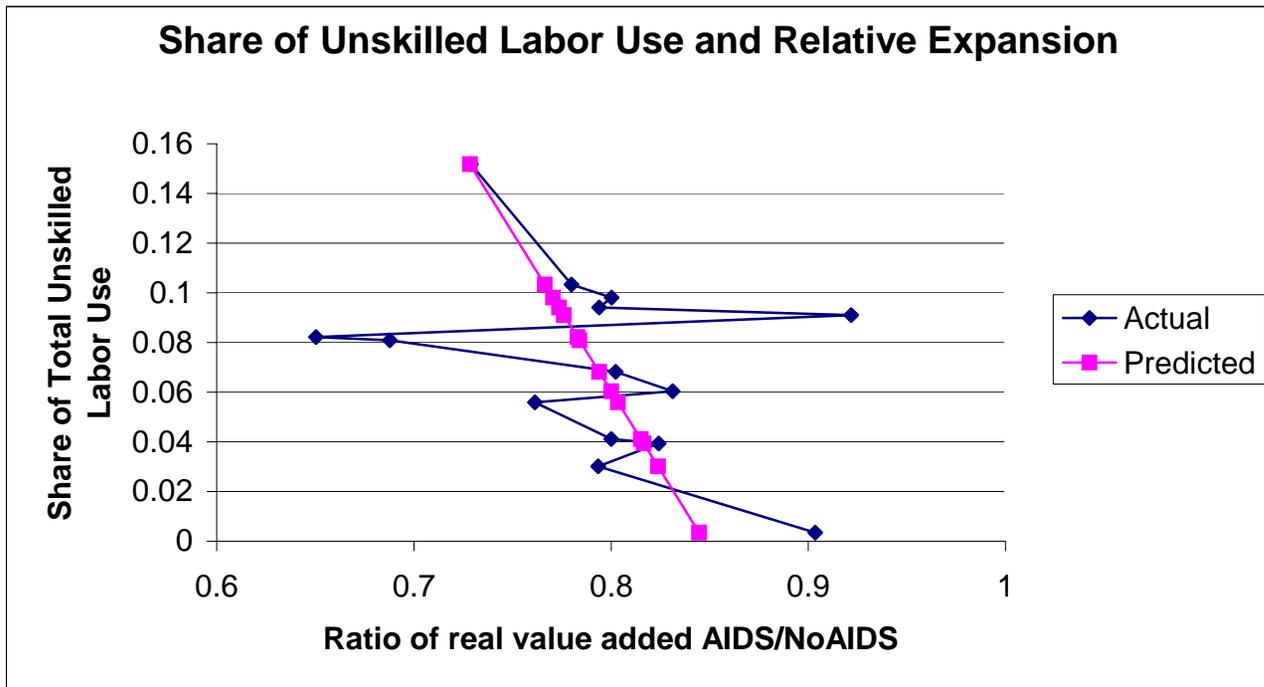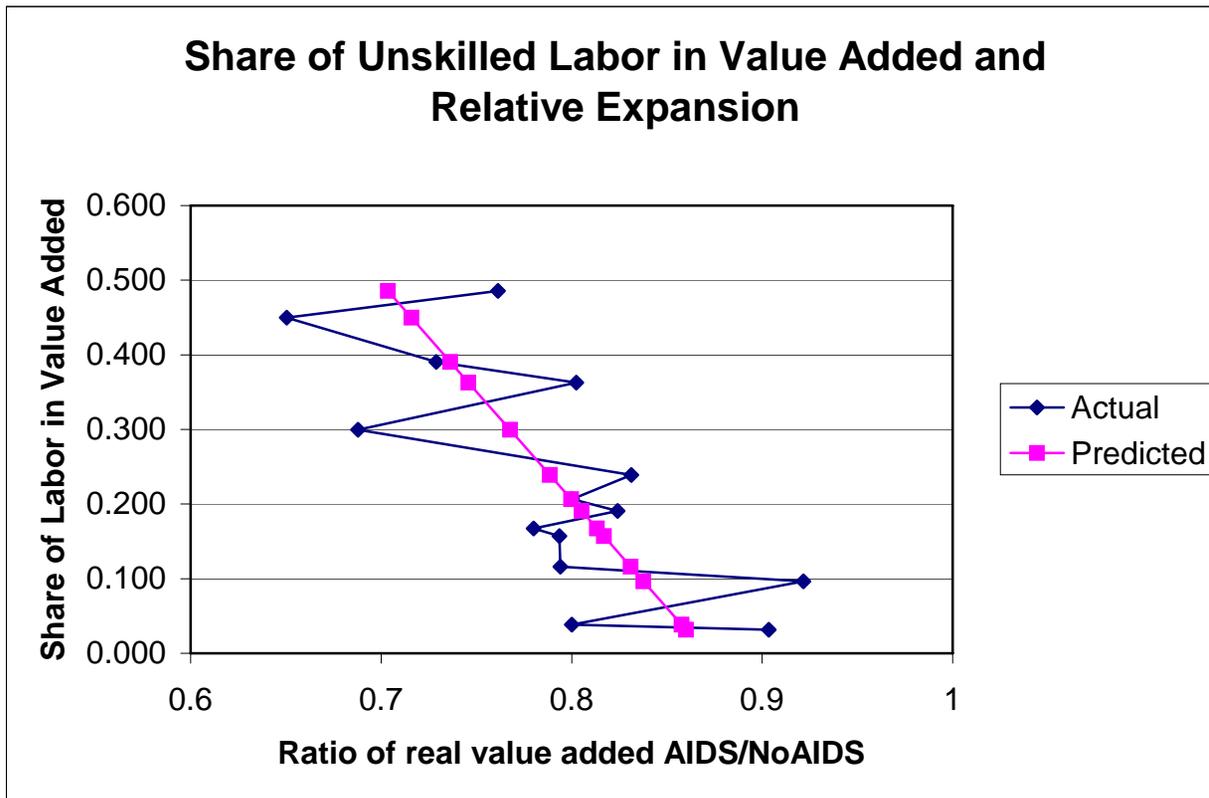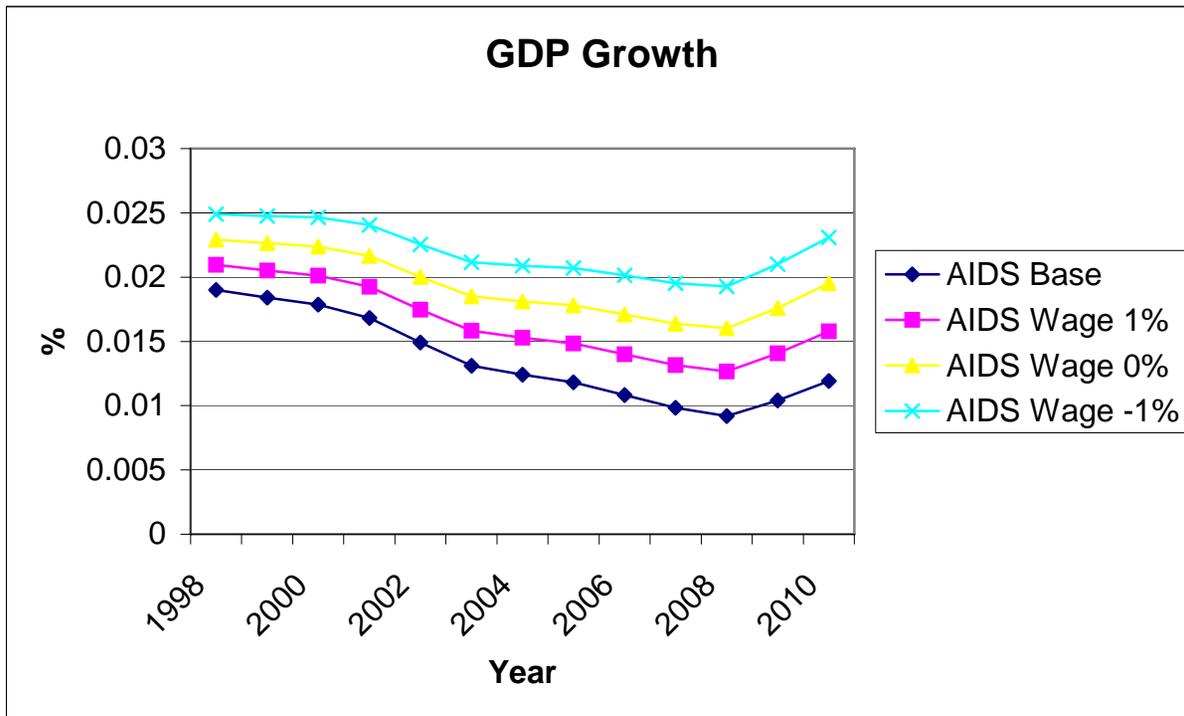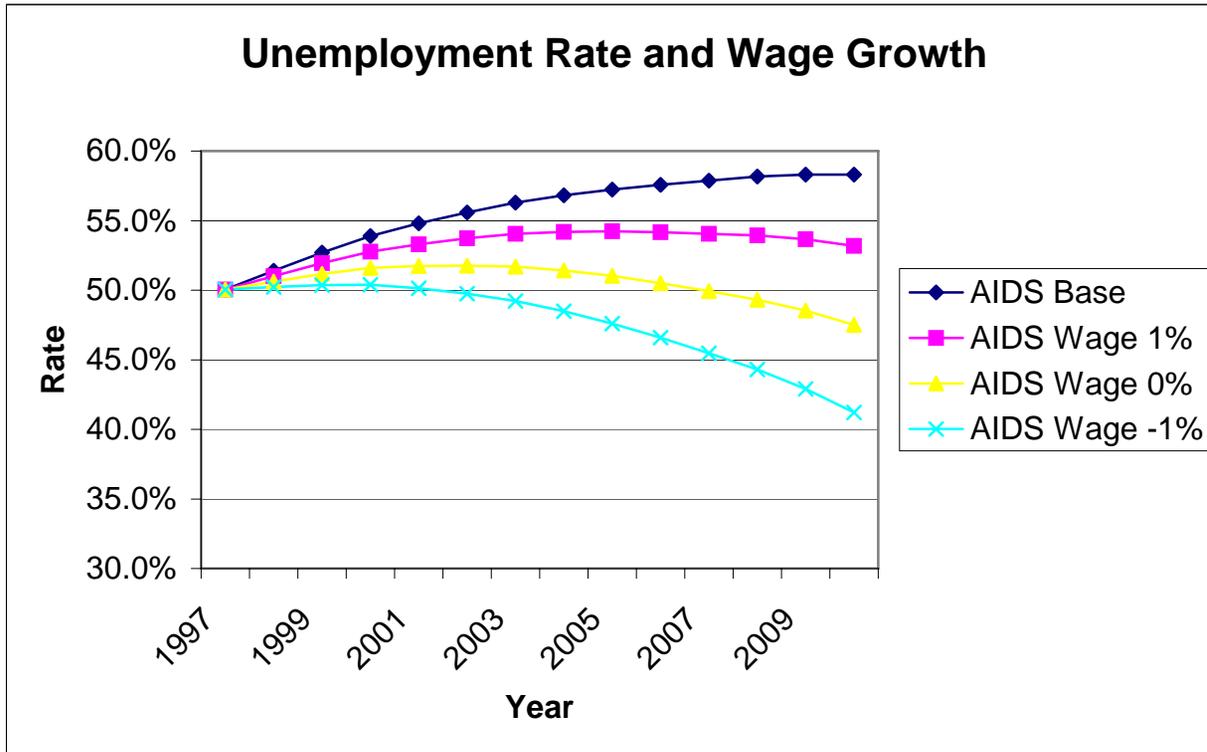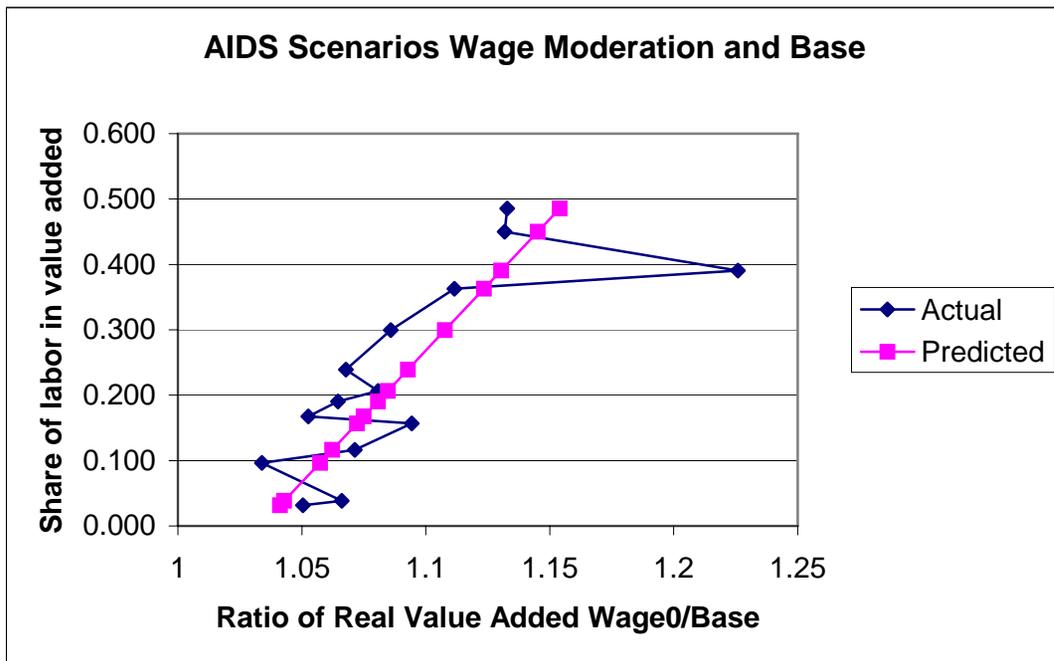
Table A1: AIDS death rate per 100 workers by category.

	1998	1999	2000	2001	2002	2003	2004
Unskilled	0.3	0.5	0.8	1.0	1.3	1.7	2.1
Skilled	0.2	0.4	0.5	0.7	0.9	1.2	1.4
Professional	0.2	0.3	0.4	0.5	0.6	0.7	0.9

|	2005	2006	2007	2008	2009	2010
Unskilled	2.4	2.7	3.0	3.2	3.3	3.4
Skilled	1.6	1.8	1.9	2.0	2.1	2.1
Professional	1.0	1.1	1.1	1.2	1.2	1.2

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

Table A2: Labor force growth rates.

		1998	1999	2000	2001	2002	2003	2004
Unskilled	AIDS	2.93%	2.82%	2.58%	2.12%	1.74%	1.40%	0.97%
	no AIDS	3.05%	3.05%	3.05%	3.05%	2.92%	2.85%	2.67%
Skilled	AIDS	1.52%	1.44%	1.28%	0.96%	0.88%	0.88%	1.08%
	no AIDS	1.60%	1.60%	1.60%	1.60%	1.69%	1.87%	2.24%
Prof.	AIDS	3.04%	2.97%	2.84%	2.62%	2.51%	2.50%	2.74%
	no AIDS	3.10%	3.10%	3.10%	3.06%	3.06%	3.16%	3.50%

		2005	2006	2007	2008	2009	2010
Unskilled	AIDS	0.66%	0.39%	0.20%	0.08%	-0.05%	-0.18%
	no AIDS	2.58%	2.48%	2.40%	2.33%	2.21%	2.05%
Skilled	AIDS	1.10%	1.03%	0.84%	0.84%	0.93%	1.02%
	no AIDS	2.40%	2.45%	2.34%	2.38%	2.46%	2.51%
Prof.	AIDS	2.83%	2.88%	2.80%	2.89%	3.07%	3.23%
	no AIDS	3.66%	3.76%	3.71%	3.78%	3.92%	4.02%

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

Figure A1
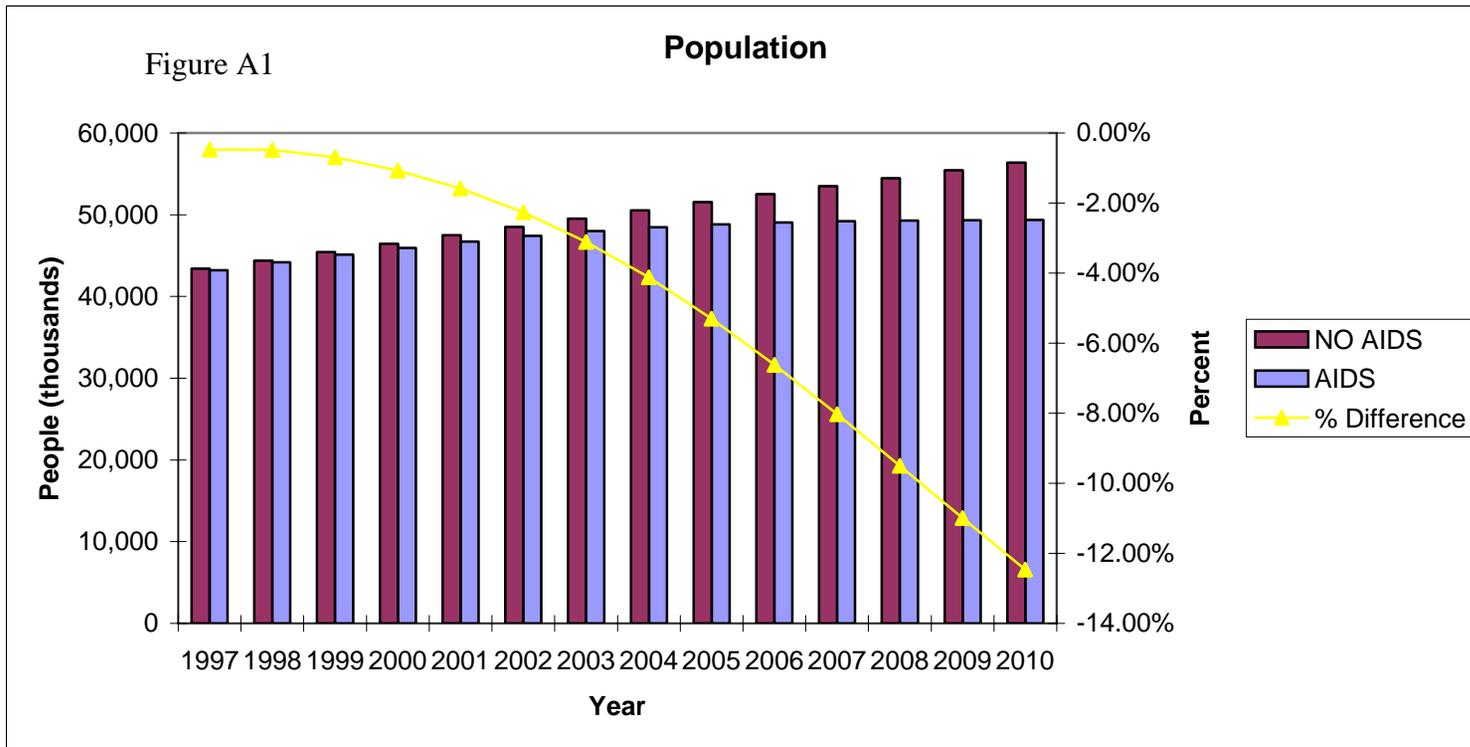
Source: ING Barings (2000).

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