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# **Measuring the Impact of HIV/AIDS on Economic Development in Zambia**

A thesis submitted in fulfilment  
of the requirements for the degree of

**Doctor of Philosophy**

in

**Economics**

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by

**Sialupapu Kanyemba Siameja**

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## **Abstract**

Zambia is one of the sub-Saharan African countries with the highest rates of HIV/AIDS prevalence in the world. One in seven adults is HIV positive and the epidemic disproportionately affects better educated and wealthy Zambians who have a prevalence rate almost twice that of uneducated and poor Zambians. As HIV/AIDS-related morbidity and mortality is concentrated among people of prime working-age, its impact on the quantity and quality of the workforce is expected to have considerable adverse effects on economic activity and the welfare of households.

There is no agreement on whether HIV/AIDS retards economic growth because it affects both the supply and demand of goods and services, despite it being acknowledged as a humanitarian catastrophe.

This thesis undertakes simulations with a computable general equilibrium (CGE) model of Zambia to estimate the impact of HIV/AIDS on the Zambian economy and well-being of Zambian households. Survey data are used to estimate whether HIV/AIDS adversely affects the willingness of public sector workers to live in rural areas where they are a vital ingredient into the economic development process of rural areas.

Simulation results show significant reductions in gross domestic product (GDP) and investment at high prevalence levels like Zambia's. Sectoral output is found to decrease in all sectors especially in the labour-intensive sectors. Household incomes and consumption, for both urban and rural households, decrease leading to reduced household welfare. Results also show that a high prevalence rate leads to a reduction in the country's trade deficit. This result is driven by the larger reduction in imports relative to exports as household incomes decrease.

Probit regression estimates of the willingness of public sector workers to live in rural areas found on evidence to support the view that HIV/AIDS would retard rural economic development by reducing the willingness of public sector workers to live and work in rural areas. To the contrary, HIV/AIDS variables tended to raise the probability of willingness.

This thesis contributes to the body of evidence suggesting that HIV/AIDS has considerable adverse effects on economic development. By using an analysis

method that takes into account the inter-relationships among the different sectors and institutions in an economy, the results are likely to be more robust and reliable than those from partial equilibrium analyses.

As a means of reversing the adverse impacts of HIV/AIDS, this thesis recommends a shift in public policy from a focus on provision of free antiretroviral therapies to a focus on prevention of new infections.

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## **Chapter 1 Introduction**

The high prevalence of HIV/AIDS in Zambia raises the possibility that HIV/AIDS is having a significant adverse impact upon Zambia's economic development.<sup>1</sup> HIV/AIDS is known to affect mostly people of prime working-age and Zambia has an adult prevalence rate of 14.3 per cent (CSO, MOH, Tropical Diseases Research Centre (TDRC), University of Zambia, & Macro International Inc., 2009). Previous national adult prevalence rates have been as high as 21.5 per cent (UNAIDS, 2000a; UNAIDS/WHO, 2007). For each of the past five years, the annual adult HIV/AIDS-related mortality has been estimated at over 95,000 people and the adult HIV positive population has increased from 1.2 million in 2005 to about 1.5 million in 2007 (CSO, 2005a; MOH & National AIDS Council, 2008). The high prevalence rate and mortality among working-age adults suggest that the epidemic is having a significant adverse effect on the quantity and quality of the labour force and consequently on the performance of the Zambian economy, and ultimately the well-being of Zambian households. This conclusion is based on what is currently known about how HIV/AIDS affects individuals, households, and firms.

There are also features, characteristic of HIV/AIDS, which make it an especially deadly phenomenon with the ability to cause considerable damage to the economy, economic well-being of households and national economic development efforts of high prevalence countries like Zambia.

### **1.1 Special features of HIV/AIDS**

The special features of HIV/AIDS that make it such a deadly phenomenon include the following.

#### **1.1.1 Epidemiological features**

HIV/AIDS is predominantly sexually transmitted from one individual to another. It tends to therefore cluster in households, killing off adults and creating many orphans (Barnett & Whiteside, 2002). In Zambia, it is estimated that up to

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<sup>1</sup> HIV refers to the Human Immuno Virus which weakens the immune system of its host making it susceptible to opportunistic infections leading to a condition known as Acquired Immune Deficiency Syndrome (AIDS).

80 per cent of infections occur through heterosexual sexual intercourse. Mother-to-child transmission makes up a significant proportion of the remaining 20 per cent, while infection through contaminated blood products and homosexual sexual activity is estimated to make up about 1 per cent (MOH & National AIDS Council, 2008).

An infected individual, unless tested, may not be aware of being infected for several years. This means an infected person may unknowingly transmit the infection to their sexual partners over many years. As of 2007, only 15.6 per cent of Zambian adults had had an HIV test and knew their sero-status (MOH & National AIDS Council, 2008). The low level of voluntary testing suggests that many individuals who are infected with HIV do not know that they are and therefore may not be taking precautions to prevent transmission of the virus to their sexual partners.

The period from time of infection to development of full-blown AIDS may be as long as 10 years. A further 2 years of serious illness may follow after development of AIDS. During this period, significant amounts of resources may be spent on treatment, leaving some households destitute. The drawing down of household savings to meet treatment costs can lead to a significant reduction in resources available to the household and for productive investment at the national level (Barnett & Whiteside, 2002).

There is presently no known cure for HIV/AIDS. Antiretroviral therapies (ARTs) prolong infected people's lives but do not eliminate the human immunodeficiency virus from their bodies. Eventually individuals on ARTs succumb to opportunistic infections and die. The high cost of antiretroviral drugs (ARVs) means a significant amount of resource is being expended to keep alive infected individuals. The high cost of HIV/AIDS treatment diverts a significant amount of resources from treatment of other health conditions.

### **1.1.2 Impact on labour**

HIV/AIDS has a direct impact on the quantity and quality of labour. Its concentration in the working-age population means that its high mortality rate leads to significant deaths among workers and potential workers some of who are highly skilled and experienced. This causes a shortage of skilled and experienced workers.

HIV/AIDS imposes significant labour costs on firms. Firm costs increase through increased medical expenses for their employees; increased funeral payments for deceased employees; increased recruitment and training costs for replacement employees; and increased terminal benefit payments to families of deceased employees. Firms may experience reduced labour productivity while some of their employees are sick. Reduced labour productivity tends to lead to reduced physical capital productivity. Overall firm productivity falls as a result. Loss of skilled workers in poor resource settings tends to lead to competition for the surviving ones. This tends to raise costs to firms as higher wages are paid to procure the services of the available skilled workers (Barnett & Whiteside, 2002; Bollinger, 2002; England, 2004; Forsythe, 2002; Fox et al., 2004; Rosen, Feeley, Connelly, & Simon, 2006; Rosen et al., 2004; UNAIDS, 2007; Vass, 2005).

### **1.1.3 Demographic features**

HIV/AIDS directly affects population growth and consequently labour force growth. HIV/AIDS by affecting people in their prime child-bearing ages reduces the number of adults in the child-bearing years through high mortality rates. Fertility rates have been found to be adversely affected by HIV/AIDS. These factors contribute to a slow-down in the population and labour force growth rates (Bruhns, 2005; Robert Greener, 2002; Hunter et al., 2003; Noel-Miller, 2003; Ross et al., 1999; United Nations, 2002; Young, 2007).

Mother-to-child transmission is high in poor resource settings. This has led to increases in infant and child mortality rates. In Zambia, about 40 per cent of children born to HIV positive mothers are estimated to be HIV positive too (MOH & National AIDS Council, 2008). Most children born HIV positive do not survive to adulthood. Therefore fewer children are making it to adulthood and into the labour force (Chokechai, Usa, Praphan, Thai Red Cross AIDS Research Centre., & UNAIDS, 2000; UNAIDS, 2000a, 2000b).

### **1.1.4 Impact on markets for goods and services**

HIV/AIDS adversely affects both the demand and supply of consumer goods and services. Through high mortality among workers, and high expenditure on HIV/AIDS-related treatment, HIV/AIDS reduces household demand and consumption of other welfare-enhancing consumer goods and services. The supply of goods and services is reduced as firms respond to reduced worker productivity, increased production costs and reductions in potential

consumer markets (Ellis, 2006; Fraser, Grant, Mwanza, & Naidoo, 2002; Vass, 2005).

### **1.1.5 Impact on human capital accumulation**

HIV/AIDS affects the quality of the workforce by reducing individuals' incentives to invest in human capital accumulation activities. Reduced incentives for human capital accumulation arise from the fact that HIV/AIDS reduces life expectancy. Individuals expecting a shorter life span may not have an incentive to invest in many years of education or skills accumulation with a long payoff period (Jayachandran & Lleras-Muney, 2009). The reduction in accumulation of human capital has long-term adverse consequences for productivity and growth (Barnett & Whiteside, 2002; Huang, Fulginiti, & Peterson, 2003).

The increasing number of HIV/AIDS orphans increases the number of potential workers who won't get much formal education or skills training. Studies have found that orphans are more likely to not be in school compared to non-orphans. The increasing number of orphans living without adult support increases the number of potential workers without adequate education. The number of orphans in Zambia is estimated at 1.3 million. An estimated 75 per cent of these are HIV/AIDS orphans (MOH & National AIDS Council, 2008). Almost 50 per cent of these orphans are not enrolled in school (G.R.Z, 2006).

These factors combine to make the HIV/AIDS epidemic a deadly, enduring killer with wide reaching social, political, demographic and economic consequences in high prevalence countries. This thesis, however, concentrates on the impact of the HIV/AIDS epidemic on economic development in Zambia.

## **1.2 Research objectives**

The aim of this research is to estimate the impact of HIV/AIDS on economic development in Zambia. As economic development encompasses both economic growth and distributional issues, the research will estimate impacts at both the macro and micro-economic levels.

### **1.2.1 Objective one – Macroeconomic impacts**

Thus the first objective is to estimate the impact of HIV/AIDS on the level of aggregate output of the Zambian economy. The impact on a number of selected macroeconomic indicators – gross domestic product, investment and trade deficit – will be used to illustrate the impact on current and future economic

growth. Economic growth is important for economic development, especially in a country like Zambia with a combination of high poverty levels and relatively high population growth. An improvement in the condition of the majority of an increasing population is unlikely in the absence of economic growth. This objective addresses the growth requirement condition for economic development.

### **1.2.2 Objective two – Microeconomic impacts**

The second objective is to estimate the HIV/AIDS impact on households. Household impacts represent the microeconomic impacts of HIV/AIDS. Household level impacts also reveal the distributional impacts of HIV/AIDS. Ability to access consumption goods and services is probably the single-most important determinant of household well-being. The microeconomic level impacts bring the HIV/AIDS macroeconomic impacts to the level of the individual participants in the economy, in this case the households. Analysing the impacts at this level is especially important because it is widely accepted that the goal of economic development is to improve the well-being of the majority of people (Todaro & Smith, 2009). Household level impacts enable us to analyse the impact on the individuals who constitute the households. Without investigating the changes to individuals' well-being, the research would be reduced to a study of the impact on economic growth rather than economic development.

### **1.2.3 Objective three – Impact on rural economic development**

The third objective is to find out whether HIV/AIDS affects the willingness of public sector workers to live and work in rural areas. If it does, rural development would be severely retarded as would be the economic development of the country as a whole.

As the majority of Zambians still live in what may be classified as rural areas, an important measure of Zambia's economic development is improvement in the well-being of rural populations. Government rural development efforts are thus essential to the overall economic development of the country. Rural development requires the presence of skilled government workers in rural areas to implement the government's rural development plans. It has been suggested that HIV/AIDS adversely affects the willingness of public sector workers to live and work in rural areas (Kamwanga, Ndubani, & Msiska, 2003; M. J. Kelly, 2000). If that were the case, then government rural development plans would be hampered by the lack of appropriate staff to implement them. This research undertakes a

survey to ascertain whether HIV/AIDS indeed affects the willingness of public sector workers to live and work in rural areas.

The three objectives together address important components of economic development in the Zambian context. Objective one addresses the economic growth component of economic development while objective two addresses the household welfare component. Objective three goes a step further by looking at the probability of HIV/AIDS affecting the rural populations through its impact on willingness of public sector workers to live in rural areas.

### **1.3 Choice of research methods**

Objectives one and two are addressed through simulations in a general equilibrium framework. A computable general equilibrium (CGE) model for Zambia is calibrated and used to simulate the impact of HIV/AIDS on the selected macroeconomic indicators. A comparison of the counterfactual and benchmark equilibrium values of the macroeconomic indicators is used to discuss HIV/AIDS' impact on economic growth. A comparison of the corresponding household incomes and consumption levels is used to discuss the distributional impacts at the household level.

A general equilibrium framework has been selected for this study because it takes into account vital linkages among the various institutions – government, households, firms, and the rest of the world – in the economy. It thus enables us to avoid making the unnecessary and unrealistic assumption of “holding other things constant” when a shock is applied to the economy. It is almost always the case that a shock applied to one part of the economy gets transmitted to other parts of the economy. This elicits changes that are transmitted back and forth among all the interlinked parts of the economy. Thus second and higher order effects of the shock are taken into account in the CGE framework. Not taking into account these interactions among the different parts of the economy has the potential to lead to either significant overstating or understating of the impacts of the shock. By accounting for the linkages among the institutions in the economy, a general equilibrium framework avoids this drawback of frameworks such as the econometric and partial equilibrium analysis frameworks that do not take a “holistic” view of the economy in the analysis of shocks with potentially economy-wide ramifications. The HIV/AIDS epidemic is one such shock.

The impact of HIV/AIDS is felt initially at the household level when a household member falls sick. The effects are then transmitted to employers, be they government or private firms, through among other factors increased absenteeism and increased labour costs. These effects in turn affect some households through reduced incomes as employers respond to increasing costs and reduced profits by demanding fewer workers. Government is affected through a reduced tax base and reduced taxable output. The impacts of HIV/AIDS therefore tend to have second and higher order effects through such feedback effects. The CGE framework is well-suited to deal with such interaction among the economic actors in the model.

The social accounting matrix (SAM)-based general equilibrium model chosen has also the advantage that it is based on the microeconomic foundations of optimising behaviour by all economic agents. Producers minimise their production costs while consumers maximise their well-being, both subject to their constraints. These sound microeconomic foundations lend more credibility to the model results. The presence of microeconomic interactions among the institutions enables the analysis of both macro and microeconomic impact results from the model. As economic development involves changes in the well-being of the majority of the population, in addition to economic growth, this framework provides the essential information for evaluating HIV/AIDS' impact on both economic growth and household welfare which are essential to economic development.

This framework is especially suited for this study because of the presence of 11 different household types ranging from small remote rural agricultural households to urban highly skilled employer households. That HIV/AIDS adversely affects households is not in question, but the extent to which it affects different households is not expected to be the same because of the different initial conditions that exist in different household types. By using a framework that allows the disaggregation of households, the extent to which different households are affected can be estimated. Such information is useful in the formulation of targeted mitigation strategies.

The fact that SAM-based models can be fairly disaggregated means that CGE models can provide an economic "simulation laboratory" with which different factors and channels of impact on the performance of the economy can

be examined (Arndt & Lewis, 2000). This makes this framework especially suitable for the analysis of the first and second objectives of this thesis.

The third objective is addressed through an econometric analysis of data collected from a survey carried out in two high HIV/AIDS prevalence provinces in Zambia. Probit regression is used to estimate the probability of public sector workers' willingness to live in rural areas. Survey respondents were asked to indicate their willingness to live in rural areas given their knowledge of HIV/AIDS, difference between urban and rural prevalence rates and other demographic and socio-economic factors. As the response variable is a binary variable, a probability model is the appropriate regression technique for analysis of the responses. Either logit or probit regression analysis can be used for this analysis. Logit and probit models produce similar results. The only difference between the two methods being the probability distribution functions that they use. While logit uses the logistic probability distribution function, probit uses the cumulative normal probability distribution function. For this study, probit regression was used.

This method restricts the predicted values of the dependent variable between zero and one. The predicted values are thus interpreted as probabilities that the dependent variable is equal to one given the values of the explanatory variables. This suits this study because the aim is to estimate the probability of willingness to live in rural areas given certain demographic, socio-economic and HIV/AIDS-related variables. Changes in HIV/AIDS variables can be used to compute changes in willingness and therefore give us an indication of whether the HIV/AIDS variables have a significant impact on the willingness of public sector workers to live and work in rural areas.

## **1.4 Organisation of the thesis**

The rest of the thesis is organised as follows:

Chapter 2 presents background information on HIV/AIDS in Zambia. Issues relating to prevalence; access to life-prolonging ARVs; morbidity; orphans; demographic impact; sectoral output impacts; public and private sector impacts; and government, private sector and civil society responses to the epidemic are presented and discussed in this chapter. This chapter shows that HIV/AIDS prevalence in Zambia is high, and that both HIV/AIDS-related mortality among

adults and the number of AIDS orphans are high enough to have a significant impact on the size and skill level of the labour force.

Chapter 3 presents a review of the literature on the economic impact of HIV/AIDS. This chapter reviews studies of economy-wide impacts as well as household level impacts of the HIV/AIDS epidemic. Impacts on orphans; the private sector and agriculture; the public sector, specifically the education and health sectors; and demographic impacts are reviewed. The literature review shows that though there is agreement that HIV/AIDS is a humanitarian catastrophe, there is no such universal agreement on the impact of HIV/AIDS on either economic growth or the well-being of households.

Chapter 4 analyses some aspects of the data in the social accounting matrix used in the modelling. Household income sources and expenditure, and sectoral labour demand are analysed. This chapter also presents the model equations and describes the calibration of the model and the price adjustment process.

Chapter 5 presents and discusses the results of simulations of the macroeconomic impacts from the modelling. It shows that gross domestic output in all sectors decreases with higher HIV/AIDS prevalence and higher assumed co-worker impact. Decreases in investment accompany the decrease in gross domestic output. However, the trade deficit improves as falling domestic incomes reduce consumption of imported output. As output in all sectors decreases it is concluded that HIV/AIDS retards economic growth.

Increase in the wage rate, a widely acknowledged impact of HIV/AIDS, also leads to reduced gross domestic output as firms respond to increased production costs by reducing their demand for labour. Tax policy, a possible instrument for raising government revenue, raises government revenue but also leads to reduced gross domestic output and reduced household welfare.

Chapter 6 addresses the household-level impacts from the national level CGE modelling. The results show that household incomes and consumption decrease with higher HIV/AIDS prevalence levels. The higher the HIV/AIDS prevalence rate, the higher is the reduction in household incomes and consumption. As household well-being is determined by the household incomes and consumption, household welfare decreases when the HIV/AIDS shock is applied to the model. Though most rural households do not pay income taxes,

increases in income tax rates lead to decreases in the welfare of the non-tax-paying rural households as well through the impact on inter-household transfers.

Chapter 7 presents and discusses the results of the econometric modelling of the survey data. Consistent with the emphasis on development, we surveyed rural public sector workers to determine whether HIV/AIDS impacts on their willingness to work in rural areas. A probability model is used to estimate the probability of willingness of public sector workers to live and work in rural areas. The results do not support the view that public sector workers' willingness to live in rural areas is reduced because of the prevalence of HIV/AIDS. Estimated probabilities show that willingness to live in rural areas is high and that there is not much difference in the willingness of either married or single public sector workers. Gender is also found to not significantly affect willingness to live in rural areas.

Other ways through which HIV/AIDS may affect rural development are discussed. These include loss of skilled personnel through HIV/AIDS-related mortality and their replacement with less skilled personnel, and loss of significant work-time due to inadequate infrastructure to facilitate access to services not available in most rural locations.

Chapter 8 concludes the thesis with a summary of the main findings of chapters 5, 6, and 7 and presents policy recommendations based on these findings. A focus on prevention of HIV infection rather than treatment is the main policy recommendation. Targeted appropriate prevention messages to all sections of society and support for prevention measures, such as subsidising the cost of both male and female condoms, are recommended.

Prevention is favoured over treatment because of the high cost of treatment and its unintended consequence of reducing resources available for the treatment of other conditions. Prevention on the other hand reduces the number of new infections and therefore the need for treatment later on.

Support for household livelihoods is recommended to reduce the number of households becoming destitute on the death of the main household income earner. Household impacts are exacerbated by the loss of households' ability to generate incomes with which to sustain themselves. The recommended support for livelihoods can be achieved through both government and civil society support for formal and informal education that eliminates gender inequality and empowers

women to become more economically independent of their spouses. Support for livelihoods can also be achieved through provision of practical education, such as agricultural, livestock and fishing extension services. Such services help affected households maintain their output levels even after the loss of the only adult with particular income-generating or food-producing knowledge and skills.

Also recommended is government commitment to maintaining an adequately trained labour force in rural areas to implement its rural development plans. Rural development efforts are more likely to founder due to lack of appropriately trained people especially at senior positions where inefficient decision-making may have serious wide-ranging adverse effects. Ongoing staff development programmes are recommended to ensure seamless transitions when there is need for replacement of personnel.

Common across the recommendations is the need for government to spend more resources to implement these recommendations. It is argued that a successful prevention strategy that reduces the need for costly treatment frees up resources that can be expended to implement these recommendations. A successful prevention strategy also reduces the adverse impacts on the economy allowing the economy to grow and provide a source for increased government revenue through a wider tax base and increased taxable output. A successful prevention strategy thus creates a virtuous cycle whereby a reduction in infections minimises the adverse effects on the economy; the economy grows and produces more resources that can be applied to continued prevention efforts and to improving the well-being of households.



## **Chapter 2 The HIV/AIDS Situation in Zambia**

### **2.1 Introduction**

The earliest AIDS cases in Zambia were identified in the mid 1980s. Given that it takes about 9.4 years from sero-conversion to AIDS, and about 9.8 months from AIDS to death (de Walque, 2004; Morgan et al., 2002; National HIV/AIDS/STI/TB Council, 2004), in the absence of antiretroviral drugs (ARVs), it seems that the human immuno virus has been in the Zambian population since the mid-to-late 1970s.

By the early 2000s, the HIV/AIDS epidemic had become a generalised one. It was no longer limited to the “at risk” populations such as commercial sex workers and their clients, long distance truck drivers, and migrant workers, but had spread into the general population.

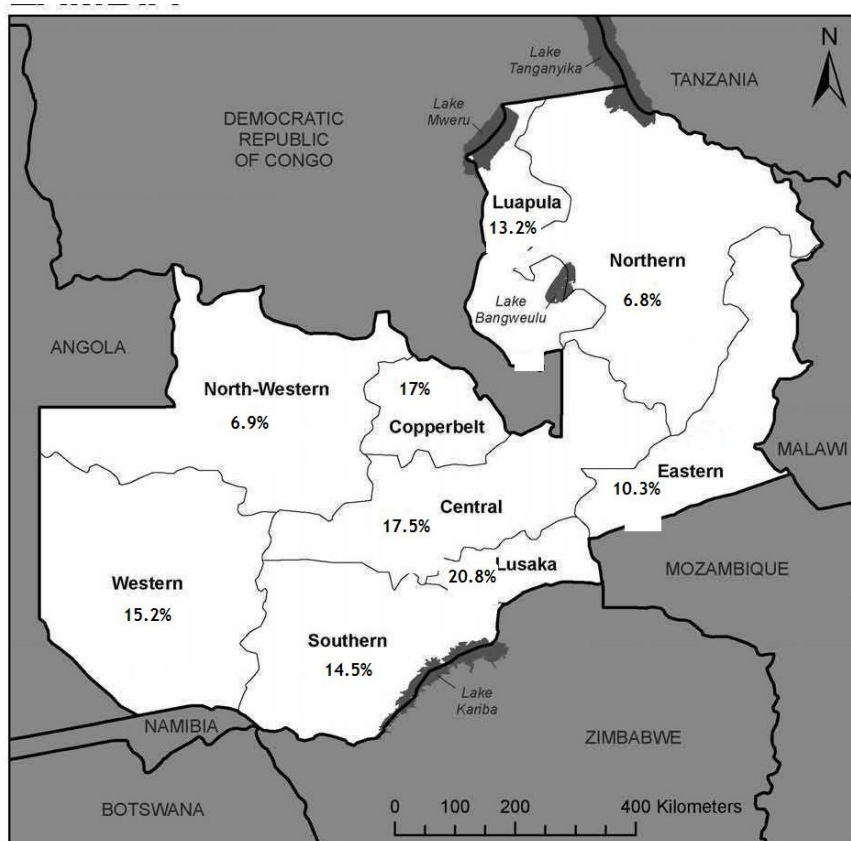
The main mode of HIV transmission in Zambia is heterosexual sexual intercourse which accounts for almost 80 per cent of infections. Mother-to-child transmission accounts for most of the other 20 per cent while less than 1 per cent is estimated to be through contaminated blood products, use of needles and sharp instruments, and sex between men (National HIV/AIDS/STI/TB Council, 2004, 2006).

All sections of Zambia’s estimated 12 million population are now affected by the epidemic, though some sections, such as the rural population, have significantly lower HIV/AIDS prevalence rates relative to the urban population. This situation is not unusual. HIV/AIDS epidemics tend to be different from one region to another within the same country and amongst different age groups within the same country and/or region (UNAIDS/WHO, 2007). For example, the Zambian government’s poverty reduction strategy paper for 2000-2004 cites national prevalence rates of 14 per cent and 28 per cent in rural and urban areas respectively. In Ndola, Zambia’s second largest town, located in the Copperbelt province, the HIV/AIDS prevalence rates for males and females between 15-24 years of age were 8 and 17 per cent respectively, and 25 and 32 per cent for those aged between 15-49 years (MFNP, 2002).

The map below shows the prevalence rates for each of the nine provinces of Zambia. The more urbanised provinces, Lusaka, Copperbelt, and Southern,

have the highest prevalence rates. However, all the provincial prevalence rates are generally high, exceeding 10 per cent in all but two provinces. While there are differences in the provincial prevalence rates, the figures indicate that there is no province in Zambia that does not have a serious HIV/AIDS epidemic.

**Figure 1 Provincial Adult HIV/AIDS Prevalence Rates, Zambia, 2007**



Source: Both figures and map from 2007 ZDHS

Though knowledge of HIV/AIDS is almost universal in Zambia<sup>2</sup>, only 39 per cent of men and 36 per cent of women have comprehensive knowledge about the modes of HIV transmission and prevention (CSO et al., 2009).

Less than 2 in 5 adult women and just over 2 in 10 men have had an HIV test at some point in their lives, according to the 2007 ZDHS.<sup>3</sup> Such low levels of transmission modes and sero-status knowledge present serious impediments to

<sup>2</sup> The 2007 ZDHS reported that 99 per cent of adult Zambians had basic knowledge about HIV/AIDS

<sup>3</sup> The 2008 Zambia Country Report to the UNGASS, compiled by the MOH and NAC, estimates the proportion of adults who have had an HIV test and know their sero-status at 15.6 for the years 2005 to 2007.

efforts to reduce the transmission of HIV in Zambia. Low knowledge levels of transmission modes and sero-status mean people may not take adequate measures to protect themselves and/or their sexual partners from HIV infection. Infection levels are therefore likely to increase at a faster rate than if people had adequate knowledge that would help them protect themselves and their partners. Among young people in school, the situation is slightly better with 60 per cent of schools reported as providing life-skills based HIV/AIDS education (MoH[Zambia] & National AIDS Council, 2008). The low levels of transmission modes knowledge lead also to stigmatization and discrimination against those who are HIV positive or have developed AIDS. The fear of stigmatization and discrimination, in turn, prevents more people from getting tested for HIV or from revealing their sero-status. This fear also prevents some infected people from accessing life-saving antiretroviral drugs and from embracing safer sex methods to prevent the transmission of the virus to their sexual partners. Low knowledge levels may thus be contributing to the continuing spread of the human immuno virus in Zambia.

One of the consequences of high HIV/AIDS prevalence in Zambia has been the increase in new TB cases diagnosed annually. The average TB case rate between 1964 and 1984 was around 100 per 100,000 population. By 1996, however, this had increased five-fold to over 500 per 100,000 population. This is the equivalent of about 40,000 new TB cases annually, a figure that was expected to increase by 10 per cent annually (MOH [Zambia], 2005). TB has become one of the most serious public health problems triggered by the HIV/AIDS epidemic and the leading killer among HIV+ individuals in Zambia.

Among the factors thought to facilitate the widespread transmission of HIV in Zambia are the high levels of poverty, estimated at 68 per cent of the population living below the national poverty line and 53 per cent living in extreme poverty (CSO[Zambia], 2005); high population mobility, social and cultural beliefs and practices such as widow inheritance<sup>4</sup> and sexual-cleansing<sup>5</sup> of widows

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<sup>4</sup> Widow inheritance involves a close relative of a deceased male spouse taking over the deceased's wife and children

<sup>5</sup> Sexual cleansing is a practice that involves the surviving widow having sexual intercourse with one of her deceased husband's relatives. It is believed that if she doesn't, she could die or go insane because she'd be tormented by the spirit of her deceased spouse. It is also

(National HIV/AIDS/STI/TB Council, 2003); stigma, inadequate information, education and communication about HIV/AIDS, gender issues such as the dominance of male interests and lack of self-assertiveness on the part of women in sexual matters resulting in women's inability to negotiate safer sex, drug and alcohol abuse, and prison confinement (MOH [Zambia], 2005; National HIV/AIDS/STI/TB Council, 2003). The presence of high levels of other untreated curable sexually transmitted infections (STIs) such as syphilis (4 per cent and 5 per cent in adult women and men respectively (CSO et al., 2009), and herpes which cause genital sores facilitates higher viral transmission rates (Oster, 2005) leading to high HIV/AIDS incidence. The 2007 ZDHS shows that HIV/AIDS prevalence is highest in the age groups with the highest STIs - 6.8 per cent in women aged 30-34, and 10.4 per cent in men aged 40-44 years as shown in Figure 2 below.

## **2.2 HIV/AIDS prevalence in Zambia**

Zambia's national HIV/AIDS prevalence rate is considered among the highest in the world. The United Nations estimates the global adult prevalence rate at less than 1 per cent of adults in the 15-49 year age group. This rate is estimated at 5 per cent in sub-Saharan Africa (UNAIDS/WHO, 2007), and 16 per cent in Zambia (MoH[Zambia] & National AIDS Council, 2008).<sup>6</sup> A prevalence rate above 1 per cent is considered, by the United Nations, as a very serious epidemic. In 2007, Zambia had an estimated 1.5 million adults and 83 thousand children living with HIV/AIDS (MOH & National AIDS Council, 2008).

One of the characteristic features of the HIV/AIDS epidemic in Zambia is the much higher prevalence rates among females compared to males in the younger age groups. Earlier figures suggested that prevalence rates for young women in the 15-19 and 20-24 age groups were 3.5 and 4 times higher than those for young men in the same age groups.<sup>7</sup> More recent figures from the 2007 ZDHS, however, suggest that these figures are now lower at 1.6 and 2.3 times

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believed that an uncleansed widow could bring misfortune upon her community. In some areas, men are sexually cleansed too.

<sup>6</sup> The 2007 ZDHS puts the national prevalence rate at 14 per cent, with women at 16 per cent and men at 12 per cent.

<sup>7</sup> These are 2001/02 figures reported by the National HIV/AIDS/STI/TB Council (2004)

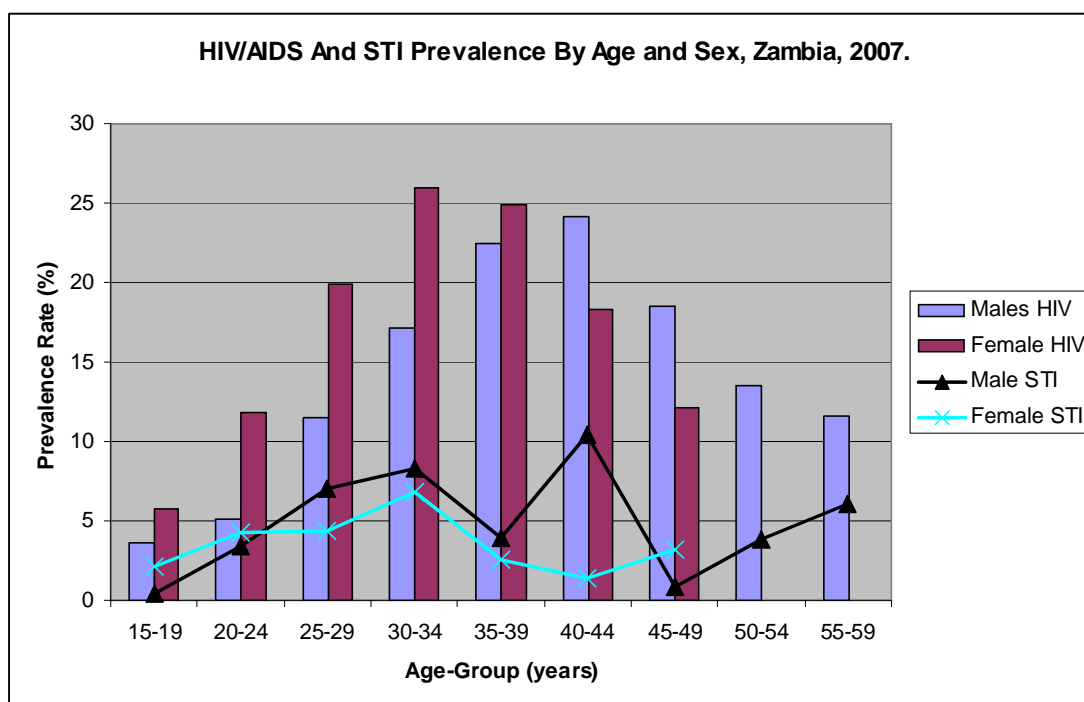
higher for young women.<sup>8</sup> The age-sex distribution of HIV prevalence for 2007 is shown in Figure 2 below.

Figure 2 shows that HIV/AIDS prevalence is higher in younger women than in men of the same age groups. The prevalence rate for women peaks earlier, in the 30-34 year age-group, compared to that of men in the 40-44 year age-group. These figures are consistent with the high levels of teenage pregnancy prevailing in Zambia. About 30 per cent of young women between 15 and 19 years of age will have begun child-bearing i.e. will already have a child or be pregnant with their first child (CSO et al., 2009). The median ages at first marriage are 18.2 years for women and 23.5 years for men. The higher HIV/AIDS prevalence rates for women in the younger ages may be explained by the fact that these are the women's prime-childbearing ages and the women are therefore more likely to engage in unprotected sexual intercourse for reproductive purposes which in turn increases their likelihood of getting infected. Other explanations include the high prevalence of inter-generational and transactional sexual relationships between younger women and much older men (National HIV/AIDS/STI/TB Council, 2006). Inter-generational relationships tend to be transactional in the sense that they tend to involve some form of material or monetary benefits for the younger women. As Figure 2 shows, the prevalence levels among older men are high. Sexual relationships between younger women and older men therefore tend to result in the infection of the younger women.

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<sup>8</sup> The 2008 UNAIDS global report on AIDS puts the ratio of 15-24 HIV positive young women to young men of the same age-group at 3 to 1.

**Figure 2. Age-Sex Distribution of HIV and STI Prevalence in Zambia, 2007**



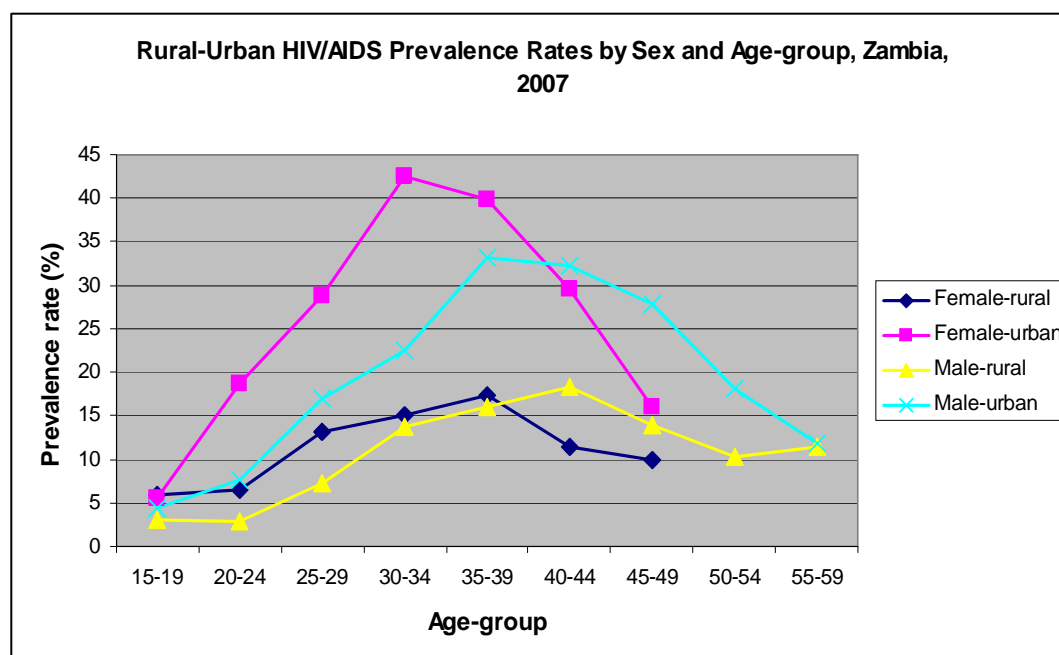
Source: data from the 2007 ZDHS, data for females 50+ years not available.

Figure 3 shows the prevalence rates for urban and rural areas by sex and age-group based on figures from the 2007 ZDHS. The 2007 ZDHS figures clearly show the differences in the extent of the epidemic between the two settings. The figures show, however, that despite the differences between urban and rural prevalence rates, the patterns of prevalence among the age groups are similar across the two settings – women have much higher prevalence in younger age groups and their prevalence rate peaks earlier, while men have higher prevalence from the 40-44 year age-group on. The rural-urban prevalence patterns mirrors the national prevalence pattern shown above in Figure 2. High population mobility between urban and rural areas may be largely responsible for the similarity in the prevalence patterns.

High population mobility also leads one to question the accuracy of the reported rural prevalence rates. As discussed below, high population mobility, for trading purposes, for example, means that rural dwellers spend much time in urban areas trading. Such individuals constitute a high risk group with usually high HIV/AIDS prevalence than the rest of the rural population. Unless such individuals are covered in surveys, prevalence will be underestimated in rural

areas. A South African study of a large rural community demonstrated this phenomenon. Using a longitudinal demographic survey, this study showed that the prevalence rate in the rural community was as high as prevalence rates in urban areas (Welz et al., 2007).

**Figure 3. Rural-Urban HIV/AIDS Prevalence Rates by Sex and Age-group, Zambia, 2007.**



Source: data from the 2007 ZDHS

Figure 3 shows that the prevalence rates for both males and females are much higher in urban areas compared to rural areas. This is especially so in the 20-24 to 40-44 age-groups. Nationally the urban prevalence rate for women at 23.1 per cent is twice as high as the rural prevalence rate of 11 per cent, while the corresponding figures for males are 15.9 per cent and 9.4 per cent respectively (CSO et al., 2009). Overall, the urban and rural prevalence rates are 19.7 and 10.3 per cent respectively. It is, however, not clear whether the low rural prevalence rates are a reflection of the inadequate placement of testing facilities in rural areas. A 2007 study of a large rural community in KwaZulu-Natal, South Africa, using a household-based HIV sero-survey of a population that had been under longitudinal demographic surveillance since the year 2000 found “extremely high” prevalence levels in that community and called for strengthening of sentinel surveillance systems in rural areas (Welz et al., 2007). Given the high population mobility between urban and rural areas, the much lower reported prevalence rates

in rural Zambia seem too low compared to the urban prevalence rates. The FAO/WFP Crop and Food Supply Mission to Zambia in 2005 found that in some rural parts of Zambia as many as 30 per cent of households had orphans and widows attributed to AIDS-related deaths. The mission found also that in some rural health centres where HIV tests were carried out, prevalence rates were as high as 30-40 per cent (FAO & WFP, 2005). Other studies have questioned the accuracy of cross-sectional surveys in determining HIV prevalence because of the high mobility of individuals between rural and urban areas. Such migrant populations tend to have higher prevalence rates than the usually non-migrant rural resident populations (Welz et al., 2007; Zaba, Marston, Isingo, Urassa, & Ghys, 2004).

HIV/AIDS prevalence levels among pregnant women have been estimated at 19 per cent. Of the children born to HIV positive mothers, an estimated 39 per cent are born HIV positive (MOH & National AIDS Council, 2008). Most children born with HIV/AIDS generally do not live past their second birthday. Infant and child mortality figures for Zambia are estimated to have increased due to the increased number of infants and children born HIV positive and dying from AIDS-related causes.

### **2.2.1 Access to life-prolonging drugs**

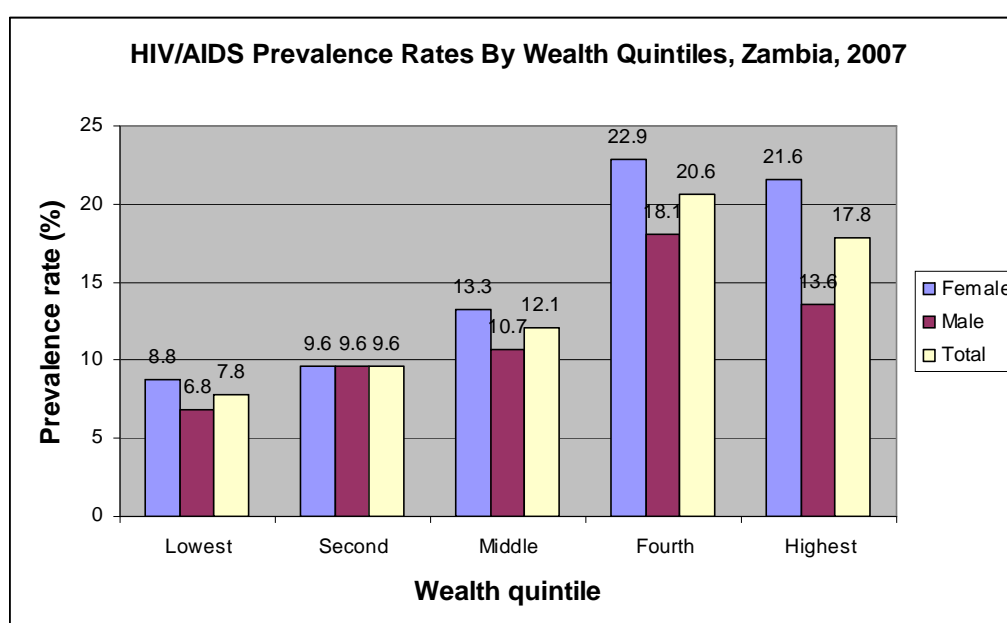
In 2002, the Zambian government undertook to provide antiretroviral drugs through the public sector at a subsidised fee. The fee was, however, revoked in 2004 and access to antiretroviral drugs is free to all through the public health sector (MOH, CSO, & ORC Macro, 2006). While an estimated 24 per cent of people requiring ARV's accessed them in 2005 (WHO, 2009), it is estimated that 35.1 per cent of people with advanced HIV infection were accessing antiretroviral drugs in 2007. The percentage of pregnant women accessing drugs to prevent mother-to-child transmission was estimated at 21.8 per cent (MOH & National AIDS Council, 2008). (G.R.Z, 2010) however reports that as at the end of 2009, 68 per cent of adults requiring ARV's were receiving them and that 61 per cent of infected pregnant women were receiving PMTCT drugs. These figures show that there is still a significant proportion of people in need of antiretroviral drugs who are not receiving them. AIDS-related mortality will thus continue to be high for sometime yet.

Though the number of sites from which one can access ARV's increased from 8 to 298 and the number of sites providing PMTCT drugs increased from 2 to 706 between 2005 and 2007 (MoH & National AIDS Council, 2008), the shortage of trained human healthcare resources has been cited as a major factor in the slow pace of the scaling-up of HIV/AIDS treatment sites and low percentage of ARV uptake by those who need them. Nonetheless, there has been an increase in the percentage of people accessing ARV's. It is therefore possible that as the number of people accessing ARV's increases, and they live longer, the HIV/AIDS prevalence rate will increase, at least in the short-term without any significant increase in the incidence rate due to reduced mortality.

## 2.2.2 HIV/AIDS prevalence, education levels, and wealth

HIV/AIDS prevalence in Zambia is positively correlated with levels of education. Individuals with more than secondary school education have the highest prevalence rate at 19 per cent, followed by those with secondary school education at 15 per cent. Those with primary school education have a prevalence rate of 14 per cent, while those with no education have a prevalence rate of 10 per cent (CSO et al., 2009). Education levels tend to be positively correlated with wealth levels. This is seen in Figure 4 which shows the prevalence rate by gender and by wealth quintiles.

**Figure 4. HIV/AIDS Prevalence Rates by Wealth Quintiles**



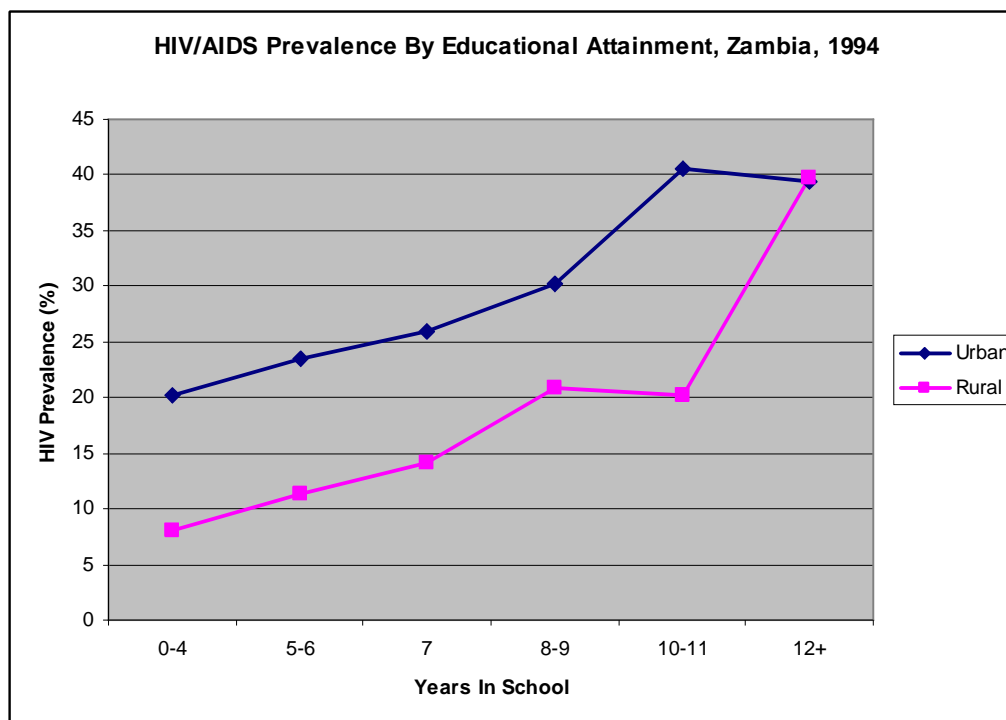
Source: data from 2007 ZDHS.

Figure 4 shows that HIV/AIDS prevalence in Zambia is positively correlated with wealth. The prevalence rates increase with increasing wealth levels. The fourth quintile has higher prevalence rates than the highest quintile, although there is very little difference in the female prevalence rates between the two quintiles. The difference is, however, significant for males. The pattern reflects that of the age-sex distribution in Figure 2. The fourth wealth quintile is equivalent to the age groups between 35 and 49 while the fifth wealth quintile would be made up of those over 50 years of age.

A similar pattern was found in an earlier study on women of child-bearing age. Sero-prevalence rose significantly with increasing levels of educational attainment in both urban and rural areas (Fylkesnes et al., 1997). Figure 5 shows the sero-prevalence rates from this study. As in

Figure 4, sero-prevalence is highest among women with the highest levels of educational attainment. The data for this study was collected between 1990 and 1994 through sequential cross-sectional surveys. However, the results are similar to those from the 2007 ZDHS – childbearing age women with the highest educational attainment show the highest HIV/AIDS prevalence.

**Figure 5. HIV/AIDS Sero-Prevalence Among Childbearing Women, Zambia, 1994.**



Source: data from Fylkesnes et al. (1997)

A later study, however, found that there had been some behavioural change between 1994 and 1998 among the more educated age-groups. The behavioural change had resulted in HIV/AIDS prevalence declining among the more educated in these age-groups (Fylkesnes et al., 2001). Despite the declines in prevalence among the more educated age-groups found in this later study, the more educated age-groups still had the highest prevalence rates. Other notable changes found in this study were prevalence declines in the 15-19 year age-group and delayed age at first birth among 17-22 year olds which led to a 40 per cent decline in fertility in the 15-24 year age-group. These latter changes were attributed to HIV/AIDS educational campaigns that were in operation in the 1990s. Michelo, Sandoy & Fylkesnes (2006) confirmed these findings and reported “a universal shift towards a decline in prevalence rate with increasing educational attainment”. This study suggests that the more educated and the younger age groups were responding to educational campaigns. It also highlighted the stable or increasing prevalence levels among the less educated. While declines among the older age groups could not specifically be attributed to behaviour change, the declines in younger age groups were. High mortality which

could have been a significant factor among the older age groups could not be a cause for lower prevalence at younger ages because of the long incubation period from infection to AIDS development and death. Therefore the declining prevalence among the younger age groups was attributed to behaviour change. As the prevalence decline was more pronounced in people with more than primary education, the study concluded that a drive towards universal secondary rather than basic education would be a better and more effective strategy in combating the spread of HIV/AIDS in Zambia.

That HIV/AIDS prevalence is highest among those Zambians who are better educated and wealthy should be a source of great concern for the economic development of Zambia. The loss of many individuals in this group has adverse consequences for the availability of skilled and experienced labour, as well as for savings for investment.

This pattern of prevalence also raises questions about the effectiveness of HIV/AIDS education campaigns in Zambia. That prevalence is still highest among those with the knowledge and ability to protect themselves from infection suggests that the dissemination of information is either inadequate, inappropriate or just ineffective. From an economic perspective, this section of the population has the most incentives to protect their health because of their significant investment in acquiring their human capital and wealth. Education is assumed to help in accessing and processing health-related information. One would therefore expect to find that HIV/AIDS prevalence was lower or declining significantly among the more educated and wealthy.

Figure 4 above shows that this is not the case in Zambia.

That HIV/AIDS is positively correlated with wealth and educational levels is not unique to Zambia. An analysis of data for 8 other sub-Saharan African countries – Kenya, Malawi, Lesotho, Cameroon, Ghana, Burkina Faso, Tanzania and Uganda – found that HIV/AIDS was positively correlated with wealth levels in these countries too (Mishra et al., 2007). Explanations for this positive association have included the fact that high income levels enable men to maintain multiple concurrent sexual relationships; the wealthy are more mobile and therefore likely to engage in risky sexual behaviour; the wealthy are more likely to live in urban areas where HIV/AIDS prevalence is higher; the wealthy are more likely to survive infection longer because of their better nutritional status and

better access to life-prolonging drugs (Dinkelman, Lam, & Liebbrandt, 2007; Lopman et al., 2007; Mishra et al., 2007). It is very likely that these are the same factors that account for the high correlation between HIV/AIDS, and wealth and education in Zambia.

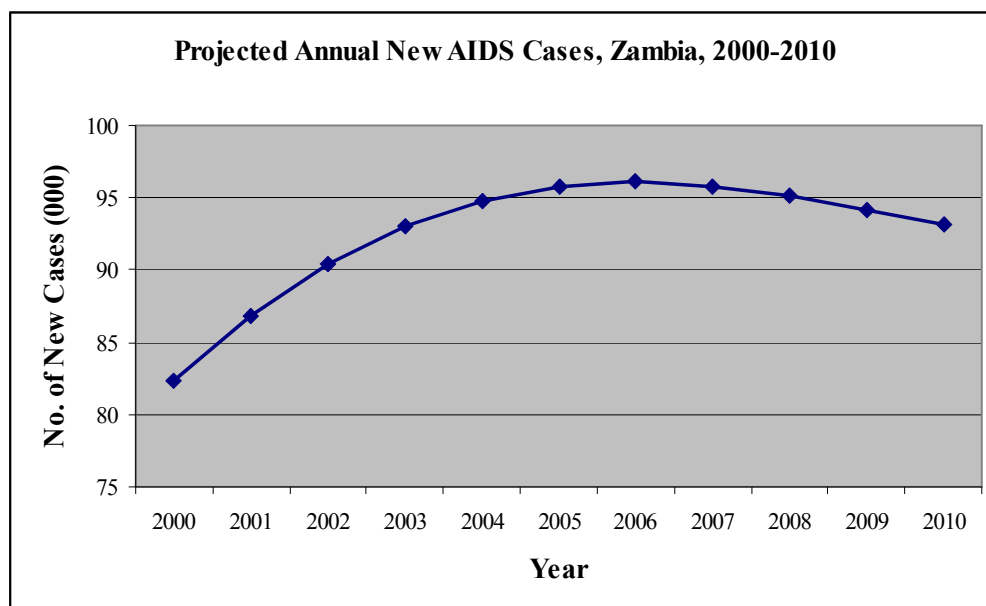
The declines in prevalence among the younger age-groups is similar to that later seen in Uganda where it was shown that education campaigns had lowered the infection rates among young adults (de Walque, 2004). From these observations, Michelo, Sandoy & Fylkesnes (2006) suggest that educational campaigns may be more successful when they are available before individuals become sexually active. The challenge, however, remains about how to reach the less educated whose prevalence rates have either remained stable over time or increased and influence their sexual behaviour.

### **2.3 HIV/AIDS-related mortality and population growth in Zambia**

Analysis of figures of HIV/AIDS-related adult deaths show that between 2005 and 2007, slightly over 260 adults per day, on average, died of AIDS-related causes in Zambia (MOH & National AIDS Council, 2008). The 2008 UN global report on AIDS, however, estimated a total of 56,000 (153 per day) AIDS-related deaths in Zambia in 2007 (UNAIDS, 2008). Whichever is the correct figure, the fact remains that an abnormally high number of adult deaths is occurring in the 15-49 year age-group.

Prevalence and mortality figures are expected to remain high for the foreseeable future because of the high number of new AIDS cases each year. Figure 6 below shows the projected annual number of new AIDS cases over the 2000-2010 timeframe.

**Figure 6. Projected Annual New AIDS Cases, Zambia, 2000-2010**



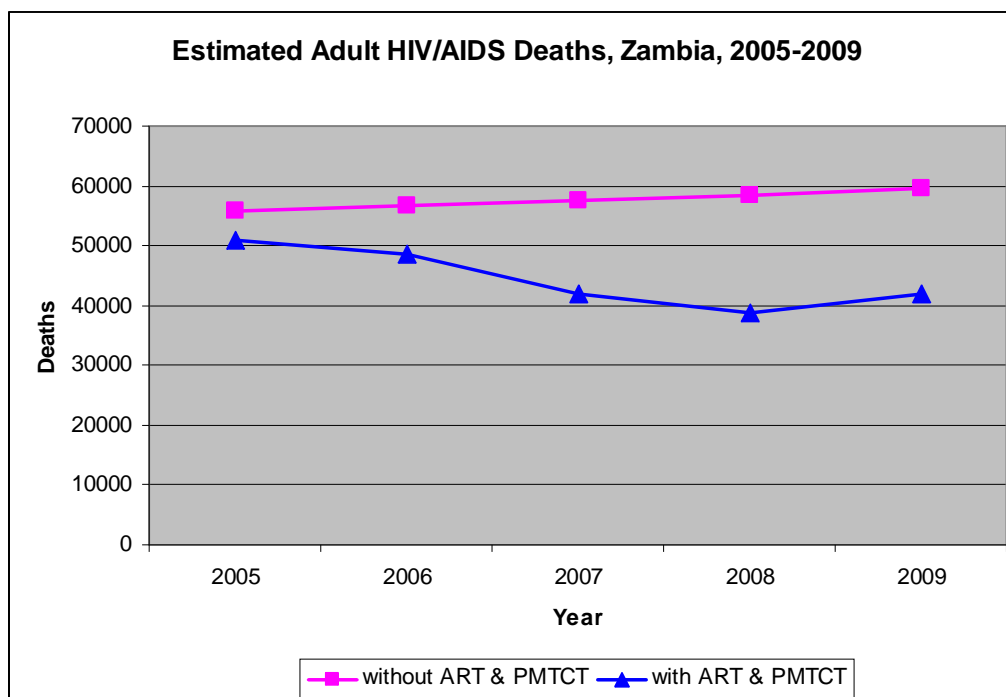
Source: data from CSO, 2005.

Though new AIDS cases are projected to decline after the year 2006, the absolute number of new cases in 2010 is still well above 90,000 - an average of 255 new cases per day. These figures suggest that high HIV/AIDS mortality will continue well into the future.

Mortality figures show also that more women than men have died of HIV/AIDS related causes in Zambia. By 2004, the ratio of accumulated female to male deaths was 1.10 (438,464 to 397,439). The projected ratio for 2010 is 1.12 (742,293 to 665,998) (CSO, 2005a).

Figure 7 below shows the total annual adult HIV/AIDS deaths in Zambia from 2005 to 2009 taking into account the impact of ARV treatment.

**Figure 7. Annual Adult HIV/AIDS Deaths, Zambia, 2005-2009**



Source: Adopted from G.R.Z. (2010)

Figure 7 shows that the number of annual AIDS deaths in Zambia since the introduction of free ARV's is estimated to have decreased from earlier projections which didn't take into account the widespread availability of ARVs. The number of deaths is still however very high at almost 42,000 in 2009. Thus a significant number of adults of child-bearing age have died and more are expected to die each year due to AIDS. The loss of these adults is compounded by the number of children who were and will not be born as a result. The demographic implications for population growth are severe, as are the consequences for the growth of Zambia's labour force.

Infant and under 5 mortality rates have variously been estimated at 95 and 168 per 1,000 live births (MOH et al., 2006), 102 and 182 per 1,000 live births (UNICEF, 2008; WHO, 2009), and, 70 and 119 per 1,000 live births respectively (CSO et al., 2009).<sup>9</sup> The UNICEF/WHO statistics suggest that the child mortality rate at 182 in 2006 was just slightly higher than it was in 1970 when it was 181

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<sup>9</sup> Census figures from the CSO, Zambia, show that under 5 mortality increased from 121 in 1980 to 151 in 1990 to 162 in 2000. Infant mortality rates increased from 99 in 1980 to 123 in 1990 and decreased to 110 in 2000 (CSO[Zambia], 2003).

per 1,000 live births. The infant mortality rate fares no better. It was 101 per 1,000 live births in 1990. Both statistics are worse in later years than they were 2 and 3 decades ago. Increased HIV/AIDS-related mortality among children has been given as one of the explanations for the deterioration of these statistics. The deterioration of these statistics prompted UNAIDS to lament that HIV/AIDS threatened to wipe out most health gains of earlier decades in high prevalence countries. UNICEF figures for 2006, for example, show that there were 470,000 new births, and 86,000 deaths of children under the age of 5 in Zambia (UNICEF, 2008). These deaths represent 18.3 per cent of the new births. This effectively reduces the increase in the under 5 population by a significant proportion that over time can be expected to have an impact on the growth and structure of the population as a whole.

Increased adult and child mortality have a significant impact on population growth – increased adult mortality reduces the number of adults that can produce more children, while increased child mortality reduces the number of children who reach adulthood to reproduce. Zambia's population is still increasing but at a decreasing rate. As mortality has increased, and fertility has declined, the annual population growth rate has slowed down from a high of 3 per cent in 1990 to just over 1.9 per cent in 2006 (WHO, 2009) and an estimated 1.6 (Intute, 2008) in 2008. Figure 8 below shows an unmistakeable downward trend in Zambia's annual population growth rate. Given the increased AIDS-related mortality, and the decline in the total fertility rate from about 7.5 in the early 1980s to 6.5 in 1990, 5.8 in 2000 and 5.3 in 2006, it is not surprising that the annual population growth rate is declining.

The association between HIV/AIDS infection and reduced fertility in women has long been recognised. There are both biological and behavioural means by which HIV infection reduces an infected woman's fertility.

Biological reasons include severe weight loss, as disease progresses, which leads to amenorrhoea; higher rates of foetal wastage through miscarriages and still births; accelerated disease progression associated with pregnancy; pathological effects on male partner leading to reduced spermatozoa production; reduced coital frequency due to illness of either or both partners, and premature mortality of partner leaving the woman to spend part of her reproductive lifetime without a sexual partner.

Behavioural reasons include avoiding pregnancy so as not leave an orphaned child; postponing marriage or sexual union for fear of contracting HIV/AIDS; reduced remarriage rates for widows and divorcees because of stigma associated with death of a partner from AIDS; break-up of partnerships because of knowledge or suspicion of HIV infection, and increased use of barrier contraception to prevent HIV infection (Ross et al., 1999; Ryder et al., 1991).

Given the high prevalence rates of HIV/AIDS in women in the childbearing age groups, these reasons provide compelling evidence to support the argument that part of the observed population growth slowdown is due to HIV-induced reduction in fertility.

As population growth has declined, so has life expectancy. In 1990 life expectancy in Zambia was estimated at 52 years for both males and females. By the year 2000, it was estimated at 42 years, and at 38.6 years by 2006 (Intute, 2008; WHO, 2009). Most of the decline in life expectancy is attributed to the high level of HIV/AIDS prevalence. Apart from directly contributing to mortality through reduced resistance to potential fatal infections, HIV/AIDS contributes to increasing poverty, worsening household nutrition and increased susceptibility to other illnesses that contribute to reduced longevity.

**Figure 8. Graph of Zambia's Annual Population Growth Rates, 1990-2006.**



Source: figures from WHO Statistical Information System, WHOSIS

## 2.4 HIV/AIDS and orphans

One outcome of the high adult death rate is the increase in the number of orphaned children. Of the estimated 1.2 million orphans in 2005, an estimated 710,000 were AIDS orphans (MOH, 2005; UNICEF, 2005). The number of orphans doubled between 1992 and 2002 (National HIV/AIDS/STI/TB Council, 2004), a period coinciding with rising AIDS-related mortality in Zambia.

Like in other high prevalence countries, the number of AIDS orphans is expected to increase in Zambia as more adults die. The number of AIDS orphans continued to increase in Uganda and Thailand a decade after HIV/AIDS prevalence had started to decline (Salaam, 2004; Zidron, Juma, & Ice, 2009). This phenomenon is attributed to the long incubation period associated with HIV/AIDS (Barnett & Whiteside, 2002; UNICEF, 2004).

The care of orphans in Zambia, as in the most of Africa, is carried out mostly through the extended family system (Heymann, Earle, Rajaraman, Miller, & Bogen, 2007; Miller, Gruskin, Subramanian, & Heyman, 2007; MOH, 2005; MOH [Zambia], 2005; Nyambedha, Wandibba, & Aagaard-Hansen, 2003). A small proportion, about 1 per cent, are placed in orphanages while an estimated 6 per cent of orphans have become street-kids with no fixed abode (MOH, 2005). The increase in the number of orphans has placed considerable strain on extended family resources (Barnett & Whiteside, 2002; MOH, 2005; MOH [Zambia], 2005; National HIV/AIDS/STI/TB Council, 2004). Among the results of this strain on family resources are the increase in wasting and stunting in young children in families that take in orphans (Barnett & Whiteside, 2002; USAID/SCOPE-OVC/FHI, 2002), and the reduced likelihood of orphans being in school.<sup>10</sup> The ratio of orphans to non-orphans in school is less than one indicating that orphans are less likely to be in school compared to non-orphans (M. J. Kelly, 2000). A Zambian study reported that household heads gave a lack of money to pay for the extra children as a reason for orphans under their care not being in school (Family Health International (FHI), 2003).

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<sup>10</sup> There is conflicting evidence of nutritional impact of HIV/AIDS on orphans. Some studies, for example, Zidron et al., (2009), He & Ji(2007), and Lindblade, Odhiambo, Rosen, & DeCock (2003) found no evidence of adverse nutritional status on orphans relative to non-orphans among Luo children in Kenya, rural Henan province, China, and western Kenya respectively.

Apart from the trauma of witnessing their parents' illnesses and consequent deaths, some orphans suffer more stress from being discriminated against in their adoptive homes. Many are reportedly made to perform disproportionately more household chores than non-orphaned children in the household and being treated more like house servants (Barnett & Whiteside, 2002; Family Health International (FHI), 2003; UNICEF, 2004; UNICEF, UNAIDS, & USAID, 2004).

The increase in the number of orphans poses a serious threat to availability of a sufficiently educated and trained labour force in the future. A lack of education, good parental guidance, and unfavourable living conditions increase the susceptibility of orphans to HIV/AIDS infection themselves and increase their chances of being poverty-stricken in adulthood (Barnett & Whiteside, 2002; Beegle, Weerdt, & Dercon, 2006; Sharma, 2006; UNICEF, 2004). The growing number of orphans, primarily due to HIV/AIDS, in Zambia, as in other high prevalence countries, poses a significant social and economic development issue.

## **2.5 Demographic impact of HIV/AIDS**

The impact of HIV/AIDS goes beyond its immediate and obvious effect on labour productivity. In the long-term, the high HIV/AIDS-related adult mortality rate will have a major impact on the composition of the population. The 15-49 year age-group can be expected to decrease considerably because of the increased premature deaths in this age-group. The average number of people dying from AIDS-related illnesses has increased from 1,820 per week in 2005 to 1,870 per week at the end of 2007.<sup>11</sup> Additionally, it is estimated that 19 per cent of pregnant women attending ante-natal services are HIV positive, and that 39 per cent of babies born to such mothers are also HIV positive (MOH & National AIDS Council, 2008). Without life-saving drugs an estimated 33 per cent of such children die before their first birthdays and 60 per cent before their fifth (Population Reference Bureau, 2006). These statistics suggest that most babies born HIV+ do not make it to adulthood. Despite reductions in both infant and child mortality rates over recent years, HIV/AIDS induced mortality is reported to

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<sup>11</sup> These figures have been calculated from the total adult HIV/AIDS deaths provided by the Zambian government's Country Progress Report to the UN General Assembly in January 2008.

be increasing and keeping the mortality rate at higher levels than it would have been in the absence of HIV/AIDS (G.R.Z, 2006; MFNP, 2002).<sup>12</sup>

Changes in the composition of the population were noted in the 2000 Census of Zambia. The final report noted that the population pyramids indicated changes in the age-sex structure of the population. These changes were attributed to increased adult mortality between 1990 and 2000 due to HIV/AIDS-related causes. Population gaps were noticeable in the age-groups between 8 and 23 and 45 to 64 years (CSO, Census 2000 Report). Similar changes in population composition showing population gaps, especially in the younger age-groups, have been found in other high HIV/AIDS prevalence countries such as Botswana and Uganda (Barnett & Whiteside, 2002). The population gaps observed in the Zambia data are a clear indication that the proportion of children living beyond age 8 has declined in the period between 1990 and 2000, and that increased adult mortality is reducing the proportion of adults living to ages between 45 and 64 years of age.

Though the fertility rate among women in Zambia has been declining even before the advent of the HIV/AIDS epidemic, some studies suggest that the fertility pattern changes are being affected by HIV/AIDS (Clark, Undated). An analysis of data from the Gwembe Valley, in the Southern province, shows that fertility had declined significantly for all ages 15 to 35 years. The total fertility rate in this study declined from 6.25 to 4.5 between the periods 1957/69 and 1990/95 (Clark, 2005?). This study observed that the age-group fertility patterns observed were not the expected rates in populations practicing modern birth control methods. It concluded that HIV/AIDS had significantly affected the fertility rates. This conclusion is similar to that of other studies, for example (Awusabo-Asare, Boerma, Zaba, & Health Transition Centre., 1997; Gregson, Zhuwau, Anderson, & Chandiwana, 1997; Ngom & Clark, 2003; Noel-Miller, 2003; Ross et al., 1999; United Nations, 2002; USAID, 2008), that found that HIV/AIDS reduces the fertility rate of infected women.

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<sup>12</sup> The figures cited by the Zambian government reports show declines in both infant and child mortality. UNESCO (2008) figures, however, show slight increases in the period 2000-2006.

The combination of reduced fertility and the increase in the number of children not progressing to adulthood is likely to contribute to a reduced labour force than would have been the case in the absence of HIV/AIDS. Coupled with the observed declining proportion of adults between 45 and 64 years of age, the labour force is expected to not only be reduced in quantity but to get less experienced and less productive as well.

The increase in the maternal mortality rate is another important factor that will affect the size of the population and hence the size of the labour force. The maternal mortality rate is estimated to have increased from 649 to 729 per 100,000 population between 1996 and 2002, with HIV/AIDS cited as one of the main factors responsible for this increase (G.R.Z, 2006). The overall mortality from HIV/AIDS-related causes has increased from 95,373 in 2005 to 96,202 in 2006 and 97,494 in 2007 (MOH & National AIDS Council, 2008).<sup>13</sup> These figures represent approximately 1.6 per cent of the adult population between 15 and 49 years of age.<sup>14</sup> These factors all combine to reduce the total population growth rate.

Figure 8 above shows that the annual growth rate of the Zambian population has decreased since the early 1990s from nearly 3 to just below 2 per cent. In the decade before 1990, the average annual growth rate was 3.2 per cent (CSO, 2003). There seems to be compelling evidence from the foregoing observations to link this decline in the population growth rate to reduced fertility rate among women and the high HIV/AIDS-induced mortality rate observed over this period.

The total population is still increasing, however, because the population growth rate is still higher than the death rate. Intute estimates show that in 2006 Zambia's birth rate was 40.52 per 1000 population, while its death rate was 20.05 per 1000 population. Comparable world figures were 21.35 and 8.67 per 1000 population respectively (Intute, 2008). So despite the comparatively high mortality rate, Zambia's population is still increasing but at a slower rate partly

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<sup>13</sup> These figures have been revised downwards in G.R.Z. (2010). See Figure 7 for revised figures.

<sup>14</sup> Incidentally, this percentage is given as the HIV/AIDS incidence rate for 2009 in G.R.Z. (2010).

because of the HIV/AIDS-induced reduction in fertility, increase in infant and child mortality, and increase in premature adult mortality (National HIV/AIDS/STI/TB Council, 2003).

A significant adverse impact of the changes in the population structure is the expected increase in dependency ratios. An increase in the dependency ratio puts more strain on household resources. In poor households this can lead to malnutrition among the young, and increased risky behaviour among the adults in order to earn more to support the enlarged household. The overall dependency ratio which had declined from 110 in 1980 to 95.1 in 1990 had increased to 96.2 in the year 2000 (CSO, 2003; CSO[Zambia], 2003) . Strain on household resources is widely reported in most high prevalence countries including Zambia (Family Health International (FHI), 2003; FAO & WFP, 2003; Grassly & Timaeus, 2003; Kidman, Petrow, & Heymann, 2007; National HIV/AIDS/STI/TB Council, 2003).

The overall demographic impact of reductions in the proportions of young people living to adulthood and prime-age adults points to realistic reductions in the quantity of available labour, reductions in the proportion of skilled and experienced labour, and ultimately a reduction in labour productivity relative to a no-HIV/AIDS scenario.

## **2.6 Sectoral impacts of HIV/AIDS**

The impact of HIV/AIDS on Zambia's economic development is acknowledged to be a significant one. In the 2002-2004 Poverty Reduction Strategy Paper, the Zambian government cites the high incidence of HIV/AIDS, in addition to poverty and external debt, as one of the "tripod of barriers" to Zambia's economic development (MFNP, 2002). The report says "efforts at poverty reduction cannot bear sufficient fruit unless complemented by simultaneous efforts to address the problems of debt and HIV/AIDS." The economic impact of HIV/AIDS is felt in all sectors of the Zambian economy mainly through its impact on the quantity and quality of labour available. This section explores the impact of HIV/AIDS in selected sectors of the Zambian economy.

### **2.6.1 Impact on agriculture**

Agricultural activity is identified as a cornerstone of economic development in Zambia because the majority of the rural population (92 per cent of all employed) is engaged in some form of agricultural activity for their livelihood (CSO, 2005b). Agriculture provides almost two-thirds of all employment and provides a direct livelihood to almost half of the country's population (CSO, 2005b; FAO & WFP, 2003). Most of this agricultural activity is labour intensive. This fact is seen also in the labour share of output in the SAM used for this study. The FAO/WFP report cites HIV/AIDS as one of the significant factors depressing the agricultural sector's development because of its impact on individuals of working age (Population Reference Bureau, 2006). The report also lists HIV/AIDS among the country's public health priorities.

The reported difference in HIV/AIDS prevalence between urban and rural areas leads to disputes about the impact of HIV/AIDS on small-scale farm production. It is argued by some that as small-scale farmers rely mostly on animal draught power rather than manual labour to work their land, the impact of the shortage of labour on their production is negligible. Others, however, emphasize the loss of farming knowledge that is lost when a vital household member dies. They argue too that other vital agricultural tasks such as sowing, weeding and harvesting are all manual labour dependent.

Increased HIV/AIDS morbidity among working age individuals tends to reduce the productivity of infected individuals as they are often physically too weak to work, and increasingly need time off-work for medical treatment and recuperation. With most agricultural work in Zambia being labour intensive, HIV/AIDS is expected to have an adverse impact on agricultural productivity through increased morbidity-induced physical weakness and absenteeism among farm workers (FAO & WFP, 2005). A large proportion of agricultural output in Zambia is produced by small scale farmers owning less than 5 hectares and relying on family labour and very basic technology. It is estimated that there are 800,000 such households producing 65 per cent of national maize production, 75 per cent of groundnuts and 85 per cent of sorghum most of which are retained for own-consumption (FAO & WFP, 2005). Significant HIV/AIDS prevalence in such households would result in shortages of labour to work the land and reduce these households' access to food. Households with chronically ill adults were

reported to have left some of their land uncultivated due to lack of labour, lack of money to hire labour, lack of inputs such as chemical fertilizers and lack of animal draught power (FAO & WFP, 2003, 2005). The reasons given for leaving land uncultivated are consistent with other reported impacts of HIV/AIDS such as reduced household incomes, and the selling off of assets in households with a chronically ill adult and households that have experienced an AIDS-related death.

Marketed food is produced mostly by an estimated 50,000 emergent farmers and about 700 large scale farmers located close to the “line of rail”. Increased morbidity or mortality among these farmers or their employees is likely to affect national food production. Significant reductions in food production would lead to increased food prices. Under normal circumstances, maize prices in Zambia tend to rise considerably during the “hunger period” –January to April – every year (FAO & WFP, 2003). Further reductions in output would push the prices even higher. The resulting reductions in non-food expenditure would set off a chain of mutually re-enforcing adverse effects in the rest of the economy. Significant contractions in most parts of the economy cannot be ruled out if food prices were to rise significantly.

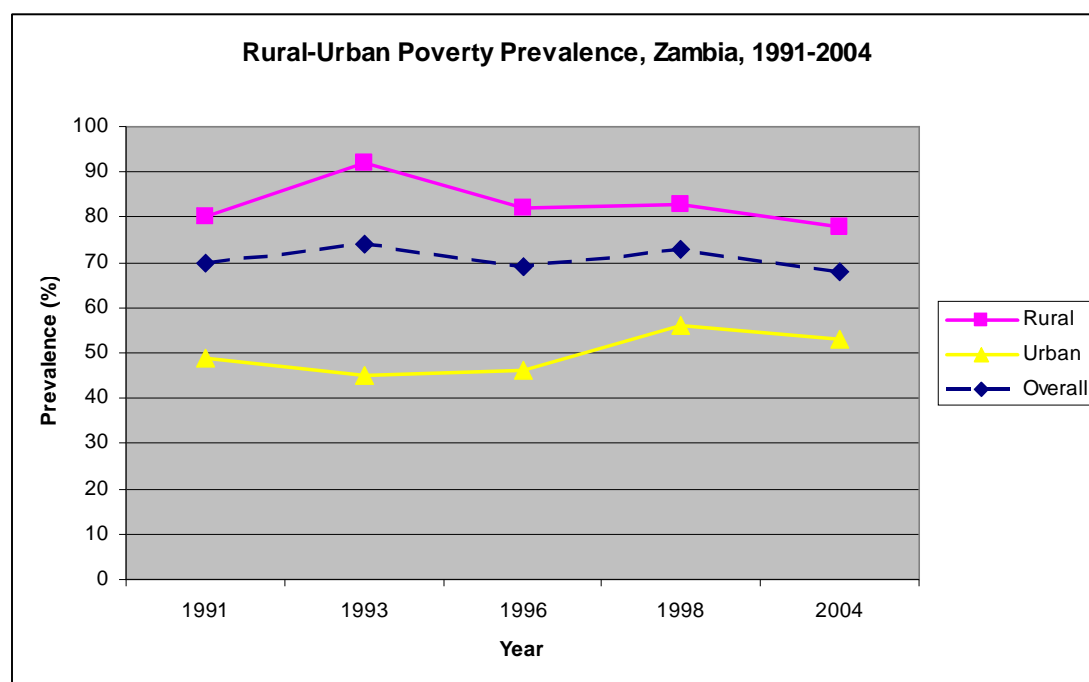
Among subsistence farmers, increased child malnutrition and mortality seem inevitable as households experience reduced food production due to HIV/AIDS morbidity and mortality among adults. Adverse effects can also be expected on children’s education as their parents lose their ability to fund their education, or require the children to contribute to food production, or provide care to ailing parents rather than be at school.

Increased morbidity leads also to reductions in household incomes which reduce the households’ capacity to access food from markets. Reduced food intake reduces the ability of the ailing person to recuperate and hastens the decline towards death.

HIV/AIDS impact on the agricultural sector has potentially far reaching negative consequences because of the very prominent role of agriculture in the Zambian economy as a provider of most employment and livelihoods for the majority of the population. Increasing poverty levels nationwide would be one obvious adverse impact of HIV/AIDS on the agricultural sector. According to the

2004 LCMS, 53 per cent of Zambians were classified as extremely poor, 15 per cent moderately poor and 32 per cent as non-poor.<sup>15</sup> Self-assessed poverty rates, however, show that 40 per cent of Zambians considered themselves very poor, 48 per cent moderately poor and only 12 per cent as non-poor (CSO, 2005b). From these figures, the percentage of poor people seems to lie between 68 and 88 per cent of the population. Poverty prevalence was reported as 70 per cent, 74 per cent, 69 per cent and 73 per cent in 1991, 1993, 1996, and 1998 respectively from comparable surveys. Though it is not possible to definitively state whether poverty had increased or decreased by 2004, these figures suggest that it had stayed the same or most likely increased. A clearer picture emerges when the poverty prevalence is disaggregated by rural-urban location. Rural poverty prevalence declined from a high of 92 per cent

**Figure 9. Rural and Urban Poverty Prevalence Rate, Zambia, 1991-2004.**



Source: figures from Living Conditions Monitoring Survey IV, CSO[Zambia], 2005b

<sup>15</sup> Extreme poverty being defined as not being able to afford the minimum basic food basket required to provide the minimum food-intake energy requirement of 2094 calories per day even if all income was applied on food, moderate poverty as being able to afford the minimum basic food basket but being unable to afford other non-food minimum basics such as adequate shelter, clothing, health and education services.

in 1993 to 78 per cent in 2004, just below the 80 per cent of 1991. Urban poverty, however, has increased to 53 per cent from 49 per cent in 1991. Despite the seemingly declining rural poverty rate, the intensity of poverty was much higher in rural areas with incomes of the rural poor on average being 44 per cent of the poverty line income compared to 58 per cent for the urban poor.

Among the reasons given for being in poverty among the self-assessed poor were: inability to afford agricultural inputs (32 per cent), lack of cattle and oxen (9 per cent), lack of capital to start or expand agricultural output (6 per cent), low agricultural production (5 per cent) for the rural poor. Among the urban poor, the main reasons were: salary/wage being too low (27 per cent), lack of employment opportunities (15 per cent), lack of capital to start own business or to expand, and lack of credit facilities (12 per cent), hard economic times/economic decline (9 per cent), commodity prices being too high and business not doing well (6 per cent each). Female-headed households reported inability to afford agricultural output (22 per cent), death of breadwinner (13 per cent), lack of capital to start own business/lack of credit facilities (8 per cent), and lack of cattle and oxen and salary/wage being too low (7 per cent each) as the main causes of their poverty (CSO, 2005b).

### **2.6.2 HIV/AIDS impact on the public health sector**

The impact of HIV/AIDS on the health sector in Zambia is severe due to increased disease burden on both the general public and healthcare professionals. The high general population HIV/AIDS prevalence rate leads to a significant increase in the demand for healthcare services provided largely by the public healthcare system (Marcus Haacker, 2004; Over, 2004). Demand for healthcare services increases because as infected people's immune systems weaken, they become more susceptible to opportunistic infections that need treatment. Diseases such as tuberculosis have become more prevalent since the advent of the HIV/AIDS epidemic. It is estimated that about 50 per cent of all TB patients are also HIV positive (Cornia, Patel, & Zagonari, 2007; MOH, 2005). Additionally, the labour intensive nature of the healthcare system means that the epidemic's effects are transmitted also through its impact on healthcare workers.

Frequent illness characterises the progression from infection to development of AIDS, after which lengthy periods of hospitalisation tend to occur

until death. Demand for hospital beds increases as a result. A study of two district hospitals in Zambia in the early 1990s showed that 44-47 per cent of bed days in these hospitals were taken up by HIV/AIDS patients (Buve, 1997). This percentage is more or less comparable to those found in some hospitals in other high prevalence countries. Occupancy rates of 50 per cent at Chiang Mai, Thailand, 60 per cent at Kigali, Rwanda, 70 per cent at Bujumbura, Burundi, 39 per cent at Kenyatta, Kenya and 56 per cent at Kampala, Uganda were reported in World Bank (1997). A Kwazulu-Natal study at a Durban tertiary hospital found up to 50 per cent of admissions to the adult medical wards were HIV/AIDS-related (Colvin, Dawood, Kleinschmidt, Mullett, & Lallo, 2001). These high percentages raise the possibility that HIV/AIDS patients, with limited life expectancy, are competing for scarce resources with non-HIV/AIDS patients who are likely to benefit the most from hospital stay, if the criterion for cost-effective healthcare is the number of life-years saved (Cornia et al., 2007; Tawfik & Kinoti, 2003; World Bank, 1997). The impact of HIV/AIDS in this case would not be only the cost of hospital care for the hospitalised HIV/AIDS patients but also the cost of the lives of the non-HIV/AIDS patients crowded out of hospital stay care. As an example, between 1988 and 1992, the number of HIV negative patients admitted to a Nairobi, Kenya, hospital decreased by 18 per cent while that of HIV positive patients more than doubled. The severity of illness of HIV negative patients increased and their mortality increased from 14 to 23 per cent while that of HIV positive patients remained the same (World Bank, 1997). The indirect costs of HIV/AIDS are therefore likely to be substantial in high prevalence countries like Zambia with severely limited capability of hospitals to admit many patients at any given time.

Early studies found HIV/AIDS prevalence to be high among medical professionals, especially nurses. A pilot study at two Zambian hospitals found that HIV/AIDS mortality among nurses increased from 2 per 1000 in the period 1980/85 to 7.4 and 26.7 in the 1986/88 and 1989/91 periods respectively (Buve et al., 1994). Rates of 24.9 and 19.8 for male and female healthcare workers in Malawi were found in Harries et. al.(2002) where HIV/AIDS and TB were found to be the main causes of death. High HIV/AIDS mortality among medical professionals is contributing to the shortage of trained medical staff in public health institutions. A 2004 study of 3 public health institutions in Zambia found that the average age at death for clinical officers and nurses was 37.7 years.

Increases of 80 and 50 per cent in the output of training establishments were required to make up for the high mortality among clinical officers and nurses respectively (Feeley, Rosen, Fox, Macwan'gi, & Mazimba, 2004). The FNDP shows that public health institutions in Zambia were operating with less than half the required number of trained staff. 45 per cent of rural health centres were run by unqualified staff, and the doctor to population ratio in some provinces was 1:69,000 (G.R.Z, 2006). The WHO recommended ratio is 1:5000. Other studies found high levels of absenteeism and resignations from the public health system due to stress of caring for increasing numbers of HIV/AIDS patients (Tawfik & Kinoti, 2003), seeing increasing numbers of their own colleagues dying of AIDS, fear of infection due to inadequate protective equipment (Over, 2004), and an increasingly inadequate infrastructure with severe shortages of drugs (Feeley et al., 2004). Poor working conditions have also been cited as a reason for many highly trained workers leaving the public health sector for private sector and overseas employment (Chankova, Muchiri, & Kombe, 2009; Huddart, Furth, & Lyons, 2004; Kirangu et al., 2008; Kruse et al., 2009).

The severe shortage of trained staff and drugs when there is increasing demand for HIV/AIDS health services compromises the quality of care that patients are likely to get from the public health system. This factor probably explains the observed significant household expenditure on private sector healthcare especially from traditional healers (see below).

Some reports suggest that the shortage of trained staff is one of the main reasons for the slow pace of scaling-up the availability of HIV/AIDS health-related services like the provision of antiretroviral therapy (ART), prevention of mother-to-child transmission (PMTCT), post-exposure prophylactics (PEP) and youth-friendly services (G.R.Z, 2006; Huddart et al., 2004; Kombe, Galaty, Mtonga, & Banda, 2005; MOH et al., 2006).

Total national spending on HIV/AIDS health-related services is considerable. Figures from the Zambia National Health Accounts (ZNHA) for 2002 show that total national expenditure on HIV/AIDS as a percentage of total national health expenditure was 43 per cent. Government per capita expenditure on each HIV/AIDS patient was 5.3 times its per capita expenditure on the non-HIV/AIDS population, while HIV/AIDS households spent 7.2 times as much as non-HIV/AIDS households on healthcare (Phiri & Tien, 2004). Government

HIV/AIDS spending as a percentage of the government's total expenditure was 11 per cent (MOH et al., 2006).

The ZNHA for 2002 showed also that government provided 17 per cent, households 29 per cent, and foreign donors 46 per cent of the total HIV/AIDS funding in 2002. The significant proportions funded by households and donors raise questions about equity and quality of services, and the sustainability of HIV/AIDS funding respectively.

Of the total household expenditure on HIV/AIDS health services, 35 per cent (same as that made to public hospitals and health centres) was made to traditional healers (Phiri & Tien, 2004). This significant proportion might be an indication of difficulty in accessing public health services, or issues about the quality of care in the public health system. It could also simply be that desperate individuals will try whatever other remedies are available when conventional medicine does not seem to be effective in treating their conditions.

Sustainability issues arise when the largest proportion of the funding is donor provided. Changes in the economic environment, such as the current economic downturn, could lead to significant reductions in the amounts external donors are able to give. The recent change in the amount of funding available through PEPFAR provides a good example, as does the suspension of aid from the Netherlands and Sweden following allegations of corruption and embezzlement of funds from the Ministry of Health by some top government officials (IRIN/PlusNews, 2009).

Over the 2002-2004 period, of the US\$1.2 bn of the poverty reduction strategy paper resource envelope, 7.9 per cent (US\$94.6m) was allocated to HIV/AIDS activities (MFNP, 2002).

The Zambian government's Fifth National Development Plan (FNDP) shows that spending on HIV/AIDS/STI will take up just over 10 per cent of the healthcare budget over the 2006-2010 period. Reliance on external donor funding is projected to remain at the high of 91 per cent of combined government and donor funding.

**Table 1 Projected Spending on HIV/AIDS/STI, Zambia, 2006-2010**

<b>Spending On HIV/STI by</b>	<b>Year Projections (billions Kwacha)</b>				
	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Govt	10.7	11.6	14.2	16.3	18.6
Donors	111.4	139.7	151.7	166.3	194
<b>Total</b>	<b>122.1</b>	<b>151.3</b>	<b>165.9</b>	<b>182.6</b>	<b>212.6</b>
<b>Spending On All Health by</b>					
Govt	557	820.1	973.7	1098.8	1331.9
Donors	571.8	540.7	571	661	712.8
<b>Total</b>	<b>1128.8</b>	<b>1360.8</b>	<b>1544.7</b>	<b>1759.8</b>	<b>2044.7</b>

Source: Compiled from the FNDP Health budget

Table 1 shows that both government and donor funding for HIV/AIDS is projected to increase at an average annual rate of about 15 per cent over the five-year period. The proportion of donor funding for health devoted to HIV/AIDS/STI is, however, expected to increase from 20 per cent in 2006 to 27 per cent in 2010.

From Table 1, and shown in Table 2 the proportion of government health expenditure devoted to HIV/AIDS/STI declines from 1.8 per cent in 2006 to approximately 1.4 per cent in each of the succeeding years. Overall, HIV/AIDS/STI takes up between 10 and 11 per cent of the total healthcare budget in each of the years of the FNDP.

**Table 2 HIV/AIDS/STI Spending as Percentage of Total Health Spending**

Spending Source	Year				
	2006	2007	2008	2009	2010
Govt	1.8	1.3	1.4	1.4	1.4
Donor	19.4	25.7	26.4	25.0	27.1
Total	10.7	11.0	10.7	10.3	10.3

Source: Calculated from projected spending figures in the FNDP

10 per cent of all health care spending is a substantial proportion of the health care budget to allocate to one disease when there are as many competing needs within the healthcare sector as there are in most developing countries. That the government plans to spend so much is an acknowledgement of the seriousness of the impact of the HIV/AIDS epidemic on the people of Zambia and on Zambia's economic and social development. The figures in the table above, exclude projected expenditure on tuberculosis (TB). As the increase in TB cases has been attributed to HIV/AIDS, it seems reasonable to include the costs associated with TB in the total costs of HIV/AIDS-related illnesses. Doing so raises the projected total proportion of HIV/AIDS-related spending to an annual average of just over 13 per cent of total healthcare budget over the 5 year period of the FNDP. As with HIV/AIDS/STI, most of the funding, over 90 per cent, for TB is expected from donor countries.

### **2.6.3 HIV/AIDS and the Education sector in Zambia**

The education sector is crucial in the development of human capital and production of a skilled and highly productive labour force. Accumulation of capital, both physical and human, has long been recognised as a necessary condition for economic growth. The provision of good quality education and training in Zambia is seriously jeopardised by high HIV/AIDS prevalence among teachers and other education sector managers.

The number of teachers dying from AIDS-related illnesses each year was reported to be close to two-thirds the number of teachers trained annually at all primary school teacher training institutions (Grassly et al., 2003; M. J. Kelly, 2000; UNICEF, 2000). Using the number of experienced trained teachers as a proxy for the quality of education being provided suggests that the quality of education is declining as more experienced older teachers die or retire due to illness. A Zambian government report shows that the total number of teachers declined by 8.3 per cent between 1996 and 1999 (MFNP, 2002). Fewer teachers lead to increased teacher-student ratios which in turn lead to reduced quality of education due to the reduced individual attention students get from their teachers. Efforts are being made to train new teachers. However, newly trained teachers lack experience and do not get the benefit of working with and being mentored by older experienced teachers. It thus takes longer for new teachers to gain experience and increase their productivity. The quality of education provided by inexperienced new teachers is therefore lower than that offered by experienced ones. The reduced quality of education has been cited by some authors as one of the reasons for some young people not attending school (Jensen & Nielsen, 1997; M. J. Kelly, 2000).

The training of new teachers to replace the dying ones is a costly undertaking because additional resources are being expended to maintain the number of teachers instead of increasing it (Goliber, 2000; Grassly et al., 2003; M. J. Kelly, 2000). Despite the increase in training costs, class sizes do not decrease, and therefore, the quality of attention individual students receive in class falls. Student-teacher ratios on average increased from 37 to 47 students per teacher between 1996 and 1999 (MFNP, 2002). Teacher attrition due to HIV/AIDS is given as one of the main reasons for this deterioration in the student-teacher ratio. Teacher mortality, estimated at 39 per 1000, was 70 per cent higher than the adult population (15-49 years) mortality rate of 23 per 1000 (M. J. Kelly, 2000). A 2003 UNDP publication reported a finding of an urban sample of teachers with 42 per cent HIV/AIDS prevalence (Kamwanga et al., 2003) which is much higher than the prevalence rate in the general population.<sup>16</sup>

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<sup>16</sup> Some authors suggest that prevalence is no higher among teachers than the general population and that estimate that it must be considered the same as in the general population

Bennell (2005a), however, argues that, contrary to earlier studies showing that teachers had a higher HIV/AIDS prevalence rate than the general population, teachers had a lower prevalence rate. He attributes this to personal and sexual behaviour change among teachers because of their education and knowledge of HIV/AIDS, and the availability of antiretroviral drugs. He argues that HIV/AIDS is more likely to lead to an oversupply of teachers rather than reduce it (Bennell, 2005a). Bennell's argument does not seem to be in line with many other studies that have concluded that being educated was highly correlated with being HIV+<sup>17</sup>. Such studies argue that educated people had higher incomes enabling them to engage in multiple concurrent sexual relationships or buy sex, were more mobile and therefore more likely to come into contact with infected individuals and get infected themselves. There is a lot of support for this argument because of the high mortality observed among the educated population especially during the earlier years of the epidemic. Though antiretroviral drugs are now available, they have been relatively expensive and out of reach of most people, including teachers. Only in the very recent years, have ARVs become freely available in Zambia. At the end of 2005, an estimated 43,000 out of an estimated 200,000 people who needed ARVs were receiving them (G.R.Z, 2006). This is just slightly over 21 per cent of the population in need. These figures show that ARVs are still not yet widely available to all who needed them in Zambia. Until recently ARV distribution centres were concentrated almost exclusively in the main urban centres. It is therefore highly unlikely that most teachers would have had access to ARVs before 2005.

It has also been suggested that teachers are generally reluctant to access treatment services for fear of having their HIV/AIDS status revealed. Their prominent role in society as educators and role models makes it especially difficult to openly access treatment services for fear of stigmatisation and discrimination (UNESCO & EI-EFAIDS, 2007). To encourage teachers to access treatment, the ministry of education has a programme of paying for teachers to

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because there are actually no accurate records kept by the Ministry of Education of numbers of teachers who have died of HIV/AIDS-related illnesses. See for example Bennell (2005), Goliber (2000).

<sup>17</sup> There is, however, evidence that among young people, there has been a change in the positive association of higher education with HIV infection. See (Michelo et al., 2006).

receive treatment at private health institutions with the aim of gradually shifting them to the free public health system (UNESCO & EI-EFAIDS, 2007). This however, is a rather expensive option, which if successful could prolong the lives of many teachers and ironically, increase costs to the education sector. As shifting such treatment into public health system is slow, this initiative will be very expensive if its uptake is high.

The quality of education is affected also by the difficulty of placing trained teachers in rural and remote area schools. High HIV/AIDS prevalence among teachers has made more teachers preferring to be located in areas with easy access to medical care (Ramos, 2007). This situation compromises the quality of education offered in rural and remote-based schools. Kelly (2007) has suggested that even when placed in urban areas, many teachers are too sick to carry out their full teaching loads resulting in significant loss of teaching time due to prolonged illness and erratic attendance. This has been found also by Ramos who reported the existence of “several hundred infected and affected teachers” on the payroll but who were too sick to teach. Kamwanga et al., (2003) found that high teacher morbidity and mortality tended to be clustered in schools in well-serviced areas. Areas with better health services were found to have recorded more cases of mortality and long-term illness among teachers than other areas. Thus urban schools too were affected by increased teacher absence and mortality. The quality of education in urban areas may thus be no different from that in rural areas. Teacher replacement costs increase without a corresponding increase in teacher productivity and divert resources from other quality and development-enhancing activities (Goliber, 2000; Kamwanga et al., 2003; M. J. Kelly & International Institute for Educational Planning., 2000). This puts further strain on educational sector resources.

The HIV/AIDS impact on education is felt also through its effect on other education sector workers and decision-makers. The loss of experienced managers and other administrators at all levels of the education system causes significant inefficiencies in the system. HIV/AIDS mortality among the staff of a teacher training college was identified as a major issue that was affecting the quality of teacher training (Ramos, 2007). In addition to staff deaths, Ramos’ study found absenteeism among the college staff was high due to funeral attendances and need to care for sick family members. Lectures were frequently cancelled due to

lecturer absenteeism and affected the quality of teacher training. Teacher absenteeism has been reported by among others (Goliber, 2000; M. J. Kelly, 2000; M.J. Kelly, 2007; M. J. Kelly & International Institute for Educational Planning., 2000; Kinghorn & Kelly, 2005; MOE [Zambia], 2004).

The generalisation of the HIV/AIDS epidemic in Zambia means that all aspects of the education sector, from managers and planners to trainers and teachers are as affected by the epidemic as is the general population. This leads to serious institutional memory loss arising from loss of experienced long-serving managers and planners; inefficiency arising from loss of experienced support staff; and inefficiencies arising from poorly staffed training institutions producing poorly trained teachers. The effects mount to a severe depletion of social capital available to the system (M.J. Kelly, 2007).

As economic performance declines, the quality of education can be expected to be at risk as the education sector will suffer from underfunding as there will be fewer resources available and with more of the available resources being diverted towards dealing with the direct and indirect health impacts of HIV/AIDS.

HIV/AIDS affects the way the education sector is organised and managed as a system. As the quality of individuals that make up the system and the quantity of resources available to the individuals in the system falls, the quality of the system itself falls too.

While the supply of education is changing, the demand for education is changing too. Though universal enrolment has not yet been achieved, the late 1990's saw an increase in the number of students enrolled in basic school. The gross enrolment ratio for basic primary school increased from 75.1 in 2000 to 89.8 in 2004 while the net enrolment ratio rose from 68.1 to 79.4 over the same period (G.R.Z, 2006). However, this period also saw an increase in the number of student withdrawals from school especially in the last two years of Basic School (years 8 and 9). The completion rates for girls and boys were 65.8 per cent and 78.3 per cent respectively (G.R.Z, 2006). Withdrawal of older children to look after sick parents or other relatives, or to provide additional labour after the loss of adult labour in the household due to HIV-related mortality is given as one of the main reasons for the low completion rates. In a 2001 study, Nampanya-Serpell found that about 21 per cent and 17 per cent of female and male students in an

urban sample dropped out of school after the death of a parent due to an AIDS-related illness ((Nampanya-Serpell, 2001). Thus HIV/AIDS is contributing significantly to the change in demand for education and the development of human capital. As this change is an adverse one, it can be concluded that HIV/AIDS is reducing the development of human capital through its impact on both the demand for education, through the reduced number of students attending school, and the supply of education, through its impact on the quantity and quality of teachers available.

The high prime-age adult mortality leads to fewer children being born. And of the children being born an estimated 30 per cent are born HIV+ and generally do not live to school going age. The supply of school-age children is decreasing. Some estimates put this reduction at 20.4 per cent for Zambia by the year 2010. The average annual growth rate has been estimated at 1 per cent instead of 2.3 per cent in the absence of AIDS over the 2000-2010 decade (Goliber, 2000).

The increase in the number of orphaned children also contributes to the reduction in the number of children demanding school services.

#### **2.6.4 Impact of HIV/AIDS on the private sector**

The impact of HIV/AIDS on the private sector is important because the private sector employs an estimated 58 per cent of all Zambians in formal employment (IOM, 2007). The private sector, through small and micro enterprises, also provides a significant amount of employment in the informal sector. The impact of HIV/AIDS on firms led to the formation of the Zambia Business Coalition on HIV/AIDS (ZBCA) in early 2000. The ZBCA is currently the officially recognised voice of the business sector on HIV/AIDS in Zambia. By 2005, it had a membership of 60 firms with a target of 120 by the year 2007 (World Economic Forum, 2006). Membership of ZBCA has been and is still exclusively made up of large firms.

The impact of HIV/AIDS on the business sector is dependent on, among other factors, how labour-dependent the firm is, the skill level of the affected employees, and the level of employee benefits (Bloom, Mahal, & River Path Associates, 2001; IOM, 2007; Rosen et al., 2006). Labour intensive businesses feel the impact more because of increased labour-associated costs. Direct labour

costs include increased medical expenses for sick employees, funeral grants, increased terminal benefit payments and lost productivity due to increased morbidity and mortality-related worker absenteeism. Other labour costs include recruitment and replacement costs of skilled workers, and training costs of new workers. Indirect costs include loss of productivity associated with employee stress resulting from frequent illness and deaths among colleagues, and employees having to do more work to cover for absent colleagues. Increasing worker inexperience, due to high labour turnover, also contributes to reduced productivity.

Early studies in Zambia showed that there was high HIV/AIDS-induced mortality among skilled workers, increased costs and reduced profitability in some large firms. Mortality among one bank's employees rose from 0.4 per cent to 2.2 per cent between 1987 and 1992. During this period the bank lost an average of 36 workers annually with 70 per cent of the deaths occurring among those under the age of 40 years and all attributed to AIDS. Ex gratia payments to families of the deceased workers increased by 350 per cent between 1991 and 1992.<sup>18</sup>

An ILO EAMAT 1995 study found that at the Indeni Oil Refinery Company, HIV/AIDS-worker related costs exceeded the firm's annual profit (ILO-EAMAT, 1995). In a study of 18 firms in Lusaka, the ILO EAMAT 1995 study found that of the 68 deaths recorded over a 10 month period in 1993, 67 per cent were either in lower, middle or top management. AIDS-related symptoms accounted for 56 per cent of deaths among general workers and 62 per cent among top management. The study also found an association between HIV/AIDS and longer periods of absenteeism.

An AIDSCAP project at two large firms found different effects of HIV/AIDS at the two firms. Chilanga Cement Company experienced a 15-fold increase in funeral related absenteeism between 1992 and 1995, forcing the firm to restrict funeral attendances to those of own parents, spouse or child, while Nakambala Sugar Estates, the country's main sugar producer, experienced

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<sup>18</sup> Cited in Bollinger & Stover, 1999

increased medical costs for its employees (Smith, 1995).<sup>19</sup> AIDS-related medical costs increased by 63 per cent in the 1995 year at the Tanzania-Zambia Railway Authority (Bollinger, Stover, & Riwa, 1999).

In a survey of 10 firms in Lusaka, 4 reported AIDS as being a problem among their employees and that high AIDS mortality had affected their operations. Half of the firms noted increases in sick leave, 4 reported increased absenteeism while 6 reported increases in rates of funerals.<sup>20</sup>

A 2003 study of 7 firms in manufacturing, transport, farming, food processing, and financial sectors in Lusaka, Kabwe, Mazabuka and Kafue found that 5 of the 7 firms had medical facilities for their employees, 4 firms had healthcare cost sharing arrangements with their employees, while 2 met the full cost of their employees' healthcare. In addition to offering paid sick leave, all firms paid funeral benefits to their employees (Guinness, Walker, Ndubani, Jama, & Kelly, 2003). This study found that firms did not generally replace workers on sick leave. Records showed that sick workers' duties were merely transferred to other employees. This finding lends support to the assertion of increased stress among non-sick workers due to extra responsibilities. Of increased absenteeism in the surveyed firms, focused discussion groups consistently found that the 3 main causes were ill health, caring for sick family members, and attending funerals of co-workers, family members or neighbours. Long working hours and poor conditions were also cited as reasons for absenteeism. Training costs were high but varied considerably among the firms. This suggests that labour-intensive firms and those requiring workers with specialised skills were most likely to be adversely affected by HIV/AIDS morbidity and mortality.

These early studies in large firms all suggest that there are significant adverse HIV/AIDS effects on firms. However, a 2006 study of a number of firms in South Africa, Botswana, Ethiopia, Uganda, Kenya, Rwanda and Zambia found conflicting evidence of the impact of HIV/AIDS on firm labour costs. In high prevalence countries with generous employee benefit schemes, like Botswana and Zambia, the labour cost of AIDS to firms was found to be high, while in the lower

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<sup>19</sup> Nakambala Sugar Estates employs mostly migrant seasonal workers who cut the cane from March to November.

<sup>20</sup> Cited in Bollinger & Stover, 1999 and (Bloom, Mahal, & River Path Associates, 2001)

prevalence countries the labour costs were found to be low.<sup>21</sup> Only at 2 of the 14 large firms in the study did the cost of losing employees exceed 5 per cent of total annual labour costs. The two firms, one in the tourism sector in Zambia had 10.8 per cent, while the other a mining firm in Botswana had 8.4 per cent. In no other large firm did the cost exceed 3 per cent of total annual labour costs (Rosen et al., 2006). The results of this study suggest that other factors such as the generosity of employee benefit schemes might play a significant part in determining the impact of HIV/AIDS on labour costs.

In Zambia, large firms typically offer one month paid annual leave, 3 months sick leave on full pay, and a further 3 months on half pay. In addition firms pay varying amounts for employees' medical costs, provide funeral grants and pay terminal employee benefits to families of deceased employees. With high HIV/AIDS morbidity and mortality among workers, costs to labour-intensive firms are bound to increase substantially and absenteeism can adversely affect productivity levels.

In response to increasing morbidity and mortality among their employees, many firms are engaged in providing some form of HIV/AIDS awareness and education campaigns in their firms and in some cases also in the communities housing their employees. An example is Chilanga Cement which, in 2000, concerned at the impact of HIV/AIDS on its employees and operations implemented a comprehensive HIV/AIDS awareness, and prevention programme at work and in the Musamba community which houses its employees. The programme involved the firm arranging for provision of voluntary counselling and testing services, provision of free male and female condoms, and the firm paying for employees', their spouses' and up to 4 other dependants' medical fees up to the value of 25 per cent of the employee's annual salary. The firm paid also for 44 workplace and 24 community peer educators for its 226 employees at its Chilanga site, near Lusaka, and 2500 community of Musamba. In addition to planning to extend its community programme to other communities near Musamba, the firm intended to extend the programme to its other site at Ndola in the Copperbelt province. The Zambia Revenue Authority implemented a similar

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<sup>21</sup> Some of the data were collected in 1999, a time when prevalence was considered low in countries like South Africa, Ethiopia and Rwanda.

programme while other firms were looking at adopting similar programmes (World Economic Forum, 2003). It is estimated that by 2007, more than 50 large firms had implemented workplace AIDS programs (IOM, 2007). This example shows that HIV/AIDS is causing larger firms to engage in costly activities to protect their employees and operations. Such activities necessarily increase costs and reduce firms' profits. It may be argued that the costs of non-action were probably greater but, nonetheless, these are extra costs that the firms would not have incurred in the absence of HIV/AIDS.

The higher prevalence of HIV/AIDS among the more educated and wealthy also suggests that the skilled workers in the private sector are disproportionately affected by HIV/AIDS than are unskilled workers. As the costs of training and hiring skilled labour are much higher, it is not unreasonable to expect that firms are incurring significant costs in maintaining their required levels of skilled labour. Competition for the limited available skilled labour in the country is likely to increase the cost of acquiring skilled labour locally. The shortage of locally available skilled workers has forced some firms in Zambia to hire expatriate workers, at significant cost, to fill positions vacated by deceased Zambians (Rosen et al., 2006).

A survey of small and medium enterprises (SMEs), which defined SMEs as having between 10 and 200 employees, found that SMEs did not consider HIV/AIDS to be a significant problem for their operations. Among tourism companies in Livingstone, Zambia, 65 per cent of managers responded that HIV/AIDS had little or no effect on their firms, 28 per cent moderate effect and only 7 per cent said it had a severe effect on their firms. In the agricultural sector, the corresponding figures were 63 per cent and 37 per cent for little or no effect and moderate effect respectively. Of the total labour attrition in the two sectors, 14.5 per cent, in tourism, and 8.2 per cent, in agriculture, were attributed to ill-health and death (Rosen et al., 2006). That 64 per cent of tourism firm employees were skilled workers compared to 37 per cent in agriculture might explain the difference in the attrition rate attributed to ill-health and death. The average annual cost of losing an employee among the surveyed firms was just over one year's compensation for the employee, which equated to about 2.4 per cent increase in annual labour costs for the median firm in the sample (Rosen et al., 2006). Across the full sample of tourism firms, annual labour costs increased by

0.6 per cent. The agricultural firms would have had even lower costs due to the largely unskilled labour they employ. These results seem to confirm the managers' responses that HIV/AIDS had little or no impact on SMEs' labour costs.

However, the majority of surveyed SMEs both in tourism and agriculture were involved in providing HIV/AIDS workplace and community educational and prevention activities to their employees, while 17 per cent in tourism and 28 per cent in agriculture were providing ARV treatment to their infected employees (Rosen et al., 2006). Despite being involved in these activities, most SMEs reported that they incurred no extra costs because the activities were funded by either government or NGOs. The only costs to the firms would be the time allocated to the activities.

The impact on micro enterprises has not been explored. It is however thought that because they tend to be small, typically employing less than 10 employees and relying mostly on family labour, and dependent on particular skills of one individual, these firms are very vulnerable to HIV/AIDS because the death of the vital person could lead to the demise of the enterprise and the loss of income for the family and its workers (Barnett & Whiteside, 2002; Bloom, Mahal, & River Path Associates, 2001). In such cases the impact is not an increase in labour costs but rather the loss of a livelihood for the family that can tip the family into poverty.

Despite the differences in the level and types of impacts HIV/AIDS has on different sized businesses, there seems to be no doubt that it has adverse effects on firms. Large labour-intensive firms employing a lot of skilled labour are most likely to feel the impact through increased labour-associated costs. SMEs employing skilled workers, as in the tourism sector, are also likely to feel the impact of increased labour turnover and loss of productive time to AIDS awareness and prevention activities. Micro-enterprises may vanish altogether as they lose the individuals on whose skills they depend on with the consequent adverse impacts on families and workers that lose their source of income.

## **2.7 National response to the epidemic**

There are three main types of responses to the AIDS epidemic in Zambia distinguished by institution. These are the government response, civil society response and the private sector response.

### **2.7.1 Government response**

The government response to the HIV/AIDS epidemic followed soon after the first AIDS cases were identified. The National AIDS Surveillance Committee was set up in 1986. Subsequently a high level Cabinet Committee of Ministers on HIV and AIDS that reports directly to the president was established. In 1987 an emergency short-term plan was developed to ensure safe blood and blood products supply in the country. Between 1988 and 1998, two 4 year Medium Term Plans were introduced. The first prioritised eight operational areas – TB and leprosy, IEC, counselling, laboratory support, epidemiology and research, STD and clinical care, programme management, and home-based care, while the second, which was multi-sectoral in design, incorporated a mechanism for inter-sectoral co-ordination and collaboration (National HIV/AIDS/STI/TB Council, 2003, 2006). In 1990 the ante-natal clinic-based National HIV/AIDS Sentinel Surveillance System was introduced to track the progression of the epidemic in the population. The National AIDS Council and Secretariat (NAC) were established by an ACT of Parliament in 2002 as a broad-based corporate body with government, private sector, and civil society representation.<sup>22</sup> The NAC serves as the single high level institution responsible for national and technical leadership, strategic management, and effective coordination of all government and civil interventions (National HIV/AIDS/STI/TB Council, 2003, 2006). The NAC is guided by national strategic frameworks the first of which was the 2001-2003 National Strategic Framework. This framework emphasized the addressing of HIV/AIDS in the country's overall development program, not just as a health issue. An important feature of the NAC is the decentralisation of planning to provincial and district levels. This was meant to introduce and encourage grass-roots participation in the planning and execution of prevention activities. The

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<sup>22</sup> The NAC was actually set up in 2000. The legislation making it a legal body was however, passed in December 2002.

2002-2005 National HIV/AIDS Intervention Strategic Plan aimed at building on the existing political commitment to promote eight major interventions covering behaviour change and communication campaigns aimed at reducing HIV/AIDS prevalence in the 15-19 year age-group, reducing MTCT by increasing access to quality MTCT services in all districts, ensuring that all blood, blood products, and body parts were safe for transfusion, improve the quality of life of HIV/AIDS infected persons, provide appropriate care, support and treatment to HIV/AIDS infected persons and those affected by HIV/AIDS, TB, and STIs, provide improved care and support services for orphans and vulnerable children and other affected persons such as refugees, prisoners and the disabled, improve HIV/AIDS information management and decision-making by developing well co-ordinated databases, and to assure impartial, transparent and effective programme operation by improving the coordination of multi-sectoral implementation of interventions. The 2006-2010 National HIV and AIDS Strategic Framework builds on the 2002-2005 framework and emphasizes intensifying prevention of HIV, expanding treatment, care and support for infected people, mitigation of socio-economic impact of HIV and AIDS, strengthening the decentralised response and mainstreaming HIV and AIDS, improving the monitoring of the multi-sectoral response, and integrating advocacy and coordination of the multi-sectoral response (National HIV/AIDS/STI/TB Council, 2003, 2006).

Significant achievements of the government response include the 2003 introduction of part-funded ARV treatment. Since 2005, ARV treatment has been provided free of charge in the public health sector. The significant increase in ARV service sites from 8 to 298 between 2005 and 2007, increase in the number of VCT sites, and the expansion of PMTCT services to all public hospitals are also significant government response achievements. Other government achievements have been the adoption of awareness and prevention programmes, the training of peer educators, and the distribution of condoms in most government ministries. As government employs almost 40 per cent of the formal workforce, adoption of workplace AIDS programmes in government ministries has the potential to reach a significant number of workers and reduce the impact of AIDS on public sector workers.

### **2.7.2 Private sector response**

The private sector response has already been elaborated on. Suffice to say the design and implementation of workplace programmes in companies and businesses are largely supported by a private sector NGO network, the Zambia Workplace AIDS Partnership (ZWAP). ZWAP serves as an umbrella organisation for about 10 institutions involved in implementing workplace AIDS programmes (World Economic Forum, 2006). The ZBCA works in partnership with ZWAP. A large number of, mostly, large firms have adopted workplace AIDS programmes aimed at awareness, prevention, treatment, care and support for affected employees and the communities in which they are located. These programmes have the potential to influence the approximately 58 per cent of the formal workforce that is employed in the private sector. However, most firms, especially SMEs and micro-enterprises still do not have workplace AIDS policies or programmes. Thus the majority of workers in SMEs and micro-enterprises do not enjoy the relatively generous benefits enjoyed by workers in firms that have AIDS policies and programmes. Though AIDS mortality is devastating for all workers and their families, the impact is probably worse on workers without the employer-provided medical and funeral benefits.

### **2.7.3 Civil Society response**

Civil Society is broadly made up of non-government organisations (NGOs), Community-Based Organisations (CBOs), and Faith-Based Organisations (FBOs). Also included are media, trade unions, traditional healers, and youth groups (Garbus, 2003; National HIV/AIDS/STI/TB Council, 2006). Civil Society in Zambia plays a critical role in the fight against HIV/AIDS and its effects. Most Zambians work in the informal sector where employers are generally not able to offer awareness, prevention and treatment information (Garbus, 2003). Civil Society, through NGOs, CBOs, and FBOs, offer the best opportunities for such workers to access HIV/AIDS information and care services.

NGOs and CBOs often lead the way in devising and implementing innovative anti-AIDS programmes. FBOs are especially important in rural areas where Churches may serve as strong community structures for decision-making and problem solving. FBOs are also prominent in the establishment and provision of home-based care programmes in most parts of the country (Garbus, 2003).

Civil Society organisations have the potential to reach a wider audience through community-based and significant participation in faith-based activities.

#### **2.7.4 Response shortcomings**

The responses by all three institutions discussed above are, however, constrained by serious shortages of resources (Garbus, 2003; Kombe et al., 2005). Government ministries often have only one or two people responsible for AIDS policy and not much money allocated to AIDS activities.<sup>23</sup> Government efforts to scale up treatment services were being hampered by a shortage of skilled healthcare staff to administer the services (Feeley et al., 2004; Kombe et al., 2005). Some big firms and most SMEs are not part of the ZBCA because they cannot afford the nominal membership fees, and cannot afford to implement workplace programmes or do not have individuals that champion HIV/AIDS issues. A survey of 71 workplaces in Lusaka and Copperbelt towns found that 73 per cent had no AIDS workplace policy or programmes (Mwaba, Nyumbu, & Bharat, 2002).

Civil Society organisations are also constrained by a lack of funding. Most Civil Society organisations tend to be concentrated in urban areas. Their geographical coverage is therefore severely limited. It has been estimated that even in urban areas, there are able to offer services such as home-based care to only about 20 per cent of the people that need it (Garbus, 2003).

The Zambian response to HIV/AIDS is largely dependent on foreign donor funding. Among the main sources of foreign funding are the World Bank's Global Fund to Fight AIDS, Tuberculosis and Malaria, PEPFAR, USAID, DFID, CIDA, EC, NORAD, GTZ, Ireland AID, JICA, DANIDA, SIDA and CDC. The poor performance of the Zambian economy over many years makes it inevitable that the country would need massive foreign aid to meet the challenges of the HIV/AIDS epidemic while continuing with its development efforts. However, the sustainability of long-term funding is not guaranteed.

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<sup>23</sup> For example, The Ministry of Education, in 2003, was reported to have had 2 people responsible for the Ministry's HIV/AIDS response. See Garbus, 2003.

## 2.8 Discussion

HIV/AIDS is expected to continue to have a significant impact on the various parts of Zambian society and its economy for many years to come. Current prevalence rates are high in both urban and rural areas. The prevalence of untreated STIs which facilitate HIV transmission, prevalence of concurrent multiple sexual relationships, gender inequality which reduces women's ability to negotiate for safer sex, unsafe traditional and cultural practices, low use of condoms and widespread poverty will ensure that new infections continue to occur well into the future. Given the long incubation period of the virus, the impacts of these new infections will not be felt for at least a decade after they have occurred. The fact that infected and infectious individuals may show no outward signs of illness for many years makes it difficult for sexual partners to insist on safer sex in light of low levels of sero-status testing. It is thus difficult to imagine the eradication of the epidemic in the absence of significant traditional, cultural and sexual behavioural change in the entire population, or discovery of a cure.

The 2007 UNAIDS update notes that there has been no observed behaviour change in the sexual habits of young people in Zambia, and in other countries, such as South Africa and Mozambique. If this is indeed true, then the HIV/AIDS epidemic is going to plague Zambia for many more years to come because of high infection rates, especially among young women. High HIV prevalence among young women and the slow increase in the number of women accessing PMTCT services have adverse effects on the number of children reaching adulthood and hence growth of the labour force.

Compounding this situation, ironically, is the increasing availability of life-prolonging antiretroviral drugs (ARVs). With ARVs infected individuals can live longer, healthier and productive lives. This is obviously of great benefit to both the families of the infected individuals and the country. However, ARVs do not cure individuals of HIV/AIDS. By prolonging the lives of infected individuals, ARVs help increase the stock of infected people capable of infecting others. Could it be that ARVs will contribute to worsening the HIV/AIDS epidemic? There is no evidence yet to suggest that this is the case, but it is a very plausible scenario. Individuals on ARVs need also to stay on their medication for the rest of their lives. This has implications for public finances when the drugs

are provided freely through the public health system as is the case in Zambia. Zambia's current reliance on foreign donors for ARV drug funding alleviates this problem but raises the question of availability of the drugs in the long-term.

Of great concern is the high prevalence among the well-educated and the wealthy sections of the population. The well-educated are expected to be able to absorb available information and use it to protect their health and well being and safe-guard their investment in human capital accumulation. That this is not what has happened in Zambia is cause for concern because many more educated people will be lost from the workforce. This is likely to reduce the productivity of the remaining workforce as they are replaced by possibly less well-educated individuals.

High morbidity and mortality among the wealthy is bound to have negative consequences for availability of savings available for investment in the long-term. 7 per cent of the poor in 2004 reported the lack of credit facilities as the cause of their poverty (CSO, 2005b). Lack of credit affects the setting up of new businesses and the expansion of existing ones. High mortality among the wealthy will likely make the availability of credit scarcer.

High mortality among the well-educated poses a serious challenge to the well-functioning of the public sector which employs a significant proportion of them. Professionals in the vital health and education sectors have been shown to be seriously affected by HIV/AIDS and have high mortality rates thereby jeopardizing the quality of services these sectors are able to offer. The loss of medical staff reduces the health sector's ability to care for the sick, regardless of their illness. This raises the realistic possibility that morbidity and mortality due to other diseases could become worse as the health sector loses increasing numbers of trained staff.

Loss of teachers compromises the ability of education to serve as an antidote by providing quality education that raises students' knowledge of health-related issues. Some studies have shown that education campaigns are effective AIDS antidotes when they are introduced to young people before they become sexually active. With education, young people have been found to delay sexual debut and to delay age at first marriage.

The loss of experienced civil servants reduces the effectiveness of the civil service. Significant institutional memory loss is likely to result in poor decision-

making that will have significant adverse effects over significant parts of the public sector. Poor or inefficient decision-making at the Ministry of Health headquarters, for example, will have adverse effects right through the public health system affecting a significant proportion of the population that uses the public health system. Public sector poor decision-making can also affect private sector performance because public sector decisions tend to set the framework in which the private sector operates. Thus public sector inefficiencies have wider reaching consequences relative to private sector ones.

The private sector faces a similar problem to the public sector. Loss of skilled and experienced managers and other workers reduces the productivity of affected firms. Increased worker costs – employment-related costs, medical costs, terminal benefits, and loss of productive time through absenteeism - contribute to reduced firm profitability. In addition, firms face shrinking local markets through increased poverty and mortality among their consumers. Firms may thus be forced to contract their activities and employ fewer workers. Job creation may be compromised if firms contract or fail to expand, leading to increased poverty prevalence especially given that the population is still increasing.

Households bear the brunt of the HIV/AIDS epidemic. When individuals die or lose their jobs, be it either in the public or private sectors, their surviving households bear the impact of losing an income. In many one breadwinner households, transition to poverty is swift on the loss of the breadwinner. Such households may have to relocate to less salubrious accommodations, cut back on food intake and other goods and services they previously consumed. This phenomenon is commonly observed among female-headed households. Household impacts extend to the welfare of children in affected households. Reduced nutritional intake has increased the incidence of malnutrition resulting in increasing stunting and wasting in young children. Poor nutritional status and trauma of experiencing the chronic illness of parents affect the academic performance of some children thereby compromising their ability to develop their human capital and achieve their potential. Children may also be fostered out as a household coping mechanism. Some studies have shown that this causes a strain on the fostering-in households' resources which have to be applied on now enlarged households. Other studies have shown that fostered-out children may suffer disadvantages compared to the biological children of their foster parents.

Fostering of orphans may thus transfer some of the HIV/AIDS impacts from their own family households to their foster households, and may continue to suffer disadvantages albeit different ones.

The increasing number of orphaned children poses some challenging problems. Some of the orphans have become street-children without adults to look after them. Such children face risks of abuse and becoming social misfits. Many, 290,000 in 2004, do not attend school. They face uncertain futures due to their lack of education and social skills. An increase in the number of such children leads to a smaller pool of educated and trained potential workers in the future and a larger pool of poor people. As poverty and HIV/AIDS seem to reinforce each other, it is likely that such children will be vulnerable to sexual exploitation and therefore have a higher risk of being infected with the HI virus.

The slow acting nature of HIV/AIDS and its invisibility makes it impossible to accurately estimate the number of infected people and therefore its full impact on any society or economy. It is however, clear from the prime-age mortality figures, numbers of orphaned children, increasing shortages of skilled and experienced workers, increasing worker absenteeism, and high HIV/AIDS prevalence among women attending ante-natal services that the prevalence of HIV/AIDS in the Zambian population is very high, and has had, and will continue to have a significant adverse impact on Zambia's social and economic development.



## **Chapter 3 Literature Review**

### **3.1 Introduction**

Measuring the economic impact of HIV/AIDS has been undertaken using different techniques including econometric models, macroeconomic models, computable general equilibrium models (CGE), and overlapping generations models (OLG).

Some studies have concentrated on measuring the impact on specific sectors of the economy, such as the agriculture, education, and health sectors; others have concentrated on measuring the impact on business firms; others have concentrated on measuring household and community level impacts; others have focussed on the impact on the elderly, while others have concentrated on the impacts on children, especially HIV/AIDS orphans.

Some studies have explored the impacts on the future size and structure of affected populations and their implications for the supply of labour.

Of the studies concentrating on the economy as a whole, the impact on gross domestic product and per capita GDP have been the main variables of interest. Other significant variables of interest have been human capital accumulation and fertility which are instrumental in OLG models.

The economic impact of HIV/AIDS stems mainly from the fact that HIV/AIDS predominantly affects people who are in their prime years of life. People in the 15-49 year age-group make up the majority of people experiencing HIV/AIDS-related morbidity and mortality. While children born to infected mothers have a 30 per cent chance of being infected at birth, the advent of drugs to prevent mother-to-child transmission, and increased access to these drugs, are reducing the probability of babies being infected at birth. It is likely that as these drugs become more widely available, the number of children born with the HI virus will decrease (UNAIDS, 2008).

The predominant mode of HIV transmission in sub-Saharan African countries is through heterosexual sexual intercourse. Infected blood products account for a very small percentage of infections because of improved blood screening capability in most countries.

Being the child-bearing age group, the 15-49 year age-group is important for the growth of the population and the labour-force. Demographic studies, however, have noted that the population in this age-group is declining. This decline has been attributed to increased HIV/AIDS-related mortality, and declining fertility, also due to HIV/AIDS-related causes (Awusabo-Asare et al., 1997; Bruhns, 2005; Gregson et al., 1997; Juhn, Kalembe-Ozcan, & Turan, 2008; Ngom & Clark, 2003; Noel-Miller, 2003; Ryder et al., 1991; Soares, 2005; USAID, 2008; Young, 2007). These studies suggest that the declining child-bearing population and declining fertility will lead to smaller future workforces compared to no-AIDS scenarios. With reduced labour forces, gross economic output is expected to be lower in the future, and lead to declining standards of living in high HIV/AIDS prevalence countries.

As the 15-49 year age-group contains the majority of the skilled workforce, increased mortality in this age group robs an economy of its skilled workers. Reductions in the numbers of skilled workers compromise not only the economy's productivity, but also its ability to save. Reduced savings reduce resources available for investment. With reduced investment, future productivity is compromised as is the ability of government to invest in basic infrastructure required to accelerate economic growth. Contraction in the size of the labour force and reduced savings play a central role in studies utilising variations of the neoclassical growth model.

HIV/AIDS has reduced life expectancy in most sub-Saharan African countries to below 40 years (Huang et al., 2003; Luboobi & Mugisha, 2005; Ngom & Clark, 2003). Reduced life expectancy has an impact on lifestyle choices that individuals make. Some of these choices are about how much time the individual is going to devote to learning and accumulating human capital. Given the reduced time over which an individual can recoup their investment in human capital accumulation activities, it is unlikely that a rational individual would invest much in such activities. The implications for the quality of the future labour force are serious because there is a very high likelihood that the labour force will increasingly become less skilled as more individuals choose to spend less time on accumulating human capital in preference for current consumption. With fewer skilled workers, productivity will be seriously undermined as will be economic growth and development.

Reduced life expectancy affects also individual saving behaviour. High death probability (or reduced life expectancy) was found to reduce household saving rates by up to 3 percentage points on average in Freire (2003). The importance of this finding stems from the fact that household savings serve as an important source of investment funds at both the micro and macro levels. In the absence of foreign investment funds, a reduction in domestic savings behaviour necessarily deprives the economy of adequate investment resources.

Reduced productivity can have the impact of raising prices of domestic output. In the case of traded goods, international competitiveness can be affected. Reduced international demand may lead to reduced output and reduced demand for labour. The negative effects of such a chain of events ultimately result in negative impacts on households and individuals through reduced job opportunities and the incomes they offer.

## **3.2 Economy-wide impact of HIV/AIDS**

Studies of the economy-wide impact of HIV/AIDS have had widely varying results ranging from no significant impact at all, to substantial reductions in output over time. This section reviews studies employing different methods to estimate the impact of HIV/AIDS on the economy of a country as a whole.

### **3.2.1 Econometric studies**

Bloom and Mahal (1997) in an econometric study of 51 developing and industrial countries concluded that “the AIDS epidemic had had an insignificant effect on the growth rate of per capita income”. They argued that the seriousness and immediacy of the threat that AIDS posed to economic growth were overstated because the presence of surplus labour would mitigate the output losses from increased AIDS-related morbidity and mortality among workers; that the link between HIV and poverty, and the fact that the educated exhibited a greater knowledge of HIV and AIDS and a greater willingness to take precautions meant that AIDS-related output losses, income losses and medical expenditures would be low on a per case basis corresponding to the relatively low productivity, earnings and utilization of medical services among the poor; other impact mitigation mechanisms such, as normal social and economic adjustments would tend to mitigate the costs of the epidemic. They further argued that AIDS medical costs would be met by reducing both consumption and savings in a balanced

manner and not be drawn disproportionately from personal savings because the prospect of future AIDS death could result in increased precautionary savings in families of persons living with HIV. The authors concluded that there was “more flash than substance to the claim that AIDS impedes national economic growth”. This result was more or less in line with the findings of an earlier study which found that if at least 50 per cent of expenditure on AIDS-related illness came out of savings and the epidemic was more disproportionately distributed among the more educated and productive workers, per capita income would decrease by about one third of a percentage point in the most affected sub-saharan African countries (Over, 1992). Over, however, acknowledged that the pandemic’s impact would be substantial on countries that had been struggling to “escape from a period of negative growth rates”. He concluded that the most affected countries would experience GDP growth rate reductions between 0.8 and 1.4 per cent per year.

Bloom, Mahal and Sevilla (2001) used projections for Thailand to demonstrate that an unchecked AIDS epidemic, like that experienced by African countries could reduce per capita GDP growth by about 0.65 percentage points annually between 1990 and 2015. They concluded that the impact on GDP was minimal and that there was a lack of conclusive evidence of the economic impact of AIDS at the macroeconomic level.

While acknowledging that the impact of HIV/AIDS on GDP growth was negative, the Bureau of Economic Research study found that the annual growth rate of the South African economy would fall by an average of 0.5 per cent between 2002 and 2015 (BER, 2001). This study concluded that the impact would unfold gradually and that though the impact on GDP was negative, “we are far from witnessing a doomsday scenario”.

The low impacts estimated by studies conducted from the mid 1980s to the late 1990s have been attributed by among others (Bell, Devarajan, & Gersbach, 2004; Crafts & Haacker, 2004; Haacker, 2002a, 2002b), to the paucity of data on the severity of the epidemic, and the low state of knowledge concerning channels through which HIV/AIDS can affect economic growth that existed at the time. Prevalence rates were also still low in most countries during the 1980s and 1990s.

However, a decade after the Bloom and Mahal paper first appeared, Young (2005), in a simulation of the impact of AIDS on future living standards in South

Africa, found similar results. This study found that the reduced fertility effect dominated the human capital accumulation loss induced by AIDS even under the “most pessimistic assumptions about reductions in educational attainment”. This study concludes that on balance, the AIDS epidemic enhances the future per capita consumption possibilities of the South African economy. Like Bloom and Mahal (1997), Young (2005) compares the HIV/AIDS epidemic with the Black Death during the Middle Ages. Both quote studies of the Black Death that suggest that reductions in labour due to increased mortality led to higher wages for survivors and increased participation of women in market activity. As a result, fertility declined and living standards improved. In a subsequent paper using data from demographic household surveys and world fertility surveys, Young (2007) found similar results. He concluded that fertility effects dominate human capital effects and that the dominance of the fertility effects frees up extra resources that can be devoted to AIDS mitigation now without harming the welfare of future generations.<sup>24</sup>

While these studies suggest that the AIDS epidemic may not have a detrimental impact on per capita incomes, and that it may actually enhance living standards for survivors, others find that the epidemic will have significant impacts on economic growth.

In a theoretical paper on modelling the impact of AIDS, Haacker (2002b) argues that there are features of the AIDS epidemic that mean that reductions in population (and labour) growth do not lead to increased employment or per capita incomes. He points to the fact that AIDS impacts both the supply and demand for labour. The increase in the capital-labour ratio that occurs when population growth declines could be offset by investors’ and firms’ responses to the resulting fall in the rate of return to capital. Consequently, there may not be any reductions in unemployment or increases in per capita incomes as a result of population decline.

### **3.2.2 CGE-based studies**

The early 1990’s, a decade after the first AIDS cases came to light, saw a number of studies suggesting that the AIDS epidemic was more than a health

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<sup>24</sup> Juhn et al find different results using a similar methodology. See (Juhn et al., 2008).

problem. These studies started to recognise that the epidemic would have serious economic growth and development implications because it was characterised by a predominance of prime working-age morbidity and mortality.

By assuming that the AIDS economic impact would be felt mostly through its impact on labour, Kambou, Devarajan and Over (1992) simulated the impact of AIDS on Cameroon using an 11 sector computable general equilibrium model for the 1987/91 period by reducing the total number of workers by 30,000. They found that the average annual growth rates for domestic production, exports and demand for investment declined by 1.9, 2 and 3.7 per cent respectively. These were accompanied by increases in domestic prices, real wages, and a deterioration of public finances. They concluded from their simulations that AIDS “adversely affects the economy, can reduce long term economic growth and can inflict significant welfare losses on society”.

Also using a computable general equilibrium model, Arndt and Lewis (2000) simulated the impact of HIV/AIDS on the South African economy. Comparing a no-AIDS scenario with AIDS scenarios, they found that the South African economy would be 17 per cent smaller over the 1997-2010 timeframe. The annual GDP growth rate between the scenarios steadily diverged over the simulation period from under 1 per cent in 1997 to 2.6 per cent in 2010. Contrary to Bloom and Mahal (1997)’s findings of increased per capita GDP, Arndt and Lewis (2000) found that per capita GDP declined by up to 8 per cent.

In CGE simulations, emphasizing human and physical capital accumulation, of the HIV/AIDS impact on the Mozambique economy, (Arndt, 2006), reported lower GDP growth rates in the AIDS scenarios over the 1998-2010 simulation period. The differences in the growth rates between the No AIDS and the AIDS scenarios were as high as 4.3 per cent by 2010. It is likely that the results would have been larger had it not been for the “mega-project investment” assumed in the model. The difference in the GDP growth rate was attributed to the “interacting effects of reduced rates of human and physical capital accumulation combined with factor-specific rates of change that are biased towards human and physical capital”. This study estimated the Mozambique economy would be between 14 and 20 per cent smaller by 2010 due to the impact of HIV/AIDS. It estimated also that per capita GDP would be between 4 and 12 per cent lower compared to a No-AIDS scenario.

### **3.2.3 Neoclassical growth models-based studies**

Cuddington (1993b), used a Solow-type model to estimate the impact of AIDS on the growth path of the economy and GDP per capita of Tanzania. Without decisive policy action, the economy was estimated to shrink by between 15 and 25 per cent over the 1985/2010 period. Per capita GDP was estimated to fall by between 0 and 10 per cent over the same period. Similar results were obtained when the single sector full-employment model was extended to a dualistic, labour-surplus model in Cuddington (1993a). Applying the single sector model to Malawi resulted in a 5 per cent reduction in the size of the economy at the end of the 1985/2010 estimation period (Cuddington & Hancock, 1994). Average annual growth in per capita GDP was estimated to fall by 0.1 and 0.3 per cent in the medium and extreme scenarios respectively. In a study using a dualistic labour surplus model, Cuddington and Hancock (1995), found that the Malawi economy would shrink by up to 10 per cent than it would in the absence of AIDS. They estimated, as with the single sector study, that per capita income would also shrink by between 0 and 3 per cent in the presence of AIDS.

Also using a dual sector economy model, MacFarlan and Sgherri (2001) estimated that GDP growth rate for Botswana would fall from between 5.2 and 5.7 per cent in the no-AIDS scenario to between 1.4 and 2.4 per cent in the AIDS scenario. The economy was found to shrink by between 33 and 40 per cent over the 1999-2010 timeframe.

### **3.2.4 World Bank studies**

In a series of country studies employing extended growth models, the World Bank estimated that annual GDP growth rate would fall from 4.4 to 3.6 per cent in Lesotho. Per capita income fell by 1 per cent per year over the period 1986-2015. In Namibia, annual GDP growth was estimated to fall from 3.5 to 2 per cent between 2000 and 2015. Average annual GDP growth rate fell from 3.2 to 2.2 per cent in Swaziland. The economy was estimated to be 34 per cent smaller by 2015, while in Botswana GDP fell from 4.7 to 2.2 per cent per year between 2000 and 2015. Per capita income was estimated to fall by 17 per cent per year over this period (The World Bank, 2000, 2001a, 2001b, 2001c).

These reports, while pointing out that the macroeconomic effects did not appear “devastating”, stress the fact that the effects are not felt uniformly across

households. They point out that HIV/AIDS morbidity and death exacerbate poverty and social inequality at the household level. For example, while per capita income was estimated to fall by an average 8 per cent in Botswana, the poorest quarter of households experienced a fall between 10 and 15 per cent in their per capita income (R Greener, Jefferis, & Siphambe, 2000). However, Cogneau and Grimm (2008) in their micro-simulation of income distribution in Cote D'Ivoire found that total household income was reduced by about 6 per cent while household per capita income, household income inequality, and poverty remained almost unchanged.

### **3.2.5 OLG-based studies**

Overlapping-generations models emphasizing different decision variables have also been used to simulate the impact of HIV/AIDS on economic growth and development. The OLG framework generally emphasizes the importance of human capital and its transmission across generations. Accumulation of capital is taken as the force that generates economic growth over the long run.

Bell, Devarajan and Gersbach (2006), emphasizing the impact of AIDS on human capital transmission across generations, estimated that the South African economy could shrink to half its current size in about four generations in the absence of intervention. Similar but less severe results were obtained when the model was extended and calibrated to data for Kenya (Bell, Bruhns, & Gersbach, 2006).

Corrigan, Glomm and Mendez (2005), emphasized the impact of AIDS on the creation of large numbers of orphans and the resulting decreases in human capital accumulation. Their model simulated the aggregate effects of an AIDS epidemic on human and physical capital accumulation and growth. They concluded that AIDS has large growth effects. The economy was found to be 17 per cent smaller when AIDS lasted for two generations, while per capita income was 13 per cent less than in the AIDS-free scenario.

In a study emphasizing the impact of AIDS on reduced incentives to accumulate human capital, due to shorter expected longevity, Ferreira and Pessoa (2003), using a continuous time OLG model found that the most affected Sub-Saharan African countries would be, on average, about a quarter poorer than they would be without AIDS. The results from these studies utilising the OLG

framework consistently suggest that the impact of HIV/AIDS on economic growth and per capita income is significantly negative.

The magnitudes of output reduction and per capita income reductions are much larger than those suggested by studies based on other methodologies especially the neoclassical growth models.

### **3.2.6 Summary of economy-wide models**

While there is general agreement that high HIV/AIDS prevalence has catastrophic human consequences, there is no such agreement about its impact on the economic development of an affected country. Early research suggested that the economic impact, especially on per capita income was minimal, if any at all. This was premised on the fact that AIDS affects both the supply and demand for labour. It has been argued by various authors that the reduction in output would be accompanied by reductions in population. In neoclassical growth models, it is possible for output (and income) per worker to increase, if the population growth rate falls more than the savings rate. However, it is not possible in this framework to say, a priori, what the result would be, because it is also possible for the savings rate to fall more than the population growth rate. This would result in lower capital-labour ratio and therefore lower output (and income) per capita. As argued by Dixon et al. (2000), the issue becomes an empirical one.

Various authors have attributed the low economic impacts found in the early studies to the fact that the AIDS epidemic was not as severe then as it has been in more recent years. They point out that there was little understanding of the channels through which AIDS could affect an economy. As such the early modelling would have substantially underestimated the epidemic's impact on the economy.

It is also clear from the review of studies that the methodology employed in a study was a significant factor in determining the study's results. Studies employing neoclassical growth models emphasizing the role of savings and population growth produced low economic impacts.

CGE models, on the other hand, emphasizing inter-linkages among many sectors in an economy have produced larger impacts than neoclassical growth models. OLG models, emphasizing the accumulation and transmission of human capital, have produced even larger impacts than CGE models.

It may be argued that, the later studies employing more recent information about the extent and severity of the epidemic give better estimates of the economy-wide impacts of the HIV/AIDS epidemic.

### **3.3 Household impacts of HIV/AIDS**

The impact of HIV/AIDS at the household level has long been recognised because AIDS tends to be more prevalent among prime-age working adults. Deaths among prime-age working adults permanently deprive households of their main income providers at a relatively early age. A study of patients at Mama Yemo hospital in Kinshasa, Zaire, found that for the 244 patients studied, 2,600 years of potential life were lost. 73 per cent of these years were attributed to premature mortality due to HIV/AIDS (Hassig et al., 1990). This study estimated the mean years lost at 30.6 years for HIV-positive patients and 21.3 years for non-HIV-positive patients. Since the years lost per patient were calculated as age at time of death subtracted from 65, these results show that HIV/AIDS killed its victims at relatively younger ages. Affected households thus lose their income earners earlier than do non-affected households. In single income-earner households, this may result in impoverishment of such households. Among poor households, this results in deepening their poverty (Bloom et al., 1997; Bloom, River Path Associates, & Sevilla, 2001; Booyesen, 2002; Nampanya-Serpell, 2000). The nature of the disease, as it progresses from HIV infection to development of AIDS and eventually death, is also an important factor in the epidemic's impact on households. Frequent illness characterises the progression from infection to development of full-blown AIDS. As a result, an infected person needs frequent medical attention for prolonged periods during which the individual may not be able to work. During this period, medical expenses may increase, as may other associated costs such as transportation costs (Barnett & Whiteside, 2002; Bollinger & Stover, 1999; Bollinger et al., 1999). Increased medical care costs for some households lead to reduced consumption of other goods and services including food, and schooling for children (Mahal & Rao, 2005; Wiegers, Curry, Garbero, & Hourihan, 2006). For some households, increased care costs lead to liquidation of productive assets which diminishes the households' ability to recover in the future (Barnett & Whiteside, 2002; Bloom, River Path Associates et al., 2001; Kongsin, 1997). Children may be withdrawn from school to provide care for ailing adults thereby reducing the children's

ability to develop and accumulate their human capital (R. C. Baggaley & Needham, 1997; Beegle, Weerdt, & Dercon, 2008; Mahal & Rao, 2005; Mutangadura, 2000; The World Bank, 1997). When AIDS sets in, the patient is plagued by one or more opportunistic infections which lead to death. Closer to death, patients become bedridden and may need full-time care. Medical care costs increase significantly at this time while the individual is unable to work and earn an income. For poor households, this may mean withdrawing children from school, reduced food consumption leading to malnutrition among the children, and liquidation of productive assets (Barnett & Whiteside, 2002; Basu, Gupta, & Krishna, 1997; Bollinger et al., 1999; Cohen, 2001; Mutangadura, 2000; Pitayanon, Sukontha, & Janjareon, 1997; The World Bank, 1997; Whiteside, 2002). For these reasons it is widely believed that the household impact of an adult death from HIV/AIDS is much greater than that from other causes of death (Pitayanon et al., 1997).

To the extent that the main household impacts of HIV/AIDS arise from its effect on individual's ability to contribute to household income and well-being, the impacts on households affect both rural and urban households. For self-employed rural households, a prime-age death deprives the household of income or food-generating labour. This leads to reduced household income and food resulting in the household's reduced consumption possibilities and ability to work. For poorer households, increased medical costs may be financed through reduced savings or liquidation of productive assets such as bicycles, livestock or land or through borrowing (Barnett & Whiteside, 2002; Bloom, River Path Associates et al., 2001; International Labour Organisation (ILO), 2003; Mahal & Rao, 2005). The household's ability to sustain itself in future is further diminished by the loss of its productive assets in addition to the loss of the prime-age productive household member. In this respect, rural and urban households experience similar impacts but to varying degrees. A study on the cost and effectiveness of home-based care in Zimbabwe, for example, concluded that home-based care in rural areas was not effective in meeting the needs of rural based AIDS patients and placed a larger burden of care on their households (Hansen et al., 1998).

The literature on household impacts, however, suggests that the impacts are not generally the same across all households experiencing AIDS prime-age deaths. The initial economic conditions of the households and the characteristics

of the deceased prime-age adult seem to be significant in determining how the households cope with prime-age mortality (Barnett & Whiteside, 2002; Beegle, 2005; Cohen, 2001; Petty, Selvester, Seaman, & Acidri, 2004; UNAIDS, 2006; Yamano & Jayne, 2004). Non-poor households have been found to be able to withstand the loss of a prime-age adult without sinking into poverty (Mahal & Rao, 2005). Such households may have sufficient savings to finance increased medical care costs without impoverishing the household (Beegle, 2005). Without the financial stress from losing an income earner, children in such households are able to continue with their education. While consumption possibilities may be reduced somewhat in these households, the households possess enough resources to avoid becoming poverty stricken. Yamano and Jayne (2004), in their study of the impact of an adult death on small-scale farm households in Kenya, found that the death of a household head or household head's spouse reduced household size more than the death of any other adult did. This had consequences for farm production because of its impact on the amount of labour available to the household. They also found that the impact on household agricultural output was different depending on whether the deceased was male or female. When the deceased was male, less high value cash crops were grown, while less land was devoted to the cultivation of cereals or root crops when the deceased was female. The division of labour between males and females in this case caused different impacts on the affected households.

Quantitative estimates of the impact of HIV/AIDS on households are fraught with many problems. Among these is the fact that a large proportion of the most affected households are not surveyed because these households no longer exist (Barnett & Whiteside, 2002). One study reported that about 65 per cent of households where an adult female died, ceased to exist (Mutangadura, 2000), while a South African study reported 2 per cent of households had dissolved in the two year period of the study (Hosegood, McGrath, Herbst, & Timaeus, 2004). Households dissolve also because of the clustering nature of HIV. As an infected spouse is likely to infect their spouse, it is often the case that spouses die not long after the other (Birdthistle et al., 2008; Chapoto & Jayne, 2005). In some cases, coping mechanisms include fostering out young children when one, especially the mother, or both their parents die. This changes the composition of the household and the dependency ratios. As the resulting households tend to have fewer members, the full impact of the HIV/AIDS-related adult death cannot be elicited

when such a household is surveyed. On the other hand, the fostering out of children creates new households that also feel the impact of HIV/AIDS. Such households include grandparent-headed households with young children, large households with unrelated fostered or orphaned children, child-headed households, cluster foster care (where a group of children is cared for formally or informally by neighbouring adult households) and homeless children in groups or gangs (Barnett & Whiteside, 2002). These new types of households, though experiencing the impact of HIV/AIDS are usually not surveyed because they haven't experienced an HIV/AIDS-related death. In reality, these households experience the impact of HIV/AIDS through increased numbers of household members as a direct result of an HIV/AIDS-related death. Household resources now have to be spread over a larger number of members than before. It seems impossible to carry out a study of households that can be generalised over all households, even within a small geographical area within the same country (Whiteside, 2002). The definition of an AIDS-affected household is usually limited to households where there has been an AIDS-related adult death. This is obviously an inadequate definition. Its use means that the impacts on dissolved households and households receiving fostered children are ignored in most studies.

Some studies, however, have tried, in various ways, to quantify the impact of HIV/AIDS on households. In a Zambian study, in 70 per cent of cases where a father died, monthly disposable income fell by more than 80 per cent (Nampanya-Serpell, 2000). A Thai study found that about a third of a rural sub-sample of households affected by an AIDS death reduced their agricultural production by nearly half (Kongsin, 1997). A Kenyan study found that off-farm income fell by between 35-40 per cent and the gross value of crop output fell by about 57 per cent in households experiencing a death of a resident male household head (Yamano & Jayne, 2004). A Cote d'Ivoire study found that affected households had incomes half of total average household incomes. In Tanzania, households that had a prime-age death showed a 7 per cent decrease in consumption in the five years following the death (Beegle et al., 2008). The studies cited all show that AIDS-related morbidity and mortality have significant negative impacts on affected households. The Zambian study remarked that one of the striking features of the economic impact of AIDS in affected families was the "rapid transition of the household from relative wealth to relative poverty". The studies

suggest that the impact emanates primarily from the loss of income earned by the deceased, or from the loss of output that would have been produced by the deceased. The poorer the household initially was, the larger the impact it experienced compared to relatively better-off households.

UNAIDS estimated that the financial burden associated with HIV/AIDS for the poorest households in India was about 82 per cent of annual income. The comparable burden to the wealthiest households was slightly more than 20 per cent (UNAIDS, 2008). In Botswana, it was estimated that every income earner would acquire an additional dependant, but that households in the poorest quartile would acquire an additional 8 dependants due to HIV/AIDS (UNAIDS, 2006). To the extent that an AIDS-related prime-age death curtails the inflow of income to the household on the death of the income earner, even rich households experience the negative economic impacts of HIV/AIDS. These impacts, in rich households, are mitigated by the fact that such households may have sufficient resources to maintain a relatively higher standard of living compared to poorer households.

Household impacts are compounded in some cases by discriminatory customary and traditional practices. In many areas, female-headed households are further impoverished by the so-called property grabbing practice – a practice in which relatives of a deceased male take most of the household property leaving the surviving widow with little to live on (Family Health International (FHI), 2003; Izumi, 2007; Strickland, 2004). The disappearing practice of wife inheritance further exacerbates the condition of widows (Wieggers et al., 2006). Not only do widows get stripped of their marital household assets but are increasingly left to fend for themselves. A panel Zambian study found that 66 per cent of households that suffered a male household head death and became female-headed lost some of the land they possessed prior to the death of the male household head (Chapoto, Jayne, & Mason, 2007). These practices are common in many sub-Saharan African countries including Zambia. Similar tales of asset dispossession for widows after the deaths of their spouses are reported in South Asia, particularly India, Bangladeshi and Sri Lanka (Swaminathan, Bhatla, & Chakraborty, 2007). Female-headed households affected by HIV/AIDS are thus asset poor and least able to respond to economic shocks. In rural areas such households typically have lower crop production, decreased investment in farm inputs and increasingly resort to low-profit activities such as food for work and

beer brewing (Wiegers et al., 2006). In such instances, however, it becomes impossible to separate the actual impact of HIV/AIDS on such households from the compounding effects of these traditional and customary practices.<sup>25</sup>

The household impact from an AIDS-related death is not limited to the household from which the deceased was a part of. The impact is transmitted to other households in the community to which that individual belonged. The inter-linkages between households ensure that the death of an individual from one household is felt across a number of households (Barnett & Whiteside, 2002). Such impacts may include the loss of the individual's knowledge and contributions to the community. Such a death becomes a loss of social capital with adverse effects on the community (Wiegers et al., 2006).

Combined with the fact that in resource poor countries, government support to affected households is minimal if any at all, the communities in which these households live are an important mechanism for mitigating the negative impacts of prime-age deaths. While during illness most of the burden falls on the affected household, the burden is felt in the community upon death through either contributions to funeral and burial costs, care of orphans, or the loss of the deceased's contribution to social capital (Barnett & Whiteside, 2002; Jayne et al., 2006; Tibaijuka, 1997; Wiegers et al., 2006). In a case study of a village in Tanzania, Tibaijuka reported that due to custom, farming activities were postponed for 2-3 days upon burial of a person. She estimated that during the year of study the community could not work for 15 days due to AIDS deaths (Tibaijuka, 1997). This study also reported increased farm labour costs due to increased AIDS mortality and the consequent reduced labour supply.

Quantifying the impact at the community level is also fraught with many difficulties. Identifying all the impacted households in the community and the level of impact they experience from a particular death has not been attempted. Given that some households may see their contributions to other households as future investments for when they themselves suffer some misfortune, they are not

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<sup>25</sup> Wife inheritance is disappearing mostly as a precaution against spreading HIV. While this is a desirable development, in Ethiopia women who refuse to be inherited on the deaths of their husbands face losing all their matrimonial property to the husbands' relatives (Ashenafi & Tadesse, 2005).

likely to see their contributions as having a negative impact on their wellbeing. Jayne et al. (2006), however, have attempted to measure community level impacts of AIDS-related mortality. Using panel data for 5,420 households in 393 communities, they found that total land area cultivated was negatively related to adult mortality rates. As mortality rates rose from zero to 24.4 per cent between the 25<sup>th</sup> and 75<sup>th</sup> percentile of all 393 communities, land area cultivated decreased by 5.2 per cent at the community level. This study found also that the community level impacts were different depending on the characteristics of the communities. Decrease in crop production was found to be higher in communities with relatively higher initial levels of educational attainment, and also where land holding were large. This result reflects the impact of the loss of skilled labour and the general reduction in the quantity of labour available to work the land. This study indicates that the impact of adult AIDS deaths extends outside their own households into their wider communities.

### **3.3.1 Impact on orphans**

As AIDS-related mortality is more pronounced in prime-age adults, one of its main impacts on affected societies is the creation of a large number of orphans (Abebe & Aase, 2007; Mishra & Bignam-Van Assche, 2008; Salaam, 2004; UNICEF, 2004; UNICEF et al., 2004). AIDS orphans are commonly defined as young people up to 18 years of age who have lost one or both parents to an AIDS-related cause (UNICEF et al., 2004).

An estimated 15 million young people world-wide were identified as AIDS orphans in 2007. Of this figure 11.6 million, or 77 per cent, were in sub-Saharan Africa (UNAIDS/WHO, 2007). The number of orphans in Sub-Saharan Africa is expected to continue increasing for the foreseeable future despite recent reductions in HIV/AIDS prevalence rates in most countries. This reflects the long-wave nature of HIV/AIDS. Deaths of prime-age adults will continue to increase because those dying in more recent times may have been infected up to 10 years ago or so (Barnett & Whiteside, 2002; Salaam, 2004; Ssewamala, Han, & Neilands, 2009; UNAIDS/WHO, 2007; UNICEF, 2004). More AIDS orphans can be expected as those prime-age adults infected in more recent times die sometime in the future. In Uganda the orphan population continued to increase 10 years after the epidemic infection rate peaked. Between 1992 and 2000, the proportion of orphans in children below school age increased from 10 to 20 per

cent while the proportion of households with a foster child tripled from 5 to 15 per cent (Deininger, Garcia, & Subbarao, 2003). In Thailand the number of orphans was still increasing 10 years after the country had significantly reduced its infection rate (Salaam, 2004).

The economic problem associated with orphans arises because the existence of a large pool of orphans has implications for the quality of the future labour force. Studies of the impact of AIDS on orphans generally tend to be qualitative. They analyse the conditions under which orphans are growing up, their health, and whether they are in school or not. From these conditions, predictions about the futures of these orphans and their implications for the economy are made. Most studies suggest that orphaned young people suffer many disadvantages compared to non-orphaned young people. These disadvantages include being isolated from their families and siblings, inadequate care from foster parents, discrimination in their foster homes and communities, not having adults to nurture and guide them, having to work to support themselves and their siblings, inability to learn or not being in school at all (Andrews, Skinner, & Zuma, 2006; Arndt, Barslund, Nhate, & Broeck, 2006; Nampanya-Serpell, 2001; Nyambedha et al., 2003).

Malnutrition has been reported as extensive among orphans. A study in the Kagera region of Tanzania found that in richer households 50 per cent of orphans compared to 29 per cent of non-orphans were malnourished. In poorer households 51 per cent of orphans were stunted compared to 39 per cent of non-orphans (The World Bank, 1997). These results are attributed partly to orphan neglect in their foster homes, inability of foster parents to adequately feed all the children, increasing strain on family resources as more children are orphaned (Ainsworth & Filmer, 2006; Nyambedha et al., 2003; UNICEF, 2004; USAID/SCOPE-OVC/FHI, 2002), and inability of surviving parent/caregivers to adequately care for the children due to bereavement and psychological depression following the death of a spouse (Nampanya-Serpell, 2000). It has also been suggested that the malnutrition observed among orphans could have been the result of poor nutrition during the periods that their own parents were sick and dying (Barnett & Whiteside, 2002). Increases in parental medical costs in poor households tend to divert resources from the care of children to the care of the sick adults (Family Health International (FHI), 2003). Crampin et al. (2003) in

their study in Karonga, Malawi, however, found that there was no difference in the physical well-being of children living in households known to be affected by HIV/AIDS compared to those in unaffected households. They nonetheless concluded that “it would be wrong to infer that the HIV/AIDS epidemic has had little impact on the surviving children’s physical well-being.” They cited the dilution of impact by the extended family system of coping on individuals. They noted that while there seemed to be little impact on individual households, the impact was significant at the community level and would increase as the epidemic worsened.

The fostering of orphans is suspected also of increasing malnutrition among other children in the homes that they are fostered into. As the number of children increases, some households are not able to provide adequate food for all of them. This leads to malnutrition among all the young children in the household. Fostering of orphans thus leads to impoverishment of their foster households because of the resulting increased dependency ratios (Barnett & Whiteside, 2002; Salaam, 2004; UNICEF, 2004). The effects of malnutrition extend to inability to concentrate in school. Malnourished orphans may fail to achieve as good results in school as non-orphans because of being unable to concentrate in class (UNICEF, 2004; USAID/SCOPE-OVC/FHI, 2002).

Orphans may not attend school as they may not be able to afford school fees or may have to work to support themselves and their siblings (Family Health International (FHI), 2003; International Labour Organisation (ILO), 2003; Salaam, 2004; UNAIDS, 2006). 83 per cent of household heads in a Zambian survey identified financial issues as the main reason for orphans in their care not attending school (USAID/SCOPE-OVC/FHI, 2002) while an Indian study found that 35 per cent of children of infected parents were denied basic amenities and 5 per cent were withdrawn from school (International Labour Organisation (ILO), 2003). Some orphans may be so traumatised by the experience of a parent dying of AIDS that they cannot learn (Family Health International (FHI), 2003; M. J. Kelly, 2000), or their performance in school is severely adversely affected (International Labour Organisation (ILO), 2003).

Household investment in productive business assets has been shown to decrease when a household hosts a foster child in Deininger et al. (2003). National household savings and investment can be expected to decrease

considerably as the orphan crisis worsens. The 2001 National Service Delivery Survey in Uganda found that up to 37 per cent of all households were hosting a foster child. The increase in the number of dependants leads to reductions in household savings and investment in productive assets. At the national level, the aggregate reduction in savings and investment could be considerable and have a significant adverse effect on the national economy as more households take in orphans.

The deaths of parents deprive young people of the guidance of their parents. In many cases young people become homeless and vulnerable to HIV infection themselves. A South African study, for example, found that orphans were not only more likely to be sexually active but also more likely to have had sexual intercourse by age 13 or younger than non-orphans (Thurman, Brown, Richter, Maharaj, & Magnani, 2006). Similar results were found in a survey of urban female adolescents in Harare, Zimbabwe, where the proportion of orphaned female teenagers that had had sexual intercourse and were HIV positive was much higher than that among non-orphans. Orphanhood was identified as a significant HIV-infection risk factor among female adolescents (Birdthistle et al., 2008). Gregson et al. (2005) found that orphaned youth had a higher prevalence of HIV, higher incidence of STI's and higher teenage pregnancy rate than non-orphans. Maternal orphans were also less likely to have received any secondary school education, a factor associated with poor reproductive health and the perpetuation of the vicious cycle of poverty and disease. Early HIV/AIDS infection is expected to lead to early premature deaths among these young people with the consequence that fewer of them would live through their prime working-age periods. This would necessarily reduce the size of the future labour force compared to a no-AIDS scenario. With a smaller labour force, *ceteris paribus*, national output would be expected to decrease compared to a no-AIDS scenario.

The lack of parental protection may expose orphans to exploitation by other adults (International Labour Office, 2005). In their Harare study, Birdthistle et al. (2008) found that among married teenage girls, maternal orphans were more likely to have married because they were pregnant rather than for love, than their non-orphaned counterparts. Maternal orphans were also much more likely to marry a man much older than themselves. These results suggest that inter-generational transactional sexual relationships may be one of the significant

causes of high HIV-prevalence among young women. A study of orphan care in Nyang'oma, Kenya, found that orphans living with elderly relatives tended to work for well-off families but were often underpaid (Nyambedha et al., 2003). This study found also that some orphans were taken in by adult strangers but were required to perform household chores and were, for all intents and purposes, treated as house servants. Focused group discussions of caregivers in this study pointed to the increased number of orphans and increased living costs as some of the main reasons for the increasing breakdown in traditional coping mechanisms resulting in orphan neglect.<sup>26</sup> A Rwandan study, however, found that orphans' close relatives were more likely to exploit the orphans than strangers were (Thurman, Snider et al., 2006), with recommendations for evaluation of whether traditional coping mechanisms were the appropriate form of caring for and supporting the increasing number of orphans.

In rural areas, the loss of parents may mean that essential survival knowledge is not transferred from adults to young people. The loss of certain skills, especially agricultural skills, when adults die deprive young people of the ability to take care of themselves and their future families (Ainsworth & Filmer, 2006). It is this impact of HIV/AIDS on society that OLG models cited above emphasize in their analyses. When essential life-skills are not transmitted from parents to children, the result may be children without sufficient skills and ability to adequately provide for themselves and their own children. This would tend to perpetuate poverty among poor households. With poverty being a significant risk factor for HIV infection, the probability of increasing HIV infection increases as does the probability of increased poverty among such affected young people.

The combination of parental loss and poor school attendance means that orphans may not be able to adequately develop their human capital (Bruhns, 2005; M. J. Kelly, 2000; Ssewamala, Alicea, Bannon Jr., & Ismayilova, 2008). This diminishes their ability to take advantage of opportunities in modern economies that require formal education and certain levels of skills. Orphans are therefore likely to end up in low skill low paying jobs compared to non-orphans. AIDS is thus creating a class of young people with diminished future prospects. Such

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<sup>26</sup> In this study one in three children had lost one biological parent, while one in nine had lost both.

young people face futures of poverty. Given the link between poverty and HIV/AIDS, there is a high likelihood that they will become infected with HIV which will in turn exacerbate their poverty and that of their own children (Ainsworth, Beegle, & Koda, 2005; Barnett & Whiteside, 2002; International Labour Office, 2005; UNICEF, 2004).

The lack of bright future prospects may lead these young people to engage in anti-social behaviours such as delinquency and crime. Social costs of dealing with such behaviours inevitably increase and divert scarce resources from other more beneficial activities.

As AIDS-related mortality increases, the number of orphans is expected to increase as well. As these young people enter the workforce, the proportion of skilled workers in the labour force will tend to decrease. As the labour force becomes less skilled and less experienced, productivity is likely to decrease significantly (International Labour Office, 2005). This is likely to have significant negative impacts on the economies of high HIV/AIDS prevalence countries over time.

### **3.3.2 Impact on the elderly population**

Elderly people are taking on increasing responsibility for raising their family members' children. As HIV/AIDS mortality increases in the 15-49 year age group, the responsibility for raising their children is falling increasingly on their older and usually retired or unemployed parents (Baylies, 2002; Wiegiers et al., 2006; Wilson & Adamchak, 2001; Zimmer, Dayton, & UN Population Council, 2003). This burden of caring for young children impoverishes the older folk who usually do not have a regular income. They end up spending their limited resources on providing for their orphaned grandchildren. In some cases these older folks have to find gainful employment to be able to care for their grandchildren. The stress on the elderly of looking after young children is significant. Their health may deteriorate faster as a consequence.

### **3.4 Impact on the private sector**

The impact of HIV/AIDS on the private sector is linked to the changes in the quantity and quality of labour. HIV/AIDS increases morbidity among the working-age population that makes up the labour force. Good health is

increasingly seen as an important input into the productive process. As worker health deteriorates, worker productivity declines. Reduced productivity for any given level of employment and wages leads to increased production costs and reduced profitability for producers (Muwanga, 2001). Producer costs increase also due to increased medical costs of increasing numbers of sick employees. One study estimated that HIV/AIDS was adding between 0.4 and 5.9 per cent to the annual wage bills of large companies in South Africa and Botswana, “under a conservative set of assumptions” (Rosen et al., 2004). Increased morbidity is often accompanied by increased absenteeism. Producers respond by employing extra or casual workers to fill in for the absent sick regular workers. This is especially so during the terminal stages of illness when the ailing worker is bedridden. The result is an increase in the number of paid workers, without a corresponding increase in the level of output. Profitability falls as a consequence. Costs increase further upon the deaths of sick workers. As many workers die, contributions to funeral expenses, and terminal benefit payments to deceased workers’ families increase (Muwanga, 2001; Rosen et al., 2004).

The increase in costs tends to make firms’ output more expensive. As a consequence demand for affected firms’ output, in both the domestic and foreign markets, falls as prices increase. High HIV/AIDS mortality among workers makes affected firms less competitive relative to unaffected firms. As lower production costs tend to be the major competitive advantage for firms in developing countries, increasing HIV/AIDS mortality erodes away this vital advantage (Rosen et al., 2004). With falling profitability and reduced demand for their output, firms may be forced to cut back their output levels. Firms’ contributions to national output fall as a consequence.

HIV/AIDS affects the quality of labour through its impact on individuals’ incentives to accumulate human capital. As life expectancy declines, individuals may have fewer incentives to invest in their own or their children’s human capital accumulation activities. Over time, the labour force becomes less skilled and less experienced as older workers are replaced by younger, less educated and less skilled workers. Labour productivity declines as the proportion of the less skilled younger workers in the labour force increases (Wobst & Arndt, 2004). This may have the effect of reducing the productivity of complementary physical capital

(Pauly et al., 2002). The fall in total factor productivity inevitably reduces the affected economy's total output.

HIV/AIDS has been shown to affect foreign direct investment into high prevalence countries. The basis for foreign direct investment rests on (i) access to lower production costs, and (ii) access to new markets (International Labour Office, 2005). HIV/AIDS affects both these avenues through increased production costs as expatiated above. Product markets are reduced through high mortality among possible product consumers not only inside affected individual countries but in the regions to which they belong.<sup>27</sup>

The erosion of the lower production cost advantage and the diminishing of potential markets reduce incentives for foreigners to directly invest in high HIV/AIDS prevalence countries (International Labour Office, 2005; Rosen et al., 2004). Foreign investment is an important source of new technology and new job creation opportunities for developing countries. High HIV/AIDS morbidity and mortality, through their impact on FDI, erode a country's ability to generate new jobs and provide incomes to more of its citizens by making high prevalence countries unattractive investment destinations. High prevalence countries are also unattractive for foreign investment because of the uncertainty regarding the availability of high quality labour. As HIV/AIDS affects the accumulation of human capital, the future supply of skilled labour becomes uncertain. Investors cannot be certain that their investments will generate the returns they want and redirect their investments elsewhere. This deprives local firms of access to new technologies and capital for expansion. The lack of new foreign investment can lead to the collapse of existing capital intensive sectors like the mining sector. The Zambian copper mining sector provides a good example. Lack of sufficient foreign investment has led to the closure of some mines and substantial reductions in the operations of others with the consequent loss of a large number of jobs.

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<sup>27</sup> This is important because regions determine which trading blocks a country may belong to. The larger the population of a trading block, the larger the potential market and the more attractive it is to invest in one of the countries in that trading block.

### **3.5 Impact on agriculture**

Agricultural activity provides the majority of the populations in poor countries with their livelihoods (Barnett & Whiteside, 2002; United Nations, 2004). As such the agricultural sector is a vital sector in the economic development of poor countries. As most agricultural activity in poor countries tends to be small scale farming, HIV/AIDS-related morbidity and mortality can seriously affect small-scale agricultural production because it reduces the amount of labour available to work the land (Barnett & Whiteside, 2002; United Nations, 2004). Poor households that cannot afford to pay for extra labour to replace the loss of their own household member's labour face reduced output and reduced consumption possibilities. Studies have shown that the impact on agricultural output, however, depends to a large extent on the characteristics of the deceased household member. A Kenyan study found that in cases where the deceased household member was the male or female household head, household size fell by about 1.5 or 2.1 persons respectively (Yamano & Jayne, 2004). This study confirms the widely held view that households that suffer an adult mortality generally have fewer economically active members. The death of an adult male was associated with a change in the area devoted to cultivation of high value crops while that of a female household head was associated with an increase in the number of boys in the household and reductions in the area devoted to the cultivation of cereals and grains, crops grown predominantly by women. This result shows that the loss of individuals with particular crop husbandry and management skills can lead to changes in the types of crops grown. Kwaramba (1997) found that agricultural output declined by nearly 50 per cent in AIDS affected households.

AIDS-related illness has been found to reduce the amount of time other family members spent on farming activities (Mutangadura, 2000). Studies in Cote d'Ivoire and Burkina Faso, quoted in United Nations (2004), found that switching from cash crops to food crops led to reductions in production of up to two thirds of previous production, and that overall food production had fallen as a result of shifting work patterns due to the effects of the HIV/AIDS epidemic. In Swaziland the government reported a 54 per cent drop in agricultural production in households where at least one adult member died from AIDS.

Though all the studies quoted above are of small areas and may not be representative, they have a similar outcome – reduction in output or reduced earnings from agricultural output due to adult AIDS-related mortality. Reduction in labour input and loss of crop husbandry and marketing skills deprive agricultural households of their ability to grow more crops and earn more from their agricultural activity.

### **3.6 HIV/AIDS Impact on the public sector**

The public sector tends to employ mostly people who are skilled or semi-skilled. The loss of large numbers of these skilled workers to HIV/AIDS-related mortality poses serious human resource problems for the public sector. The loss of experienced public sector employees affects the quality of decisions made in the public sector. As public sector decisions tend to affect the entire economy, the consequences of poor decision making will have far reaching adverse consequences. The provision of public services is at great risk from increased HIV/AIDS-related morbidity and mortality among public sector employees (Shisana & Letlape, 2004; UNAIDS, 2006). UNAIDS estimated that in 2005, for example, HIV/AIDS-related mortality reduced the capacity of the Zambia Wildlife Authority by 6.2 per cent and increased labour costs by 10 per cent, constraining the government's ability to protect the country's wildlife and parks (UNAIDS, 2008). The quality and range of public services is dependent not only on government revenues and other sources of funding, but crucially so on the availability of public sector employees with the requisite skills and expertise (International Labour Office, 2004). The education and health sub-sectors, which are often seen as basic human rights as well as being important for social and economic development, of the public sector are used below to illustrate the impact of HIV/AIDS on public sector activity.

Impact on government is compounded by the fact that high mortality in the working age-group reduces the tax base. If skilled workers are disproportionately affected, then government income tax revenue will be adversely affected because the highest income tax payers are dying-off in large numbers. Reductions in government revenue amidst increasing government costs in terms of increased healthcare costs, and increased costs of maintaining a skilled public sector workforce will reduce government's ability to provide high quality government services and government's ability to provide and maintain infrastructure needed

for rapid economic growth. The HIV/AIDS epidemic, if unchecked, has the potential to decrease the rate of economic growth and improvements in the well-being of individuals and households by depriving government of the ability to fund public welfare-enhancing activities. In poor countries, governments play an important role in promoting economic growth by investing in basic infrastructure that facilitates the growth of both public and private sector economic activity. If the AIDS epidemic prevents governments from investing in this infrastructure, then economic growth is likely to slow down.

### **3.6.1 Impact on the education sector**

Studies indicate that the education sector in high prevalence countries is at great risk from increasing HIV/AIDS-related teacher mortality. Teachers in Zambia, Kenya, Tanzania and Malawi, for example, have been found to have higher mortality rates than the general population. Teacher mortality in Zambia was found to be about two-thirds the number of new teachers the country was able to train in a year (Badcock-Walters & Whiteside, 2000). Such high mortality among teachers threatens the supply of good quality education with serious adverse consequences for the development of human capital among young people. The high mortality among teachers not only reduces the number of experienced teachers, but leads also to increased pupil-teacher ratios (International Labour Office, 2004). It was estimated that by 2006, 45000 newly trained teachers would be required to replace those that had died of AIDS in Tanzania; that in Botswana mortality among teachers had risen from 0.7 per 1000 teachers to 7.1 between 1994 and 1999, while the teacher-pupil ratio in South Africa has increased 25.5 per cent from 1:27 to 1:34 between 1990 and 2001 (International Labour Office, 2004). With increasing numbers of newly trained teachers, the quality of education is bound to decline. The quality of education is threatened also through the loss of valuable school time due to teacher absenteeism as a result of increased morbidity, and frequent attendances of their colleagues' funerals.

HIV/AIDS also threatens the demand for education. Increased household costs may lead to the withdrawal of children from school. Thus the number of children going to school may decline as a result of increased HIV/AIDS-related morbidity and mortality among parents. Children may also give up school due to the frequent absences of teachers as teacher morbidity and mortality increase.

As HIV/AIDS affects both the demand and the supply of education, its net effect on education is not absolutely clear (Bennell, 2005a, 2005b; Bennell, Swainson, & Hyde, 2002). The reduced demand may offset the expected increased class sizes, and the reduction in the number of teachers available. However, what is clear is that the issue of teacher quality remains, especially in rural areas. Some studies have found that teachers are less willing to be posted to schools in rural areas where health services are not easily accessible. With increased HIV/AIDS-related morbidity, teachers prefer to be in urban areas where they can easily access medical services. This deprives rural schools of experienced teachers and disadvantages rural school children. The quality of education in rural areas therefore seems especially at risk relative to that in urban areas.

The view that prevalence among teachers is higher than in the general population is, however, not universally accepted. (Bennell, 2005a; Bennell et al., 2002), argue very strongly that prevalence is no higher among teachers than it is in the general population. They argue that teachers with relatively higher levels of education and HIV/AIDS knowledge are more likely to change their sexual behaviour and therefore should have a lower prevalence rate than the general population. They suggest that the results of studies indicating higher prevalence among teachers were misinterpreted or that the studies were wrongly designed. While this argument may be logically valid, the experience in Zambia is that HIV/AIDS prevalence is highest among the better educated (CSO et al., 2009).

### **3.6.2 Impact on the health sector**

Health professionals, especially nurses, have high morbidity and mortality rates. A Zambian study found that nurse mortality had increased significantly due to HIV/AIDS-related illnesses. The reduction in the number of trained medical staff threatens the quality of health services available. This is especially so, given the increased demand for health services at the same time (Dieleman et al., 2007).

High morbidity and mortality among health professionals, like that among teachers, has been found to affect their performance due to increased absenteeism for funeral attendance; stress from watching increasing numbers of their colleagues dying, and having to pick up the workload of sick and absent

colleagues. Fears of HIV infection at work contribute to anxiety and emotional exhaustion among medical personnel (Dieleman et al., 2007).

The increased demand for HIV/AIDS-related health services impacts on the availability of other health services due to the higher costs of the AIDS-related services. Longer average hospital stays increase the costs of HIV/AIDS patient care relative to that of other patients (Guinness et al., 2002; Hassig et al., 1990). In 5 of 7 hospitals in a Zimbabwe study, the average stay of HIV/AIDS patients was twice as high as that of other patients (Hansen, Chapman, Chitsike, Kasilo, & Mwaluko, 2000). In some hospitals in Zambia, Rwanda, Kenya, Zaire and Zimbabwe, HIV/AIDS patients have occupied the majority of hospital beds and possibly crowded out patients of other illnesses (Arthur et al., 2000; Buve, 1997; Guinness et al., 2002; Over, 2004). While direct medical costs have not been found to be different between HIV positive and HIV negative patients, HIV positive patients who survived their hospitalisation tended to have longer average hospital stays than HIV negative patients (Arthur et al., 2000; Guinness et al., 2002; Hansen et al., 2000). HIV positive patients were found to have significantly higher pre-hospitalisation costs than HIV negative patients (Hassig et al., 1990). In resource poor settings, the higher cost of HIV/AIDS care thus diminishes the quantity of resources available for the treatment of other illnesses.

More resources are diverted to the training and recruitment of new medical staff to replace those that are dying. This is a costly process that exacerbates the shortage of all health services. The training of new staff does not increase the total numbers of staff, but merely attempts to maintain current numbers. Staff workload does not decrease despite new staff being trained. The quality of services does not therefore improve despite the expenditure of extra resources. This diversion of resources to training more medical workers, like that of training new teachers, to maintain staff levels is clearly a drain on valuable scarce resources that could be applied to the provision of other services.

Although accurate quantitative estimates of the impact of HIV/AIDS on the public sector are impossible to make, it is clear from the impacts on the education and health sectors that the HIV/AIDS impacts on the public sector are significant.

Education and health are important inputs into economic activity. Both education and health improve worker productivity through their impact on human

capital. Education develops human capital while good health enables the development of human capital through wellness. Educated healthy workers are more likely to be more productive than uneducated or unhealthy workers. Education and health improve labour productivity and contribute to improved productivity of complementary physical capital. This point illustrates the economy-wide impact of public sector services. The impacts of education and health services are felt through the whole economy because they affect labour productivity throughout the economy. Other public sector services such as law and order have similar economy-wide impacts through their impact on the environment in which economic activity takes place. Bad laws, poor security, poor infrastructure and poor community services may hinder economic activity and exacerbate poverty. This can lead to a vicious cycle where HIV/AIDS leads to increased poverty, and poverty increases the risk of HIV infection. This cycle can lead to increased HIV/AIDS prevalence. With HIV/AIDS and poverty reinforcing each other, the negative impacts on the economy are likely to get worse.

HIV/AIDS may also adversely affect the public sector through high staff turnover which inevitably leads to institutional memory loss and poor decision-making. Poor public sector decisions tend to have economy-wide consequences as noted earlier.

### **3.6.3 Impact on governance**

In most sub-Saharan African countries the AIDS epidemic is no longer limited to particular at-risk groups like commercial sex workers, long distance truck drivers or injecting drug users. The epidemic is generalised in the entire population. Infections and mortality among the highly skilled are high. This applies in both the private and public sectors. The consequences of high morbidity and mortality in the public sector include poor governance as experienced and skilled senior government employees die and are replaced by less skilled and less experienced ones. The government sector being a large and leading component of most countries' economies is vital for economic growth. Inefficient decisions made in the public sector impact not only the publicly provided services but also impact on the ability of the private sector to carry out its activities. Bad or inefficient government decisions may lead to policies that do not promote but hinder economic growth. If AIDS reduces the number of

experienced government employees, governance of the country may be at risk, as may be economic growth. With failed governance, the consequences for all citizens are dire. HIV/AIDS-related morbidity and mortality are occurring at all levels of society including among senior political figures. The impact on governance cannot be underestimated (De Waal, 2003a, 2003b; Moran, 2004).

### **3.7 The demographic impact of HIV/AIDS**

One of the major consequences of increased HIV/AIDS mortality is the changing population structure. With mortality predominantly in the 15-49 year age-group, the population structures of high prevalence countries are bound to change (Ngom & Clark, 2003). The proportions of the very young and elderly in the population are expected to increase. This suggests that there are going to be significant reductions in the number of prime-age working people. By 2010, adult crude death rates are projected to be inflated by between 14 and 36 deaths per 1000 adults in some Southern African countries including Zambia (Epstein, 2004) due to increased AIDS mortality. Projections for Botswana show that by 2025, more than half of the potential population aged 35-59 will have been lost to AIDS (United Nations, 2004). Dependency ratios are likely to increase. Increased dependency ratios put strain on households because of the increased number of people that rely on fewer working people (Epstein, 2004). The consequences of this outcome are a likely increase in child labour and an increase in the numbers of elderly people working longer.

An increase in child labour increases the number of unskilled and inexperienced workers in the labour force. Labour productivity falls as child labour increases. Reduced labour productivity necessarily reduces household well-being due to reduced incomes (Epstein, 2004).

Though elderly people will tend to be more skilled than younger people, they make up such a very small proportion of the population that they cannot make up for the significant losses of prime-age workers. In professions where physical strength is important, elderly people may not be suitable replacements. Labour shortages may become pronounced in these areas as HIV/AIDS mortality increases.

A further demographic impact is the possible reduction in the overall population growth rate as HIV/AIDS affects fertility rates (Epstein, 2004; Ngom

& Clark, 2003). HIV/AIDS affects the fertility of infected women by reducing both their desire for more children (Young, 2007) and their ability to have more children (Gregson et al., 1997). The desire for more children may be reduced by the fear of passing on the infection to their children. Earlier HIV/AIDS infection in women means that fewer women live through to the end of their child-bearing ages (Hannan, 2003; United Nations, 2004; Young, 2007). The combination of reduced desire for more children and the reduced number of child-bearing age women leads to reduction in overall fertility and a reduction in the population growth rate (Epstein, 2004). With population growth reduced, the growth of the labour force is likely to decrease as well (United Nations, 2004). For some very high prevalence countries like Botswana, Lesotho and South Africa some projections are for population size declining as a result of increased AIDS mortality (United Nations, 2004). Labour shortages and higher labour costs may arise with detrimental effects on economic activity.

HIV/AIDS reduces fertility also through increased use of condoms and other non-viral protective contraception methods (Gregson et al., 1997; Young, 2007). The increase in HIV/AIDS prevalence has coincided with increased use of contraception methods that do not protect against viral transmission. This suggests that contraception is being used not only to protect against HIV transmission but rather to prevent pregnancy. In Zambia, for example, of the 30 per cent of women that use any form of contraception 33 per cent reported using the pill compared to 28 per cent that used male condoms as their form of contraception (CSO et al., 2009). The 30 per cent using contraception marks a big increase from the 12 per cent reported in the 1992 survey. The increase in contraception use has occurred at a time of high HIV/AIDS prevalence and may signal a desire to have fewer children which contributes to slowing down population growth.

An accurate quantitative estimate of the HIV/AIDS demographic impact on economic growth and development is impossible to make. However, the facts that HIV/AIDS will have an impact on the population composition in high prevalence countries by reducing the proportion of prime-age working people, and that HIV/AIDS will slow down overall population growth rate leading to a reduction in the growth of the labour force, suggests unambiguously that HIV/AIDS will have a detrimental effect on economic activity in high prevalence

countries. The change in population composition will reduce the proportion of prime-working-age people and increase the proportion of younger, possibly child, and inexperienced workers in the workforce. The reduction in fertility has negative consequences for overall population and labour force growth. Ultimately, the demographic impacts will have adverse consequences for economic activity.

### **3.8 Discussion**

The literature on the impact of HIV/AIDS on economic activity and factors that affect economic activity is wide and varied. As understanding of the channels through which HIV/AIDS affects economic activity has improved, most studies have tended to report relatively larger impacts.

While there is universal agreement that HIV/AIDS is a catastrophic humanitarian disaster, there is no such agreement regarding its impact on economic activity and welfare of surviving populations. Modelling approaches seem to be important determinants of results obtained by various studies with econometric methods almost consistently predicting little or no change in per capita output, and welfare of future generations. Neoclassical growth models predict small negative changes in total output depending on assumptions made about savings behaviour and population growth; CGE models estimate relatively larger negative changes in both total and per capita output while OLG models predict considerably larger negative impacts than all the other methods. The latter three approaches, however, differ only on the magnitudes of the negative impacts rather than whether there are adverse economy-wide impacts or not.

Household impact studies, also bedevilled by methodological problems, point to adverse impacts on households arising from HIV/AIDS morbidity and mortality. The identified adverse impacts on households result mainly from reduced household incomes, increases in dependency ratios and increases in costs of healthcare due to increased morbidity. Poor households are further impoverished by high funeral costs and the loss of productive assets.

Household studies' definition of affected households as being households that experience AIDS-related adult mortality tends to lead to underestimation of the impact of HIV/AIDS on households. Various household coping mechanisms transfer the impact of HIV/AIDS onto households that may not have experienced

an adult AIDS death. Exclusion of such households from impact studies therefore underestimates the total impact of HIV/AIDS on households.

Quantification of the household impacts has been carried out using different measures such as reductions in total household income, reduction in land-area cultivated, reduction in crop production, and changes in the health status of children. Given that all these impacts are strongly dependent on the initial household conditions, including household wealth, health, and access to other forms of support, they may provide misleading results if they are generalized to all households and in different settings.

The dissolution of some households as a result of HIV/AIDS mortality compounds the problem of measuring household impacts. Since these households no longer exist, how is the impact that HIV/AIDS has had on them to be measured?

Despite these problems, the studies reviewed help to identify the issues facing households that are identified as having been affected by HIV/AIDS. They provide a useful, initial basis for identification and development of household mitigation strategies. They also highlight the difficulties involved in trying to get accurate measures of the impact of HIV/AIDS and lay foundations for further research.

Impacts on the public sector suggest that high HIV/AIDS-related morbidity and mortality will reduce the quality of public sector decision making as older experienced public sector workers die and are replaced by younger inexperienced workers. As decisions made in the public sector tend to pervade the whole economy, inefficient ones could have significant adverse impacts on the wider economy.

The quality of public services provided by sectors such as the education and health sectors, have been found to be under threat from increased HIV/AIDS-related mortality. These public sectors provide vital public services that enhance economic activity by producing skilled and healthy labour.

HIV/AIDS increases public sector costs of recruiting and training new workers to replace those that are dying from AIDS-related causes. The fiscal burden is increasing, while the tax base is diminishing as increasing numbers of workers fall sick and die. The increasing fiscal burden may lead to reprioritising

of resources from other areas to address the impacts of HIV/AIDS. Reallocating resources to address HIV/AIDS impacts may retard improvements in the areas from which the resources are taken.

In the private sector, increased production costs emanating from increased medical care costs, recruitment and training costs, and terminal benefit costs will reduce the competitiveness of some firms. Reduced labour productivity reduces the productivity of physical capital leading to reduced investment as returns to capital decrease. This is already apparent in reduced foreign direct investment into high HIV/AIDS prevalence countries (ILO, 2005). The uncertainty surrounding the availability of skilled labour and high returns to capital make high prevalence countries unattractive investment destinations for foreign capital. This source of new technology and much-needed new capital is thus threatened by HIV/AIDS.

Firms face smaller markets for their output as HIV/AIDS-related mortality increases. The age-group most affected by AIDS mortality also happens to be the working age-group with incomes and therefore the ability to purchase firms' outputs. As more workers die and household incomes fall, household demand for firms' outputs decreases. This could trigger a vicious cycle of decreased firm demand for labour and the exacerbation of reductions in household incomes as fewer workers are employed and further reductions in firms' output etc. Shrinking product markets are a real threat to employment as firms respond to the impacts of the HIV/AIDS epidemic by cutting back their demand for labour.

The informal sector that tends to rely on the entrepreneurial ability of one or a few individuals is particularly at risk from high HIV/AIDS-related mortality. The loss of a critical individual may lead to the demise of the enterprise they were involved in because no one else in their household possesses the particular skills and ability that the deceased individual had. The demise of such an individual leads to the demise of the enterprise and the loss of an income source for their household and therefore reduces their consumption possibilities and welfare.

Some high prevalence countries face negative population growth rates while others face positive but lower growth rates. As the population growth rates decrease the populations of affected countries will grow at lower rates. This means that the labour forces of such countries will also grow at lower rates. With labour being an important input in most economic activity, it is to be expected that

the economies of such countries will grow at reduced rates. Lower growth rates imply reduced growth in the quantity of resources that can be applied to the improvement of the welfare of the majority of the population. Where negative growth rates are predicted, the size of the labour force will shrink and unless there is an adequate substitute for labour in economic activities, overall economic activity can be expected to shrink too.

The literature on household impacts, private and public sectors and demographic impact is clear that HIV/AIDS has considerable negative impacts on the population and some sectoral economic activity. It is tempting to categorically conclude that there should be negative impacts at the macroeconomic level as well because its constituent parts are all adversely affected by HIV/AIDS. The impacts at the macroeconomic level, however, need to take into account the behavioural responses of the various economic actors to rising AIDS morbidity and mortality.

Individuals may respond to rising morbidity and mortality by reducing the number of their sexual partners or by practising safer sex. This could lead to lower infections and fewer households experiencing an adult AIDS death in the future. Firms could respond to increasing labour costs by employing more capital intensive methods of production that require less labour. It is also the case that at the macroeconomic level, there is interaction among the various economic sectors and among the various institutions. Modelling the HIV/AIDS impacts at the macroeconomic level without taking into account the inter-sectoral and inter-institutional interactions may lead to inaccurate results. This is most likely the reason that econometric studies have consistently not found significant adverse HIV/AIDS macroeconomic level impacts.

This thesis aims to contribute to this body of knowledge on the impact of HIV/AIDS on economic development by estimating the impacts at both the macro and microeconomic levels using a method that is built on strong microeconomic foundations. Computable general equilibrium (CGE) analysis, because of its strong microeconomic foundations, is well suited to accomplishing this task. The presence of many different household types in the modelling enables the impact for different household types to be estimated simultaneously. The presence of other economic institutions – productive sectors, government, and the external sector – enable the estimation of the macroeconomic impacts. Thus both the

microeconomic and macroeconomic impacts are modelled under the same assumptions.

This thesis also extends available knowledge by estimating HIV/AIDS's impact on rural based public sector workers who are crucial for the implementation of government rural economic development efforts. The economic development of rural areas is important for Zambia's economic development because the majority of Zambia's population is based in rural areas. If HIV/AIDS reduces the willingness of public sector workers to live and work in rural areas, rural economic development would be severely compromised. It is therefore important to find out whether HIV/AIDS, because of its severe adverse effects on infected individuals and their co-workers, and poor access to utilities and other public services in rural areas, would discourage public sector workers from living and working in rural areas.

Estimating the impacts of HIV/AIDS at both the macro and microeconomic levels has important policy implications. The results of this thesis should be able useful in formulation of an overall strategy to address the impact of HIV/AIDS at both the macro and micro-levels. By identifying the important channels through which the HIV/AIDS impact is transmitted through the economy, it is possible to formulate informed policies with which to minimise its adverse impact on the economy. Identification of worst affected household types also enables formulation of evidence-based effective impact mitigation strategies. This is especially important in resource-poor countries with limited resources to expend on combating and mitigating the adverse impacts of HIV/AIDS. This thesis aims to produce such evidence on which an overall policy for combating the HIV/AIDS epidemic in Zambia and formulation of effective impact mitigation strategies at the household level can be based.

## **Chapter 4 Data Analysis and Model Calibration**

### **4.1 Introduction**

This chapter presents and analyses some aspects of the social accounting matrix (SAM) used in simulating the impact of HIV/AIDS in chapters 5 and 6. In particular, it looks at the composition of labour in the various sectors, allocation of household expenditure on sectoral output, sources of household incomes, the external sector and its influence on domestic economic activity, sources of factor incomes and the levels of taxes and savings among households.

The chapter also describes the model equations and the process of calibrating the model. It concludes with a description of how all the accounts in the SAM are reproduced to attain the benchmark equilibrium against which the counterfactual equilibria from the simulations will be compared.

### **4.2 Overview of the SAM**

The database used in this study is a social accounting matrix (SAM) originally created by James Thurlow and Sherman Robinson of the International Food Policy Research Institute, (IFPRI), and David Evans of the Institute of Development Studies (IDS), University of Sussex, UK. The authors of this SAM note that

“the most recent available data was used during the compilation of the SAM. At the macro level, the SAM is made to be consistent with the World Bank’s 2001 Revised Minimum Standards Model (RMSM) of Zambia. At the micro level, the macro SAM was disaggregated using national and foreign trade accounts, and a variety of other sources. These included the 1998 Living Conditions Monitoring Survey (LCMS) and the input-output structure contained in the 1995 Zambia SAM, also produced by IFPRI (Hausner, 1999)” (Thurlow, Evans, & Robinson, 2004).

Though this SAM may seem dated, it is the latest available that has the disaggregation level that is suitable for this study. It is also arguable that the structure of the Zambian economy is not much different now from that represented by this SAM and that as the direction of impact of the shocks is our

primary concern, the fact that the data are a bit old should not pose much of a problem. The benchmark data merely provide a snapshot of the economy at a particular point in time that enables us to model the different growth paths that the economy could follow given certain parameter changes.

The original SAM is made up of 28 sectors producing 27 commodities. Two of the sectors both produce Maize – one on a large scale, the other on a small scale. The producing sectors can be divided into roughly three main sectors - Agriculture, Manufacturing, and Service sectors. The rest of the SAM consists of 11 representative households, 8 factor types including 4 of labour, 4 tax accounts, 1 government account, 1 savings-investment account, 1 external account, and 2 enterprise accounts. All the values in the SAM are in 2001 billions of Zambian Kwacha.

For the purposes of modelling, the commodities and activities accounts were combined, as were the large-scale and small-scale maize producer accounts. The aggregated SAM used in the model thus consists of 27 sectors and 27 commodities.

### **4.3 Analysis of some aspects of the SAM**

An analysis of the aggregated SAM provides some useful insights into the structure of the Zambian economy and the linkages among the various institutions. Among the issues of interest are the usage of labour in various sectors, the sources and distribution of factor incomes, household and government expenditure, significance of the external sector, household saving behaviour, and government tax policy. Insights gained from the investigation of such issues are helpful in clarifying the extent of impacts that external shocks are likely to have on the various institutions and the economy as a whole. Identifying the likely institutions that would be affected by a shock enables estimation of the magnitude of impacts on those institutions and allows us to identify which other institutions will be affected by these “first round” effects. Through the identified linkages in the economy, it becomes possible to quantify the total effect of a shock on the entire economy. With estimation of impacts on households, household welfare can be estimated and the full impact of a particular shock quantitatively evaluated. In the analysis that follows, the following abbreviations in Table 3 are used.

**Table 3 Description of abbreviations used**

Category	Abbreviation	Description
Commodities	C <sub>MAI</sub>	Maize
	C <sub>STA</sub>	Drought tolerant staples
	C <sub>GNT</sub>	Groundnuts
	C <sub>SUG</sub>	Sugar
	C <sub>COT</sub>	Cotton
	C <sub>TOB</sub>	Tobacco
	C <sub>COF</sub>	Coffee
	C <sub>WHE</sub>	Wheat
	C <sub>HCR</sub>	Horticulture
	C <sub>OCR</sub>	Other crops
	C <sub>LIV</sub>	Livestock
	C <sub>FIS</sub>	Fishing
	C <sub>FOY</sub>	Forestry
	C <sub>MIN</sub>	Mining
	C <sub>FBT</sub>	Food, beverages and processed tobacco
	C <sub>TAG</sub>	Textiles and garments
	C <sub>WAF</sub>	Wood and furniture
	C <sub>FER</sub>	Fertilizer and industrial chemicals
	C <sub>OMA</sub>	Other manufacturing
	C <sub>EAW</sub>	Electricity and water
	C <sub>CAG</sub>	Equipment and machinery (capital goods)
	C <sub>CON</sub>	Construction
	C <sub>TSV</sub>	Trade and transport services
	C <sub>TOU</sub>	Tourism
	C <sub>SER</sub>	Other private and community services
	C <sub>FIN</sub>	Financial services
	C <sub>PUB</sub>	Public services
Households	H <sub>RRS</sub>	Rural-Remote-small-scale
	H <sub>RRM</sub>	Rural-Remote-medium-scale
	H <sub>RRN</sub>	Remote-Rural-non-farm
	H <sub>RS</sub>	Rural-nonremote-small-scale
	H <sub>RM</sub>	Rural-nonremote-medium-scale
	H <sub>RL</sub>	Rural-nonremote-large-scale
	H <sub>RN</sub>	Rural-nonremote-non-farm
	H <sub>USE</sub>	Urban-low-skilled self-employed
	H <sub>UPR</sub>	Urban-Private employee
	H <sub>UPU</sub>	Urban-Public employee

Category	Abbreviation	Description
	H <sub>UHEM</sub>	Urban-high-skilled employers
Labour	L <sub>NONE</sub>	Labour-uneducated
	L <sub>PRIM</sub>	Labour-primary schooling
	L <sub>SECD</sub>	Labour-secondary schooling
	L <sub>POST</sub>	Labour-post-secondary schooling

Source: Adopted from the SAM by Thurlow et al., 2004

### 4.3.1 Sectoral Labour Composition

Table 4 below shows the proportions of each labour-type used in each of the production sectors. The last 3 columns in the table aggregate uneducated labour, L<sub>NONE</sub>, and primary school educated labour, L<sub>PRIM</sub>, as unskilled labour, while secondary school educated labour, L<sub>SECD</sub>, is labelled semi-skilled and post-secondary school educated labour, L<sub>POST</sub>, as skilled labour.

#### 4.3.1.1 Agricultural sector labour composition

Table 4 shows that the agriculture sector employs predominantly unskilled labour relative to the manufacturing and service sectors. Unskilled labour in the agricultural sub-sectors makes up more than 80 per cent of the labour employed. In over one-half of the agricultural sub-sectors, it makes up more than 90 per cent of the labour employed. The only exception being in the Forestry sub-sector where unskilled labour makes up 66 per cent of the labour force, still a significant proportion but less so compared to the other agricultural sub-sectors. The table shows also that more semi-skilled than skilled labour is employed in this sector. The combination of unskilled and semi-skilled labour makes up more than 90 per cent of labour in all agricultural sub-sectors but one.

#### 4.3.1.2 Manufacturing sector labour composition

In the manufacturing sector, unskilled labour makes up less than 50 per cent of the labour force in five of the nine sub-sectors. However, the combination of unskilled and semi-skilled accounts for over 80 per cent of labour employed in most sub-sectors. While the agricultural sub-sectors employ smaller proportions of skilled labour, the manufacturing sub-sectors employ relatively more skilled labour. The percentages of skilled labour in these sub-sectors range from 13 to 35 per cent compared to mostly less than 9 per cent in the agricultural sub-sectors.

This outcome is also evident for semi-skilled labour where the proportions for the manufacturing sub-sectors are significantly higher than those for the agricultural sub-sectors. These figures show that the manufacturing sector labour force consists of a relatively higher proportion of semi-skilled and skilled workers than the agricultural sector.

#### **4.3.1.3 Service sector labour composition**

In the service sector, unskilled labour makes up about half of the labour force in 3 of the 5 sub-sectors. In the other 2 sub-sectors, the financial and public sub-sectors, it makes up less than 20 per cent of the workforce. These two sub-sectors, separately, employ more semi-skilled and skilled labour than any other sub-sector in the entire SAM.

**Table 4. Sectoral Labour Composition**

Sector	PROPORTION OF LABOUR-TYPE USED				(1) + (2)	(3)	(4)
	L <sub>NONE</sub> (1)	L <sub>PRIM</sub> (2)	L <sub>SEC</sub> (3)	L <sub>POST</sub> (4)	Unskilled (%)	Semi-skilled (%)	Skilled (%)
<b>Agriculture</b>							
C <sub>MAI</sub>	0.527	0.387	0.054	0.031	91.5	5.4	3.1
C <sub>STA</sub>	0.637	0.345	0.015	0.003	98.2	1.5	0.3
C <sub>GNT</sub>	0.625	0.310	0.020	0.045	93.4	2.0	4.5
C <sub>SUG</sub>	0.356	0.453	0.116	0.074	80.9	11.6	7.4
C <sub>COT</sub>	0.508	0.422	0.055	0.015	93.1	5.5	1.5
C <sub>TOB</sub>	0.893	0.084	0.018	0.005	97.7	1.8	0.5
C <sub>COF</sub>	0.355	0.455	0.116	0.074	81.0	11.6	7.4
C <sub>WHE</sub>	0.356	0.453	0.116	0.074	80.9	11.6	7.4
C <sub>HCR</sub>	0.586	0.232	0.089	0.093	81.8	8.9	9.3
C <sub>OCR</sub>	0.572	0.367	0.051	0.010	93.9	5.1	1.0
C <sub>LIV</sub>	0.502	0.351	0.084	0.064	85.2	8.4	6.4
C <sub>FIS</sub>	0.484	0.432	0.059	0.025	91.6	5.9	2.5
C <sub>FOY</sub>	0.377	0.282	0.176	0.165	65.9	17.6	16.5
<b>Manufacturing</b>							
C <sub>MIN</sub>	0.023	0.463	0.349	0.165	48.6	34.9	16.5
C <sub>FBT</sub>	0.401	0.362	0.107	0.131	76.2	10.7	13.1
C <sub>TAG</sub>	0.024	0.485	0.281	0.210	50.9	28.1	21.0
C <sub>WAF</sub>	0.053	0.327	0.304	0.316	38.0	30.4	31.6
C <sub>FER</sub>	0.082	0.313	0.479	0.127	39.4	47.9	12.7
C <sub>OMA</sub>	0.064	0.441	0.313	0.182	50.5	31.3	18.2
C <sub>FAW</sub>	0.091	0.188	0.478	0.243	27.9	47.8	24.3
C <sub>CAG</sub>	0.093	0.454	0.193	0.260	54.7	19.3	26.0
C <sub>CON</sub>	0.123	0.348	0.177	0.351	47.2	17.7	35.1
<b>Services</b>							
C <sub>TSV</sub>	0.083	0.420	0.296	0.201	50.3	29.6	20.1
C <sub>TOU</sub>	0.059	0.496	0.179	0.266	55.5	17.9	26.6
C <sub>SER</sub>	0.149	0.364	0.158	0.329	51.3	15.8	32.9
C <sub>FIN</sub>	0.048	0.131	0.431	0.390	17.9	43.1	39.0
C <sub>PUB</sub>	0.041	0.144	0.306	0.509	18.5	30.6	50.9

Source: Calculated from the SAM (Thurlow et al., 2004).

Semi-skilled and skilled workers in these sub-sectors make up approximately 82 per cent of the workforce. No other sub-sector in the entire SAM has a proportion of semi-skilled and skilled workers within 10 percentage points of those in the financial and public service sub-sectors. Other sub-sectors

with relatively high proportions of skilled labour in their labour forces are the construction, private services, and wood and furniture sub-sectors all with at least one in three workers being either semi-skilled or skilled.

The overall picture that emerges is that most labour employed in all sub-sectors, other than the financial and public sub-sectors, is largely unskilled labour. It is clear that there is a dearth of skilled labour in the Zambian economy as represented by this SAM. Implications for the economic development of Zambia can be inferred from the foregoing. Economic growth, a necessary condition for economic development, and productivity growth can be improved in all sectors with substantial increases in the use of skilled labour. This point suggests that factors that lead to increases in the availability of skilled labour can lead to productivity growth and increased output in most sub-sectors.

The use of predominantly unskilled labour highlights also the vulnerability of the Zambian economy to the impact of HIV/AIDS. Unskilled labour tends to be less educated labour. Some studies, for example (Corno & de Walque, 2007; de Walque, 2004, 2006), indicate that less educated people may be at higher risk of contracting HIV/AIDS because they don't have sufficient knowledge to protect themselves against the HI virus. The 2007 Zambia Demographic and Health Survey shows that although HIV/AIDS is more prevalent among the educated than among the less educated, prevalence among the uneducated was increasing at a faster rate. This being the case, it is clear from Table 4 that the Zambian economy is extremely vulnerable to the negative impact of HIV/AIDS because of the very high proportion of less educated labour employed in all sectors.

Both reduced vulnerability to the effects of HIV/AIDS and productivity growth call for substantial increases in education, human capital accumulation, and skills training.

### 4.3.2 Household Expenditure

Table 5 shows proportions of household-type expenditure on sectoral output.

**Table 5 Household Expenditure on Sectoral Output**

Household type	Commodity Expenditure on		
	Agric. (%)	Manuf. (%)	Serv. (%)
H <sub>RRS</sub>	67.9	26.1	5.9
H <sub>RRM</sub>	56.7	33.6	9.7
H <sub>RRN</sub>	33.6	59.6	6.8
H <sub>RS</sub>	67.2	25.9	6.9
H <sub>RM</sub>	40.1	44.9	14.9
H <sub>RL</sub>	43.0	35.3	21.7
H <sub>RN</sub>	33.8	53.8	12.4
H <sub>USE</sub>	24.9	53.5	21.6
H <sub>UPR</sub>	16.1	58.6	25.3
H <sub>UPU</sub>	18.3	56.7	25.0
H <sub>UEM</sub>	13.1	55.0	31.9

Source: calculated from SAM (Thurlow et al., 2004).

#### 4.3.2.1 Expenditure on agricultural output

From Table 5, rural households spend significantly more on agricultural output than urban households with the remote rural small households spending the largest proportion of 68 per cent. With the exception of the urban self-employed households, urban households spend less than 20 per cent on agricultural output.

#### 4.3.2.2 Expenditure on manufactures

Manufactures take up between of 53 and 60 per cent of the commodity expenditure of each of the urban and rural non-agricultural household types. The rural agricultural small and medium households allocate between 26 and 45 per cent of their total commodity expenditure on manufactures.

### 4.3.2.3 Expenditure on services

Rural households spend the least on services. Their expenditure on services ranges from 6 to 15 per cent in small and medium-sized households, and 22 per cent in the large rural households.

With the prices all set to 1 in the benchmark equilibrium, these expenditures can be interpreted as quantities consumed by the various households. In the presence of HIV/AIDS, the impact on particular household consumption will depend on HIV/AIDS' impact on the sectors producing the goods which particular households consume most of.

### 4.3.3 Household Income

Household income is a significant determinant of well-being. An analysis of household income sources is therefore important in identifying households that will be significantly affected by changes in particular income-generating activities.

Table 6 below shows percentages of household income by source.

**Table 6 Household Income by Source**

Household type	Income Source				
	Labour	Capital	Govt	Enterprises	Intra/Inter household transactions
H <sub>RRS</sub>	78.6	15.3	3.3	0.0	2.8
H <sub>RRM</sub>	65.4	28.8	4.5	0.0	1.2
H <sub>RRN</sub>	36.2	0.5	8.7	51.9	2.6
H <sub>RS</sub>	76.1	13.4	8.0	0.0	2.5
H <sub>RM</sub>	73.2	21.4	4.2	0.0	1.2
H <sub>RL</sub>	75.7	5.6	0.0	18.6	0.1
H <sub>RN</sub>	28.9	0.6	5.8	63.4	1.3
H <sub>USE</sub>	14.5	0.9	1.9	81.7	1.1
H <sub>UPR</sub>	57.2	0.4	3.7	37.7	0.9
H <sub>UPU</sub>	50.9	0.5	4.2	43.0	1.3
H <sub>UEM</sub>	7.9	0.1	1.2	90.7	0.1

Source: Calculated from SAM (Thurlow et al., 2004)

#### **4.3.3.1 Rural households' income sources**

All agricultural household types get the largest proportion of their incomes from providing labour services. They all get at least 65 per cent of their incomes from providing labour services. Capital services provide the second highest source of income for all but one of these households. Enterprise activities provide the second largest proportion of income to large agricultural households but, provide no income at all to small and medium agricultural households. Government transfers provide between 3 and 8 per cent of incomes to rural households while inter- and intra-household transfers provide between 1 and 3 per cent of rural households' incomes.

Non-agricultural rural households on the other hand get most of their incomes from enterprise activities with labour income providing the second largest proportion. Government transfers at 6 and 9 per cent, and inter- and intra-household transactions at 3 and 1 per cent make up the next highest proportions. Capital services provide the least at 0.5 per cent of total income.

#### **4.3.3.2 Urban households' income sources**

Urban households providing labour services to the private and the public sectors get 57 and 51 per cent of their incomes from their labour services to these sectors respectively. Enterprise activities are the most significant source of incomes for the other two urban household-types. Incomes from enterprise activities for these households make up 82 and 91 per cent of their total incomes. Government transfers provide between 1 and 4 per cent of total incomes for urban households. Capital, and inter- and intra-household transfers provide the least proportions of incomes for these households. Their proportions range from 0.1 to 0.9 per cent and 0.1 to 3 per cent respectively.

This analysis suggests that factors that adversely impact on labour's ability to earn will significantly affect the agricultural households and the urban privately and publicly employed households more than any of the other households. On the other hand factors adversely affecting enterprise activities will have a larger impact on incomes of all urban and rural non-agricultural than agricultural households.

Changes to government transfers would have a similar impact on both rural and urban households as the proportions of incomes from this source are

similar for all households. Inter- and intra-household transfers, however, are more important to rural households than they are to urban households.

#### **4.3.4 The External Sector**

##### **4.3.4.1 Exports**

The external sector provides an outlet for domestic output and is a source of imports and transfers to households. Domestic producers allocate their production to the domestic and external markets based on the relative prices of their products in these markets. Higher world prices relative to domestic prices, cause producers to increase their production for export relative to production for the domestic market. Producers' incomes will therefore be affected by changes in the relative prices of their output. Identifying commodities that have a high proportion of exports will help to identify which sectors will be affected by factors affecting the relative prices of these sectors' outputs.

##### **4.3.4.2 Imports**

Imports make up part of domestic consumption. As domestic commodity prices are composite prices made up of the weighted averages of the domestic and import prices, the higher the proportion of imports in domestic supply the higher the influence of world import prices on domestic prices, domestic consumption, and ultimately the well-being of domestic consumers.

##### **4.3.4.3 Zambia's external sector**

Table 7 shows real exports and imports as proportions of domestic output and domestic supply respectively.

It shows that most sectors in the SAM are tradeable sectors characterised by two-way trade. The tradeable sectors are characterised by a significant proportion of either exports or imports. This suggests that world commodity prices will have a significant impact on domestic household welfare. This impact is transmitted through relative prices which affect the quantity of domestic output available for domestic consumption. As domestic consumers consume composite goods, made up of domestic production and imported output, the prices they face are affected by the proportion of imports in domestic supply available for domestic consumption. Changes in world commodity prices and the exchange

rate will therefore have a significant impact on domestic prices. Higher world prices for exports or a higher exchange rate will tilt domestic production in favour of exports, leading to a reduction in the amount of domestic production available for domestic consumption. In the short-term, this will tend to lead to a reduction in the welfare of domestic consumers as prices rise. Exchange rate policy, through its impact on the domestic prices of imports, the composition of domestic output, and the prices of exports, is thus an important factor in determining domestic household welfare.

**Table 7 Export and Import Proportions**

<b>Commodity</b>	<b>Exports (ZK bn)</b>	<b>Imports (ZK bn)</b>	<b>Domestic Output (ZK bn) (1)</b>	<b>Domestic Supply (ZK bn) (2)</b>	<b>Exports (%) of (1)</b>	<b>Imports (%) of (2)</b>
C <sub>MAT</sub>	0.0	0.0	866.5	866.5	0.0	0.0
C <sub>STA</sub>	0.0	0.0	499.6	499.6	0.0	0.0
C <sub>GNT</sub>	0.0	0.0	441.3	441.3	0.0	0.0
C <sub>SUG</sub>	118.9	24.4	268.3	173.8	44.3	14.1
C <sub>COT</sub>	126.9	50.0	347.6	270.6	36.5	18.5
C <sub>TOB</sub>	35.7	2.6	115.2	82.1	31.0	3.2
C <sub>COF</sub>	32.1	10.2	70.3	48.5	45.6	21.0
C <sub>WHE</sub>	5.3	46.1	152.8	193.6	3.5	23.8
C <sub>HCR</sub>	130.4	161.3	1365.2	1396.2	9.5	11.6
C <sub>OCR</sub>	3.4	21.4	765.0	782.9	0.4	2.7
C <sub>LIV</sub>	3.0	6.8	1231.0	1234.9	0.2	0.6
C <sub>FIS</sub>	1.6	5.2	791.6	795.2	0.2	0.7
C <sub>FOY</sub>	0.0	0.0	124.9	124.9	0.0	0.0
C <sub>MIN</sub>	2218.7	81.0	4408.8	2271.2	50.3	3.6
C <sub>FRT</sub>	29.2	227.0	4626.5	4824.3	0.6	4.7
C <sub>TAG</sub>	21.2	191.0	1798.6	1968.4	1.2	9.7
C <sub>WAF</sub>	27.2	294.8	1221.3	1488.8	2.2	19.8
C <sub>FFR</sub>	11.3	217.7	244.9	451.3	4.6	48.2
C <sub>OMA</sub>	534.7	1497.5	3395.3	4358.1	15.7	34.4
C <sub>FAW</sub>	209.4	0.0	1971.3	1761.9	10.6	0.0
C <sub>CAG</sub>	25.6	1787.9	2317.8	4080.1	1.1	43.8
C <sub>CON</sub>	0.0	0.0	2908.9	2908.9	0.0	0.0
C <sub>TSV</sub>	0.0	568.3	14638.5	15206.8	0.0	3.7
C <sub>TOU</sub>	113.7	0.0	275.7	162.0	41.2	0.0
C <sub>SFR</sub>	0.0	0.0	1108.8	1108.8	0.0	0.0
C <sub>FIN</sub>	111.4	708.7	5063.0	5660.3	2.2	12.5
C <sub>PUB</sub>	0.0	0.0	4942.9	4942.9	0.0	0.0

Source: calculated from SAM (Thurlow et al., 2004).

A decrease in the exchange rate would have the opposite effect of tilting domestic production in favour of producing for the domestic market, increasing consumption of both domestic output and imports leading to an overall increase in household consumption and welfare.

### 4.3.5 Factor Incomes

Changes in factor incomes are affected by changes in the demand for both domestic output and imports. As it is the factor incomes that get redistributed as household incomes, an analysis of factor incomes by source is useful for shedding light on which households' incomes will be affected by adverse shocks in particular sectors. Table 8 presents the factor incomes by source.

**Table 8 Factor Incomes by Sectoral Source**

<b>Factor</b>	<b>Agric. (%)</b>	<b>Manuf. (%)</b>	<b>Services (%)</b>	<b>Total (%)</b>
L <sub>NONE</sub>	78.0	8.9	13.2	100.0
L <sub>PRIM</sub>	38.1	15.1	46.8	100.0
L <sub>SECD</sub>	12.6	14.0	73.4	100.0
L <sub>POST</sub>	9.5	13.7	76.8	100.0
K <sub>AGR</sub>	100.0	0.0	0.0	100.0
K <sub>MIN</sub>	0.0	100.0	0.0	100.0
K <sub>OTH</sub>	0.0	30.4	69.6	100.0
LAND	100.0	0.0	0.0	100.0

Source: calculated from SAM (Thurlow et al., 2004).

Table 8 shows that the agricultural sector provides 78 per cent of uneducated labour's income and 38 per cent of primary educated labour's. Secondary and post-secondary educated labour gets significantly less income from the agricultural sector - 13 and 10 per cent of their total incomes respectively. These factors get their incomes predominantly from the service sector which provides 73 and 77 per cent of their incomes respectively. The manufacturing sector income proportions are similar among primary, secondary and post-secondary educated labour

These figures suggest that factors adversely affecting the agricultural sector will initially disproportionately affect uneducated and primary educated labour, while factors impacting on the service sector will initially affect the secondary and post-secondary educated labour significantly more.

Identifying the sources of incomes and therefore which households will be directly affected by an adverse shock is useful for the process of formulating mitigation strategies. Appropriate and targeted strategies can be formulated and implemented to mitigate the income impacts of particular shocks. This, however,

requires that the income sources and targets of the shocks be correctly identified. Targeting, in resource-deficient countries, is desirable because it helps to minimise the costs of mitigation efforts. The impact of an adverse shock in the service sector, for example, is likely to be felt by all labour types through the initial reduction of incomes of secondary and post-secondary educated labour. However, if appropriate mitigation strategies targeting secondary and post-secondary educated labour categories were implemented, the negative impacts on other labour categories could be minimised.

#### 4.3.6 Household taxes and savings

Table 9 shows that only urban households and large rural households pay direct (income) taxes.

**Table 9 Household Tax and Saving Rates**

Household type	Tax Paid (ZK bn)	Savings (ZK bn)	Total Income	Tax Rate (%)	Savings Rate (%)
H <sub>RRS</sub>	-	1.5	1279.6	0	0.12
H <sub>RRM</sub>	-	0.1	100.0	0	0.12
H <sub>RRN</sub>	-	0.3	140.6	0	0.24
H <sub>RS</sub>	-	2.5	1592.9	0	0.16
H <sub>RM</sub>	-	0.3	168.8	0	0.17
H <sub>RL</sub>	17.4	1.6	143.4	12.14	1.15
H <sub>RN</sub>	-	1.7	348.3	0	0.48
H <sub>USE</sub>	174.6	26.4	2763.8	6.3	0.96
H <sub>UPR</sub>	227.4	20.4	1522.7	14.9	1.34
H <sub>UPU</sub>	280.3	33.3	2798.6	10.0	1.19
H <sub>UEM</sub>	247.3	26.7	1113.3	22.2	2.40

Source: calculated from SAM (Thurlow et al., 2004).

Income tax policy is therefore likely to have an immediate direct impact only on the urban and large rural households. If government increased taxes to pay for the provision of more health services, for example, the immediate impact would be a reduction in disposable incomes of urban and large rural households. The welfare of these households would immediately be affected by the reduction in their disposable incomes than the welfare of the non-tax paying rural households.

Table 9 also shows that household savings rates are very low. The rates range from 0.12 to just over 1 per cent for rural agricultural households and from 0.9 to 2.4 per cent for urban households. These savings rates suggest that factors adversely affecting household savings will not have a significant impact on investment. The low savings rates suggest that household savings are not a significant source of domestic investment. If, as argued by among others Haacker (2002b), Masha (2004), Brown (2004), and UNAIDS/WHO (2004), that one of the impacts of HIV/AIDS is to cause households to run down their savings, the impact of HIV/AIDS on economic development through reduced domestic savings is likely to be very minimal on the Zambian economy because the current levels of household savings are insignificantly low.

#### **4.3.7 Conclusion**

The agricultural sector provides most employment and income for unskilled labour. Adverse impacts in the agricultural sub-sectors will thus significantly affect unskilled labour and rural households that obtain most of their income from providing agricultural labour. Reduced unskilled labour income would affect rural household consumption of both agricultural output and manufactures on which rural households allocate the highest proportions of their expenditures.

Agricultural employment is dominated by unskilled and semi-skilled labour. This has serious negative implications for productivity and productivity growth in this sector if the argument that uneducated workers are more vulnerable to HIV infection holds.

Urban self-employed households,  $H_{USE}$  and  $H_{UEM}$ , get 82 and 91 per cent of their incomes respectively from enterprise activities while the formally employed urban households,  $H_{UPR}$  and  $H_{UPU}$ , get 57 and 51 per cent of theirs from providing labour services, and 38 and 43 per cent from enterprise activities. These households allocate most of their expenditure on manufactures and services. Personal income tax changes affecting these households would therefore have a direct impact on the earnings of the manufacturing and services sectors and on their ability to employ more labour.

The services sector emerges as the most important source of factor incomes for semi- and skilled labour. This sector provides 73 and 77 per cent of

incomes for semi-skilled and skilled labour respectively, as well as 13 per cent for unskilled labour. Adverse impacts on the service sector will have a considerable impact on the welfare of households relying on income from semi- and skilled labour.

The external sector directly affects 19 of the 27 sectors in the SAM. In most of the tradeable sectors, the proportions of exports in domestic output and the proportions of imports in domestic supply are significant. The effects of factors affecting traded commodities will therefore be transmitted to most households in the economy. Exchange rate policy and world prices, though not modelled in this study, are some of such factors and therefore important factors affecting the welfare of domestic households.

The linkages between factor incomes, household incomes, household consumption, and sectoral output are apparent from this analysis of the SAM. It is clear that an impact in one sector will be transmitted to the rest of the sectors either directly or indirectly through changes in the behaviour of either households, producers, or both. It is also clear that these behavioural changes will have feedback loops that serve to reinforce the initial changes. It is such changes that are neglected by partial equilibrium analysis, making the use of a general equilibrium approach more suitable for analysis of the impacts of shocks on the entire economy.

## **4.4 Model Equations and Calibration**

### **4.4.1 Introduction**

The model developed for simulations is based on a model by (Sadoulet & de Janvry, 1995). This model extends Sadoulet & de Janvry's 3 sector model of Morocco to 27 sectors and incorporates (Cuddington & Hancock, 1994; Cuddington, Hancock, & Rogers, 1994)'s idea of modelling the effect of HIV/AIDS on the quality and size of the labour force by taking into account the effect of HIV/AIDS on the co-workers of infected workers, and the accumulated work experience of individuals in the workforce. Other significant extensions include the extension of the number of households from 3 to 11. Labour types are increased from 1 in Sadoulet & de Janvry to 4, although in the simulations the

labour types are aggregated into a single labour type to fit the functional form of the production function chosen. An assumption is made that the single labour type is comprised of the different labour types in their original proportions of the total quantity of labour used. This enables the changes in demand for the different labour types to be calculated from the observed total labour demand changes from the simulations.

This SAM is a particularly suitable one for analysing the impact of shocks on households and economic development in Zambia because it consists of many household types and it captures the prominence of the agricultural sector which provides most employment and means of livelihood in Zambia. It includes also the mining sector, the largest source of exports and export earnings, and also a significant source of formal employment.

The model is a one-period static model. This is typical of short-to-medium term models in which it is assumed that the structure of the economy does not change significantly over the period of analysis.

Firms produce all the domestic output. In some sectors, some of the domestic production is exported to the rest of the world. Firms' output can be categorised as either intermediate or final output. Intermediate output is consumed by other producers in the production of their own output. Final output, on the other hand, is output consumed by households and government as final consumption. Final consumption thus includes exported output. In their production activities, firms utilise the primary factors, labour and capital, owned by households. Firms pay wages and rent to households for use of the factors of production. Other firm expenditure is on production taxes to government, and on intermediate inputs from other firms.

The 11 household types are defined by their size and location. They range from remote rural small agricultural households to urban highly skilled households. The households own the primary factors of production and receive income from firms for their use. Household income is spent on income taxes, consumption of goods and services, and inter- and intra-household transfers. Unspent income goes into household savings. Household consumption, in the model, is based on a linear expenditure system. Under this formulation, households allocate some of their income on "subsistence" consumption initially. Uncommitted income is then spent on a marginal budget share basis (Sadoulet &

de Janvry, 1995). This way, households are able to satisfy their basic survival needs first. Uncommitted income is allocated on the basis of each good's or service's marginal share of income after the satisfaction of subsistence needs.

Government receives income in the form of production taxes from firms, indirect taxes from consumption of goods and services, tariffs on imported goods, and income taxes from households. In the SAM, the tax accounts are separated from the government account. This separation is a convenient one because it enables the simulation of the impact of changes in tax policy. Tax policy is determined by government and is therefore exogenous to the model. As such it is possible to shock the tax rates and observe their impact on the model. Government expenditure is also exogenous because it is set by government officials. It is possible, therefore, to shock and simulate the impact of changes in the level of government expenditure. Government expenditure includes expenditure on goods and services from domestic firms, transfers to firms and households, and payments to foreign producers. Unspent government income goes into the savings account as government savings.

Because the model is a short-term (static) model, the amount of capital used in production is assumed to be fixed and sector-specific. There is therefore no impact on output resulting from changes in the capital stock arising from changes in savings behaviour. Changes in output arise only from changes in the quantity of labour and intermediate inputs used in the production process.

#### **4.4.2 Agents' behaviour**

##### **4.4.2.1 Competitive economic agents**

All agents are assumed to act competitively. No agent, producer or consumer, is assumed to be capable of influencing or setting the price of any commodity. All agents take prices as given. The prices in the model serve as signals to which all agents respond by changing either their production or consumption plans.

##### **4.4.2.2 The producer's problem**

The model assumes that producers make profit-maximising decisions. Production technology is represented by a constant elasticity of substitution (CES) production function in primary factors. The factors are combined with fixed-share

intermediate inputs using a Leontief specification. Profit maximisation implies that factors receive income such that marginal revenue equals marginal cost based on endogenous relative prices. This condition implies that firms are competitive and make normal profit. The producer's problem can be stated as one of choosing a feasible production plan that maximises the producer's profit given prevailing prices (Ginsburgh & Keyzer, 1997; Jehle & Reny, 2001; Starr, 1997).

Substitution possibilities exist between domestic production and export production. Producers' decisions are governed by a constant elasticity of transformation (CET) function, which distinguishes between export goods and domestic goods, and captures the differences between the products sold in the two markets. Profit-maximisation drives producers to sell in those markets in which they can achieve the highest returns. These returns are based on domestic and export prices (where the latter are determined by world prices and the exchange rate). World demand is perfectly elastic at a fixed world price under the small-country assumption (De Melo & Robinson, 1989). The ratio of exports to domestic goods is determined by the endogenous interaction of relative prices.

#### **4.4.2.3 The consumer's problem**

Under a CES Armington specification, imports and domestic goods are imperfect substitutes (Abrego, 1999; De Melo & Robinson, 1989), and the composition of domestic supply depends on their relative prices and the cost-minimising decisions of domestic consumers. World supply is infinitely elastic at fixed world prices, under the small-country assumption. Based on relative prices, consumers substitute between domestic and imported goods. Consumers maximise their utility by choosing the cost-minimising or utility-maximising combination of domestic and imported goods consistent with their budget constraints (Ginsburgh & Keyzer, 1997; Jehle & Reny, 2001; Kehoe & Kehoe, 1994; Varian, 1992).

#### 4.4.3 Model Calibration

Calibrating the model involves deriving model parameters from the figures in the base SAM and using parameters obtained elsewhere in the literature (Shoven & Whalley, 1992).<sup>28</sup>

Parameters calculated from the SAM are shown in the model as derived parameters. These parameters typically are ratios. For example, the household income tax rates are calculated as the tax paid by a household as a proportion of the household total income, while the input-output coefficients are calculated as the ratios of the values of intermediate inputs to the total value of total expenditure of each sector.

The model is calibrated by combining the behavioural equations, the derived parameters, and the external parameters to reproduce the figures in the original SAM. This process is equivalent to replicating the process that generated the figures in the original SAM. The economy, as represented by the model, is considered to be at its initial or benchmark equilibrium when the model is able to reproduce the figures in the original SAM.

Simulating the impact of shocks or policy changes on the economy is accomplished by changing one or more appropriate model parameters and observing their effects on the variables of interest after the model has settled at a new equilibrium. In the literature, the scenarios that result from changing some parameters are called counterfactual scenarios. The impact of the policy or parameter change on a variable of interest is the difference between the variable's counterfactual and benchmark scenario values.

The figures in the SAM are mostly of the expenditure/value type, i.e. they are mostly payments of the price multiplied by quantity type. Following Harberger (1962) all prices are initially assumed to be unity. With this assumption, most figures in the SAM can be interpreted as quantities in their appropriate units of measurement. In this formulation the prices in the base scenario can be thought of as price indices. There is therefore no need for a

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<sup>28</sup> Reliance on single observations for each variable in a SAM means benchmark data cannot be used to identify a unique set of values for parameters in a model (Shoven and Whalley 1992) hence the need to use parameters, especially elasticities, calculated elsewhere.

particular numeraire price against which to measure all other prices in the model (Sadoulet & de Janvry, 1995).

#### 4.4.3.1 Production

Domestic production is described by a two-level nested production process. At the top level is a Leontief nest in which value-added is combined with intermediate inputs, while at the bottom level, the primary factors, labour and capital, are combined by a constant elasticity of substitution (CES) nest to produce value-added (Dervis, De Melo, & Robinson, 1982; Karadag & Westaway, 1999). While labour is mobile across sectors, capital is assumed to be sector specific and as is the case with short-run models, its quantity is assumed to be fixed. The Leontief nest level can be written as:

$$X_j(L_j, K_j, V_{ij}) = \min \left\{ \frac{VA_j(L_j, K_j)}{a_{0j}}, \frac{V_{1j}}{a_{1j}}, \dots, \frac{V_{ij}}{a_{ij}} \right\}$$

$$j = 1, 2, \dots, 27$$

where  $X_j$  is output of sector  $j$ ,  $a_{0j}$  is the value-added requirement per unit of sectoral output;  $VA_j(.)$  is value-added;  $L$  and  $K$  are labour and capital respectively;  $V_{ij}$  is the physical quantity of intermediate input from sector  $i$  to sector  $j$ ; and  $a_{ij}$  represents the fixed input-output coefficients.

Within each production sector, the CES production function is used to generate value added which is then combined with intermediate inputs from other production sectors to produce each sector's output. Intermediate inputs are assumed to be used in fixed proportions. This function is

$$VA_j = \bar{A}_j (\alpha_j L_j^{-\rho} + (1 - \alpha_j) K_j^{-\rho})^{-1/\rho} \quad j = 1, 2, \dots, 27$$

where  $\bar{A}_j$  is the total factor productivity parameter in sector  $j$ , and  $\alpha_j$  is the labour share parameter in sector  $j$  and  $\rho$  is the labour-capital substitution parameter.

The labour-capital substitution parameter,  $\rho$ , is calculated as

$$\rho = \frac{1 - \sigma}{\sigma} = \frac{1}{\sigma} - 1$$

where  $\sigma$  is the elasticity of substitution of labour for capital.

The different labour types are combined into one labour type and are assumed to be used in fixed proportions to each other. There is thus a single elasticity of substitution among all labour types (Dervis et al., 1982).

Under a Leontief input-output technology for intermediate inputs, the shares among different intermediate inputs in a sector and the ratios of intermediate inputs to output are fixed (Dervis et al., 1982). Following this assumption of fixed coefficients technology, the intermediate demand of each sector is calculated as

$$V_j = \sum_{i=1}^n (a_{ij} * X_j)$$

where  $a_{ij}$  are the input-output coefficients and  $X_j$  is sectoral expenditure.

The demands for intermediate inputs per unit of output,  $a_{ij}$ , are computed and shown in the input-output matrix in the derived-parameters part of the model. These coefficients are calculated as

$$a_{ij} = \frac{V_{ij}}{X_j}$$

where  $V_{ij}$  is output of sector  $i$  used in sector  $j$ , and  $X_j$  is total output of sector  $j$ .

In addition to producing goods used as intermediate inputs by other producing sectors, the production sectors produce output that satisfies the final demand of the households, government and the external sectors.

With the fixed proportions technology assumed, the price of value-added can be determined from the value of the price of final output in each sector, as

$$pva_j = p_j^d * (1 - t_j) - \sum_i (a_{ij} * p_j)$$

$$i, j = 1, \dots, 27$$

where  $pva_j$  is the price of value-added in sector  $j$ ,  $p_j^d$  is the price of final output in sector  $j$ ;  $t_j$  is the production tax rate in sector  $j$  and  $p_j$  is the composite price of sector  $j$ 's output; and  $a_{ij}$  are the input-output coefficients. The term  $\sum (a_{ij} * p_j)$  represents the total value of intermediate inputs used to produce one unit of output in each production sector,  $j$ .

By setting all initial prices to 1, the labour share parameter in each production sector is calculated as

$$\alpha = \frac{L^{1-\rho}}{L^{1-\rho} + K^{1-\rho}}$$

from the observed values of labour and capital in each sector. This parameter measures the labour share in output, given the factor substitution parameter  $\rho$ .

Sadoulet & de Janvry (1995) show that given that profit-maximising firms employ labour until the marginal product value of labour equals the labour wage rate, the actual labour demand in each sector is a derived demand and is calculated

as

$$L = K \left( \left( \frac{w}{pva} * \frac{1}{A\alpha} \right)^{\sigma-1} * \frac{1}{1-\alpha} - \frac{\alpha}{1-\alpha} \right)^{\frac{\sigma}{1-\sigma}}$$

where  $w$  is the labour wage rate;  $pva$  the value added price;  $\sigma$  the labour-capital elasticity of substitution;  $K$  the observed capital;  $A$  the total factor productivity parameter; and  $\alpha$  the labour share in output parameter.

Since the Zambian economy is essentially a surplus labour economy characterised by high unemployment and underemployment, equilibrium in the labour market is attained whenever the demand for labour is satisfied.

Export demand is considered to be exogenously determined because it is determined by demand from the rest of the world. As such, it cannot be determined inside the model. This demand is assumed to be a function of the ratio of domestic prices to the world price. Export demand,  $E$ , is calculated as

$$E = E_0 * \left( \frac{p^d}{e * p^w} \right)^\epsilon$$

where  $E_0$  is the observed value of exports;  $p^d$  is the domestic price;  $e$  the exchange rate;  $p^w$  the world price of exports in foreign currency; and  $\epsilon$  the export constant elasticity of transformation, CET. Thus producers use the ratio of prices to determine how to allocate their production between output for domestic consumption and output for export, as part of their profit maximisation behaviour.

#### 4.4.3.2 Consumption

Consumers maximise their well-being by maximising a utility function subject to their budget constraints. Household utility is maximised by choosing a

feasible bundle of goods and services for each household type. In the model, households are assumed to maximise a Stone-Geary type utility function. This function can be written as

$$u = \prod_{i=1}^n (q_i - c_i)^{b_i}, \text{ with } 0 < b_i < 1, \sum_{i=1}^n b_i = 1, \text{ and } q_i - c_i > 0$$

where  $u$  is utility;  $q_i$  total consumption of good  $i$ ;  $c_i$  subsistence consumption of good  $i$ ; and  $b_i$  marginal budget share of good  $i$  in uncommitted income. In this formulation, the  $c$ 's are interpreted as minimum subsistence quantities below which household consumption cannot fall (Jehle & Reny, 2001; Sadoulet & de Janvry, 1995). The linear expenditure system (LES) demand function for households is obtained from the maximisation of this utility function subject to the budget constraint. The LES is

$$p_i q_i = p_i c_i + b_i \left( y - \sum_j (p_j c_j) \right)$$

where the  $b$ 's and  $q$ 's are as previously defined;  $p_i$  is the price of good  $i$ ; and  $y$  is the consumer's income. The marginal budget shares,  $b_i$ , show how expenditure,  $pq$ , on each commodity changes as income,  $y$ , changes ie  $\delta pq / \delta y$ . The term in brackets is uncommitted or discretionary income which is spent on all consumption goods in the fixed proportions,  $b$ 's.

The total consumption of each commodity,  $q_i$ , is a linear function of total expenditure,  $y$  and prices  $p_j$ . Thus total demand for a particular commodity can be derived from maximising the utility function subject to the budget constraint and solving the first order conditions. The resulting demand function is

$$q_i = c_i + b_i * \frac{(y - \sum (p_j c_j))}{p_i}$$

This expression shows that total consumption of a particular good,  $q_i$ , is made up of the subsistence quantity,  $c_i$ , and the quantity purchased from that commodity's share of uncommitted income. Following Sadoulet & de Janvry (1995), both the parameters  $c_i$  and  $b_i$  are computed from observed values of consumption,  $C_i$ , the income elasticity,  $\eta_i$ , and the Frisch parameter,  $\omega$ , as follows:

$$c_i = C_i \left( 1 + \frac{\eta_i}{\omega} \right)$$

and

$$b_i = \frac{\eta_i * p_i * C_i}{y}$$

respectively.

The Frisch parameter,  $\omega$ , is a measure of the flexibility of money. It is a substitution parameter that measures the sensitivity of the marginal utility of income to income (total expenditures).

Imports are treated as imperfect substitutes for domestic output under the Armington assumption. This is a common treatment of imports in CGE models. The justification for this treatment of imports is that the model cannot be disaggregated so far that only homogenous commodities are represented (Gunning & Keyzer, 1995). It is assumed that consumers consume a composite good made up of domestic output and imported output. This composite good is aggregated using a constant elasticity of substitution function.

In the model imports are calculated as

$$M = (Q - E) * \left( \frac{m}{1 - m} * \frac{p^d}{e * p^w} \right)^{\sigma_m}$$

where  $Q$  is total real domestic output;  $E$  real exports;  $m$  the import share parameter;  $p^d$  domestic output price;  $p^w$  world import price;  $e$  the exchange rate; and  $\sigma_m$  the import elasticity of substitution.

As consumers consume a composite product, it follows that the consumer price is a composite price made up of a combination of the prices of domestic output and imports. The consumer price is calculated as a weighted average of the domestic and world import prices. The quantities of real domestic and imported output in domestic supply are used as the weights. The composite price,  $p^c$ , for each commodity is calculated as

$$p^c = \frac{(Q - E) * p^d + M * p^w * e}{Q - E + M}$$

where all the symbols are as previously defined.

Households finance their consumption of goods and services with income obtained from (i) selling their labour and capital services to firms, (ii) government transfers, (iii) inter-and intra-household type transactions, (iv) dividends from

firms, and (v) transfers from the rest of the world. Income from capital services is assumed to be distributed from firms to households in fixed proportions representing fixed household ownership shares in firms (Ginsburgh & Keyzer, 1997; Sadoulet & de Janvry, 1995; Starr, 1997). This household income is exhausted by expenditure on consumption of goods and services, inter- and intra-household transactions, income tax and savings.

Household welfare is maximised subject to the household budget and output constraints. These constraints ensure that households cannot consume more than the value of their incomes or the total quantity of output available (Ginsburgh & Keyzer, 1997; Sadoulet & de Janvry, 1995).

#### **4.4.3.3 Equilibrium**

Equilibrium in the external sector is achieved by ensuring that the value of imports and the net balance on the capital account are equal to the value of exports and factor incomes from abroad.

The government budget is balanced by changes in government saving or dissaving. The government deficit is funded through borrowing from the capital account which gets most of its funds from the rest of the world.

The goods market attains equilibrium when all excess demand in the goods and services markets is eliminated (Ginsburgh & Keyzer, 1997; Jehle & Reny, 2001; Sadoulet & de Janvry, 1995; Starr, 1997; Varian, 1992). Excess demand is calculated as the difference between real demand and domestic production as a percentage of domestic production. The goods market equilibrium is thus characterised by prices and quantities of goods that eliminate excess demand for all goods simultaneously. The profit-maximising and utility maximising behaviours of producers and consumers respectively ensure that the goods market attains equilibrium.

#### **4.4.4 Summary of model calibration**

The agents' behavioural assumptions imply a competitive environment in which producers make normal profit while consumers maximise their utility by consuming the optimal cost-minimising bundle of goods and services. The production and consumption equations specify the quantities produced and consumed respectively, given production and consumption, income, export, and

import elasticity parameters. The behavioural assumptions of the agents ensure that the model is based on strong microeconomic foundations. Complementing these microeconomic foundations is the fact that the model is based on a SAM, which requires, among other things, that key behavioural and accounting constraints be maintained, which in turn serves as an important check on the “reasonableness” of the model outcomes (Arndt & Lewis, 2000).

## **4.5 Reconstructing the SAM**

### **4.5.1 Introduction**

The model production equations specified above are used to generate the domestic production, export and import quantities. The quantities generated are used in reconstructing the original SAM. The process of reconstructing the original SAM involves redistributing the calculated quantities of domestic production, exports and imports to the various accounts that make up the SAM. This process makes use of parameters derived from the original SAM in addition to the exogenous parameters. The reconstruction of each of the accounts in the SAM is explained below.

### **4.5.2 The commodity accounts**

#### **4.5.2.1 Intermediate input sub-matrix**

The intermediate input values are reconstructed using the calculated total production of each commodity, the input-output coefficient, and its consumer price. Multiplying the total production of each commodity by its consumer price and input-output coefficient allocates the total expenditure of the column sector on the output of the row sector. For example, the calculated total production of the Maize sector at benchmark equilibrium is 866.54. Its consumer price is 1, while its own input-output coefficient is 0.2537. Multiplying these figures gives 219.85, which is the value of Maize intermediate output consumed in the Maize sector. This figure is the same as the figure in the original SAM. All the other figures in the reconstructed intermediate output sub-matrix are calculated similarly. This calculation can be represented as

$$V_{ij} = a_{ij} * Q_j * p_i^c$$

where  $V_{ij}$  is intermediate input from sector  $i$  to sector  $j$ ,  $a_{ij}$  is sectors  $i$  and  $j$ 's input-output coefficient,  $Q_j$  is sector  $j$ 's total output, and  $p_i^c$  is sector  $i$ 's consumer price.

#### 4.5.2.2 The factor-commodity sub-matrix

The factor-commodity sub-matrix figures are calculated by multiplying the calculated total commodity sectoral output by its reproduced price of value added and the factor type's proportion of total factor income from the derived parameters section of the model. This can be formulated as

$$F_{ij} = Q_j * pva_j * f_{ij}$$

where  $F_{ij}$  is the total demand of factor  $i$  used in sector  $j$ ;  $Q_j$  is sector  $j$ 's total output;  $pva_j$  is sector  $j$ 's price of value added; and  $f_{ij}$  is factor  $i$ 's share of factor income in sector  $j$ . Using this formula the value of uneducated labour ( $L_{NONE}$ ) demand in the Maize sector is calculated as 143.39 ( $866.54 * 0.39295 * 0.42111$ ). Applied across all commodities and factors, this formula reproduces the factor demands in all productive sectors.

#### 4.5.2.3 Value added and indirect taxes

The figures in the value added tax and indirect tax/commodity matrix are calculated by multiplying the calculated total production by the consumer price and the derived value added and indirect tax rates respectively. The formulae can be written as

$$VAT_j = Q_j * p_i^c * t_{vat}$$

and

$$IndT_j = Q_j * p_i^c * t_{indt}$$

where  $VAT_j$  and  $IndT_j$  are the value added tax and indirect taxes in sector  $j$  respectively,  $p_i^c$  is the consumer price in sector  $j$ , and  $t_{vat}$  and  $t_{indt}$  are the derived value added and indirect tax rates respectively.

At benchmark equilibrium, the value added tax for the Maize sector, for example, is calculated as 866.54495 multiplied by 1 (consumer price) multiplied by 0.0014 (value added tax rate). The result of this calculation, 1.23, reproduces the figure in the original SAM.

#### 4.5.2.4 Tariffs

Tariff figures are reconstructed by multiplying the domestic value of calculated real imports by the derived tariff rate. The domestic value of calculated real imports is the real imports multiplied by the world price of imports and by the exchange rate.

$$Tm_j = M_j * p_j^w * e * t_m$$

where  $Tm_j$  is the tariff paid in sector  $j$ ;  $M_j$  the real imports in sector  $j$ ;  $p_j^w$  the world price of imports in sector  $j$ ;  $e$  the exchange rate; and  $t_m$  the observed tariff rate.

#### 4.5.2.5 Imports

The values of imports, represented by the ROW row, are reconstructed by multiplying the calculated real imports by their world price and by the exchange rate.

$$M_j = M_j^c * p_j^w * e$$

where  $M_j$  is the value of imports in sector  $j$ ;  $M_j^c$  is the calculated real imports in sector  $j$ ;  $p_j^w$  is the world price of imports; and  $e$  the exchange rate defined in terms of units of domestic currency required to purchase one unit of foreign currency. The sugar ( $C_{SUG}$ ) import value of 24.43, for example, is the result of multiplying the calculated real sugar imports (24.43) by the sugar world price (1) and the exchange rate (1).

Summing up the individual figures down the commodity account columns gives the total commodity expenditure at the benchmark equilibrium. This total expenditure is equal to the total expenditure in the original SAM.

#### 4.5.3 The factor accounts

The factor accounts are reconstructed by redistributing total income earned by each factor in the production of commodities to the various household-types that provide the factors. The redistribution of factor income is based on the household-types' shares of each factor's total income. The household-types' shares which are derived from the original SAM are assumed to be fixed. The formula for this redistribution can be expressed as

$$HH_f^h = Y_f * hh_f^h$$

where  $HH_f^h$  is household  $h$ 's income from factor  $f$ ;  $Y_f$  is factor  $f$ 's total income, and  $hh_f^h$  is household  $h$ 's share of factor  $f$ 's total income.

Application of this formula across all factors by household type generates the households' income from factors. For example, the  $H_{RRS}$  household-type's share of uneducated labour ( $L_{NONE}$ )'s total income is 0.359. Multiplying this share by  $L_{NONE}$ 's total income of 1519.54 (from the  $L_{NONE}$  row total) gives  $H_{RRS}$  household-type's share of  $L_{NONE}$ 's income of 545.7. All the other figures in this section of the SAM are calculated similarly. This procedure equates the row and column totals of the factors. At the benchmark equilibrium, these totals are equal to the corresponding totals in the original SAM.

#### 4.5.4 The household accounts

##### 4.5.4.1 Household commodity consumption

In the SAM, household income is allocated to expenditure on commodities, inter and intra-household transactions, direct taxes to government and to savings. Households receive their incomes from their supply of labour services in the production of commodities. The household expenditure accounts are thus reconstructed by redistributing their incomes onto their spending areas.

Household expenditure on commodities is of a linear expenditure type. This involves the calculation of subsistence consumption and a share of consumption from uncommitted disposable income for each commodity. Uncommitted disposable income excludes household saving, assumed to be in fixed proportions according to observed figures in the original SAM. Household expenditure on each commodity is calculated as

$$p_i q_i = p_i c_i + b_i \left( y - \sum (p_j c_j) \right)$$

where  $p_i$  is the price of commodity  $i$ ,  $c_i$  subsistence consumption quantity of commodity  $i$ ,  $b_i$  the marginal budget share of commodity  $i$  in uncommitted income,  $y$  is disposable income, the summation term is the total value of subsistence consumption of all commodities.

In reconstructing the SAM, subsistence consumption is not recalculated. The subsistence consumption calculated in the parameter derivation part of the model is used. Subsistence consumption was calculated as

$$c_i = q_i \left( 1 + \frac{\eta}{\omega} \right)$$

where as before,  $q_i$  is observed total consumption of commodity  $i$ ,  $\eta$  is the household's income elasticity of demand for good  $i$ , and  $\omega$  is the household flexibility of money parameter.

The share of a commodity in uncommitted income is the uncommitted income multiplied by the commodity's marginal budget share. Dividing this share of income by the commodity's price gives the quantity of the commodity purchased from its share of uncommitted income. Adding this extra quantity to the subsistence quantity gives the total quantity of the commodity consumed by the household. Following this procedure reproduces the household consumption of all commodities. The marginal budget shares are calculated in the derived parameters part of the model.

#### **4.5.4.2 Intra- and inter-household transfers sub-matrix**

The household/household sub-matrix is reconstructed by redistributing total household disposable income according to the inter- and intra-household shares in total household expenditure. The intra- and inter-household shares in expenditure are derived from the observed inter- and intra-household transfer figures in the original SAM and are assumed to be fixed. For example, in the first cell of this sub-matrix, the figure 17.8, which represents  $H_{RRS}$  transfer to  $H_{RRS}$  (intra-household-type transfer), is calculated by multiplying  $H_{RRS}$ 's disposable income by  $H_{RRS}$ 's share of  $H_{RRS}$ 's expenditure (0.014) from the derived parameters section.

#### **4.5.4.3 Household direct (income) tax**

The direct taxes row is reconstructed by multiplying each household-type's total income by the derived direct tax rate. The direct tax rate is calculated as the observed direct tax of a household-type as a proportion of that household-type's total income. The tax rates are assumed to be exogenously determined.

#### 4.5.4.4 Household savings

Households are assumed to save fixed proportions of their incomes. The proportions are determined from the observed savings in the original SAM as a proportion of household disposable income. In the reconstruction of the SAM, household savings are thus calculated as total household disposable income multiplied by the proportion of savings derived from the original SAM. This can be written as

$$S^h = s^h * y^h$$

where  $S^h$  is household savings;  $s^h$  the household saving rate; and  $y^h$  the household disposable income.

Summing the individual entries in each household-type sub-matrices makes up the total household-type income. The reconstructed totals equal the totals in the original SAM.

#### 4.5.5 The enterprise accounts

The enterprises get their income from the redistribution of capital income and from government transfers. To reconstruct the enterprise accounts, total enterprise income is redistributed to the enterprises' spending areas. Enterprise income is exhausted by payments to households, government, tax, and savings. Payments to households, government and savings are all calculated based on their fixed shares of the enterprises' disposable income. The shares are all derived from the observed payments to these institutions in the original SAM. Tax payments on the other hand are calculated as the enterprises total income multiplied by the tax rates. The tax rates are also derived from observed tax payments in the original SAM as a proportion of the enterprises' total income.

Household income from enterprises calculation can be written as

$$HH_{yE}^h = hh_E^h * Y_E * (1 - t_y)$$

where  $hh_E^h$  is household  $h$ 's share of enterprise income,  $Y_E$  is enterprise income, and  $t_y$  is the enterprise income tax rate.

Similarly, government income from enterprises is calculated as

$$G_{yE} = g_E * Y_E * (1 - t_y)$$

where  $g_E$  is government's share of enterprise income, and  $Y_E$  and  $t_y$  are as previously defined.

Income tax is calculated as

$$T_{yE} = Y_E * (1 - t_y)$$

where both  $Y_E$  and  $t_y$  are as previously defined.

Summation of the payments to households, government, savings and tax, exhaust all enterprise incomes. The totals in the reconstructed SAM equal the totals in the original SAM.

#### **4.5.6 The tax accounts**

The tax accounts comprise the direct tax, value added tax, indirect tax and tariff accounts. Direct tax is tax on institutional incomes; value added tax is tax on production; indirect tax is tax on sales of commodities, while the tariff is the tax levied on imported commodities.

All tax flows into the government account. Thus reconstruction of the tax accounts consists of reallocating the total tax take into the government account. The total tax take is simply copied into the government row account.

#### **4.5.7 The government account**

##### **4.5.7.1 Government consumption of goods and services**

Government expenditure is exogenous determined. It is not determined inside the model but rather by government officials. The observed government expenditure in the original SAM is maintained in the reconstructed SAM. The value of government expenditure may change in the simulations because of the changes in the prices of the commodities. Since government expenditure on goods and services in the original SAM is all grouped under the  $C_{PUB}$  commodity, the relevant price is the price of  $C_{PUB}$ . Multiplying the observed government expenditure by the price of this commodity gives total government expenditure on goods and services. Real government expenditure is, however, maintained as in the original SAM.

#### **4.5.7.2 Government transfers to households and enterprises**

As with government consumption of goods and services, government transfers to households and enterprises are simply the observed transfers multiplied by the price of the government commodity  $C_{PUB}$ . This procedure maintains real government transfers at the same level as the observed values.

#### **4.5.7.3 Government transfers to the rest of the world (ROW)**

Government transfer to the ROW is also maintained as in the original SAM but might change in simulations that involve changes in the exchange rate. The observed government transfer to the ROW is multiplied by the exchange rate.

#### **4.5.7.4 Government saving**

Government account is balanced through the saving account. When government payments exceed its receipts, government borrows the shortfall from the savings account. In reconstructing the SAM, government savings are -428.3, at the benchmark equilibrium, indicating that government receipts are less than government payments. The government savings figure is thus the difference between total government receipts (total of the government row) and the sum of the government payments for commodities, payments to households and enterprises, and payments to the rest of the world. This calculation can be expressed as

$$S_G = Y_G - G - GT^{HH} - GT^E - GT^{ROW}$$

where  $Y_G$  is government income,  $G$  is government expenditure on goods and services,  $GT^{HH}$  is government transfers to households,  $GT^E$  is government transfers to enterprises, and  $GT^{ROW}$  is government transfers to the rest of the world.

#### **4.5.8 The ROW account**

The column ROW account represents payments from the rest of the world for exports, and transfer payments to households. This account captures also the foreign borrowing which is represented by the figure in the capital (row) account. Payments by the rest of the world for domestic goods are worked out as the calculated real exports multiplied by the domestic price.

Payments to households are assumed to be exogenous. Thus the observed payments in the original SAM are maintained, but multiplied by the exchange rate. As the exchange rate is set at 1 at the benchmark equilibrium, the reconstructed payments are exactly the same as in the original SAM.

The account is explicitly balanced by subtracting from the total payments to the ROW (row account), the total payments received for exports and transfers to households. The difference goes into the capital account. At the benchmark equilibrium, this difference is 2628.9. Summing up the individual entries in the ROW column account, results in the same total as in the original SAM.

#### **4.5.9 The capital account**

The capital account is reconstructed by redistributing the total amount in the capital account according to observed original productive sectoral proportions. These proportions are assumed to be fixed. In the original SAM the  $C_{CAG}$  and  $C_{CON}$  sectors receive 81.9 and 18.1 per cent of the capital account income respectively. The capital account total in the reconstructed SAM is allocated to the two sectors in these observed proportions.

This reconstruction procedure results in a SAM whose figures are exactly the same as the figures in the original SAM. All the row totals equal the corresponding column totals. Thus the receipts (supply) and expenditures (demand) of the various accounts balance.

The model reproduction process is complete at this stage and the model can be used for carrying out various simulations.

#### **4.6 Price adjustment procedure**

When the benchmark equilibrium is disturbed, commodity prices, which are determined endogenously and are the signals that all agents in the economy react to, change. This leads to changes in demand for labour and therefore changes in sectoral output. To return to equilibrium, the model needs to find a new set of prices that will simultaneously eliminate excess demand for all commodities. The prices therefore need to change until this new set of equilibrium prices is attained. This price adjustment process is accomplished by applying the Newton-Raphson method. The Newton-Raphson method is an iterative process for finding the root of a function. In the model, the method is

used to find the set of prices at which the value of the excess demand function for goods is equal to zero. The application of this method in this model follows that of Sadoulet & de Janvry, (1995). The price vector is adjusted by a quantity  $\Delta p$  proportional to the vector of excess demand  $\Delta ED$ ,  $\Delta p = \alpha * M * \Delta ED$ , where  $M$  is the inverse of the derivatives of excess demands with respect to prices, and  $\alpha$  is a step length found by trial and error. Though the model has 27 sectors, the matrix of inverse derivatives is calculated for 26 sectors only. This procedure takes advantage of Walras' Law that in a market with  $n$  sectors, if  $n-1$  sectors are in equilibrium, then the  $n^{th}$  market must be in equilibrium as well (Fuente, 2000; Jehle & Reny, 2001).

The iterative procedure adjusts the vector of domestic prices by a quantity  $\Delta p$ , ie Domestic Price – ( $\alpha * M * \Delta ED$ ). The resulting vector of prices serves as the input into the next iteration. The process continues until excess demand is equal to zero at which point the term  $\alpha * M * \Delta ED$  is equal to zero. The vector of prices at this point establishes a new commodity equilibrium for the model.

## **4.7 Simulations**

Carrying out simulations on the model involves making changes to one or more exogenous variables connected to the model and letting the model re-establish a new equilibrium in response. When a new equilibrium is found, there will be a new set of prices associated with the new quantities in the SAM. The new equilibrium is the counterfactual equilibrium. The impact of the shock on the variables of interest is found by analysing the differences between the benchmark values of these variables and their counterfactual values.

### **4.7.1 Description of the shocks to be modelled**

Applying a shock to the model involves making changes to exogenous variables that are not determined in the model but affect other variables in the models. Thus shocking the model involves an external shock effecting a change in the value of an exogenous variable which affects the values of some endogenously determined variables. Depending on the directions and severity of these changes the economy is set on different paths with different outcomes in the values of the variables of interest such as the economy's output, output prices, and household incomes and consumption, and household welfare.

In this model the exogenous variables of interest are quantity of labour, the labour wage rate, government expenditure, and tax rates.

#### 4.7.1.1 HIV/AIDS shock on labour

HIV/AIDS affects both the quantity and quality of the labour force. The higher the HIV/AIDS prevalence rate, the higher the morbidity and mortality rates. Higher morbidity reduces the effectiveness of labour while higher mortality reduces the quantity of labour (The World Bank, 2000, 2001a, 2001b, 2001c). The combination of higher morbidity and higher mortality can be modelled as a reduction in the total labour force. In the model, the equilibrium labour force is multiplied by a factor representing the reduction in the “effectiveness” of labour. While higher mortality reduces the actual number of workers, higher morbidity affects the effectiveness of workers through illness, absenteeism, illness-related stress etc (Brown, 2004; Casale & Whiteside, 2006; Commission on HIV/AIDS and Governance in Africa, 2003; Fox et al., 2004; Shisana & Letlape, 2004). For example, due to high HIV/AIDS morbidity, a total workforce of 100 workers may be only as effective as 90 healthy workers. In such a situation the effectiveness factor would be 0.9. Following Cuddington & Hancock (1994), this factor takes into account the general health of the workforce and the workers’ experience. This effectiveness factor is calculated as

$$E_t = \sum (1 - a_{it} * z) * \rho_i * L_{it}$$

where  $L_{it}$  is the number of workers of age  $i$  at time  $t$ ;  $a_{it}$  represents the reduced healthiness of the population due to HIV/AIDS;  $z$  the units of labour lost per AIDS-stricken worker as a result of absence or reduced productivity; and  $\rho_i$  is the productivity of a worker of age  $i$ .

The HIV/AIDS prevalence rate is used as a proxy for the reduced healthiness of the population,  $a_{it}$ , due to AIDS, while the productivity factor,  $\rho_i$  is computed as

$$\rho_i = \rho_1 + \rho_2 (i - 15) - \rho_3 (i - 15)^2$$

with the assumption that a worker’s experience is the worker’s age,  $i$ , minus 15;  $\rho_1 = 0.8$ ,  $\rho_2 = 0.02$ , and  $\rho_3 = -0.0002$  (Cuddington & Hancock, 1994).

As explained above, the effect of the effectiveness factor is to reduce the number of effective workers employed at any time. Equivalently this factor

represents the impact of HIV/AIDS on labour productivity. Several studies, for example (Markus Haacker, 2004; Meintjes, Bowen, & Root, 2007; United Nations, 2004), report this impact as being negative. This effect is the direct impact of HIV/AIDS on the quantity and quality of the labour force. In the absence of HIV/AIDS, one would expect the value of this factor to be 1 ie the entire labour force would be considered effective.

In recent years estimates of the adult HIV/AIDS prevalence rate in Zambia have ranged between 14.5 and 19 per cent. See for example (CSO et al., 2009; MOH & National AIDS Council, 2008). A prevalence rate of 17 per cent is used in the simulations unless stated otherwise.

#### **4.7.1.2 Wage increase shock**

An often cited impact of HIV/AIDS is an increase in the wage rates of surviving workers (Bollinger & Stover, 1999; Bollinger et al., 1999; Wall, 2003). The high mortality rate among the educated and skilled workers is hypothesized to lead to a reduction in the numbers of such workers. The combination of high demand for skilled workers and their scarcity drives their wages up.<sup>29</sup> If, as theory suggests, the increase in wages leads to fewer such workers being employed, it is likely that there is going to be a reduction in output resulting from the use of fewer skilled workers and use of more inexperienced and less skilled workers. The shortage of skilled workers hypothesis is consistent with the hypothesis that individuals will invest less in their human capital accumulation due to reduced life expectancy. According to this hypothesis, individuals faced with a significant reduction in their life expectancy, would choose to invest less time on their human capital accumulation activities because the expected returns from investment in human capital accumulation may not be realised due to reduced life spans (Bonnell, 2000; Brown, 2004; Robert Greener, 2002; Huang et al., 2003; Nathan Associates Inc, 2004). High mortality among the skilled workers will thus gradually lead to a shortage of skilled workers because those

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<sup>29</sup> Despite this being a labour surplus model, there is a shortage of skilled workers which drives the wages of skilled workers up. Arndt & Lewis, 2000, for example, found that unemployment increased among unskilled workers in South Africa as firms spent more on skilled workers. It is also argued that even among unskilled labour, location and task-specific skills gained make it difficult to replace unskilled labour with previously unemployed unskilled labour.

dying will not all be replaced by equally skilled replacement workers. Surviving skilled workers, will therefore, command a higher wage rate due to their scarcity.

The higher wage rate can also be seen as a proxy for increased costs that firms face from HIV/AIDS-related costs. These costs include increased medical costs for workers, funeral costs, and recruitment and training costs (Haacker, 2002a; Muwanga, 2001; Rosen et al., 2004; Vass, 2005). Since all these costs are directly related to firms responding to the impact of HIV/AIDS on their workers, it seems reasonable to model them through increased worker wages/costs.

In the simulations, a 5 per cent increase in wages is assumed unless stated otherwise. This wage increase is assumed because there is no way of disaggregating the various causes of wage increases. The 5 per cent wage increase though assumed seems to be a conservative figure and should therefore be seen as representing a conservative scenario.

A co-worker impact value of 1.25 is assumed in most simulations. This figure implies that 1 infected worker affects the productivity of the equivalent of 0.25 of a worker which also seems to be a conservative assumption.

#### **4.7.1.3 Government expenditure shock**

Government expenditure on HIV/AIDS-related health services is expected to increase as more people access the services. The higher the prevalence rate, the higher the expected cost of HIV/AIDS-related health care services, and the higher government expenditure is expected to be. In the absence of a well developed and affordable private healthcare system, the increasing costs of HIV/AIDS-related health care will increasingly fall on the public healthcare system. In a limited resource setting, such an increase in government expenditure necessitates a reallocation of expenditure from other areas. HIV/AIDS has led to significant government spending on the training of workers to replace dying workers in vital service sectors such as health, education, law and order, and defence (National HIV/AIDS/STI/TB Council, 2004). Thus a significant amount of resources is being expended to maintain current services rather than improve their quality or increase the quantity available. This is a drain on scarce resources that could be used to increase or improve the quantity and quality of services provided by government. The increase in HIV/AIDS-related government expenditure, if financed out of domestic funds, is therefore likely to crowd out other activities

that would have led to possibly more job creation, increased economic growth and other welfare-enhancing activities.

Government expenditure is not, however, disaggregated in the base SAM. It is therefore not possible to evaluate how much non-HIV/AIDS areas are impacted upon by the increase in HIV/AIDS-related expenditure. Regardless, other studies such as Arndt & Lewis (2000), Nathan Associates Inc., (2004) and Shisana & Letlape (2004) have concluded that increases in government HIV/AIDS-related expenditure lead to reductions in other areas of government spending because of the limited availability of government resources, especially in poor countries, unless the increased expenditure is externally funded. It is therefore highly likely that increases in HIV/AIDS-related government expenditure results in reduced economic growth and ultimately reductions in household incomes and welfare.

An increase in government revenue would minimise the re-allocation of expenditure from non-HIV/AIDS areas to HIV/AIDS-related areas and the possible resulting impact on economic growth and household welfare. Government ability to increase its expenditure depends significantly on its ability to generate its revenue domestically, or borrow from other countries. Taxes provide one mechanism for raising government revenue domestically.

In the simulations, a 5 per cent change in government expenditure is assumed. This, like the wage increase, is assumed because there is no way of empirically estimating the change in government expenditure due to the impact of HIV/AIDS from that of other economic factors. The reduction in the tax base and reduction in taxable output due to high mortality and reduced firm output suggest however that the reduction in government revenue due to HIV/AIDS may be significantly greater than the assumed 5 per cent. This figure should therefore also be seen as representing a conservative scenario.

#### **4.7.1.4 Tax shock**

As taxes are exogenously determined, they can be shocked and their impact analysed. Increased income taxes reduce households' disposable incomes, while indirect taxes on goods and services raise those goods and services' prices. Both increases necessarily reduce the quantities of goods and services that households consume. Though increased production taxes increase government

revenue, they also reduce firm profitability and therefore reduce firms' transfers, in the form of dividends, to households. This also reduces household incomes. Taxes, whether levied on household incomes or firms in the form of production taxes, ultimately lead to reductions in household welfare through reduced household purchasing power.

This tax-related welfare change can be estimated by the use of the compensating or equivalent variation measures. As household utility is based on the consumption of goods and services, the compensating and equivalent measures can be used to assess the impact of the tax-induced changes in household incomes. One would expect that as taxes reduce household incomes, and therefore household consumption, household utility would decrease as taxes were increased. The compensating and equivalent variations in this case would theoretically be negative.

#### **4.7.2 Summary of scenarios considered**

Each of the shocks discussed has been shown to have a clear and direct link to HIV/AIDS. This satisfies the requirement for transparency of links between shock variables and the phenomenon being modelled.

The impacts can be modelled singly and or in combination with each other. It is unlikely, however, that only one of the impacts will be operating at any given point in time. It is more likely that there will be a combination of a number of shocks impacting the economy at any given time. Scenarios with combinations of shocks form more realistic scenarios than single shock scenarios.

However, the single shock scenarios are useful for simulating the impact of a particular shock in the absence of other shocks. This provides the ability to test particular hypotheses about the impacts of particular shocks. Such testing may highlight the seriousness or lack of, of the various shocks and therefore suggest which ones have more detrimental effects on the economy and household welfare. Such knowledge is beneficial in designing impact mitigation policies.

#### **4.7.3 Conclusion**

This section has described the procedure for reconstructing the original SAM. This is a vital step in the calibration of the model. Successful reproduction of the benchmark figures means there has been a successful replication of the

process that generated the original figures. It is precisely the identification of such a process that the modelling takes advantage of during simulations. The modelling proceeds under the assumption that the process that generated the original figures would still be operating. The simulations, therefore, represent the figures that the original process would have generated given the new conditions represented by the shocks applied to the model.

Shocks to the economy change the signals that economic agents respond to. Prices represent these signals in competitive markets. As prices change, economic agents change their decisions be they production or consumption decisions. The economy moves away from its initial equilibrium and settles at a new one with a new set of prices and new set of production and consumption quantities. The price adjustment process described above ensures that a new set of equilibrium prices is attained after the model has been shocked. Achieving a new equilibrium enables the carrying out of comparative statics analyses. Such analyses enable comparison of the two equilibrium positions in terms of production and consumption decisions. Household welfare can be computed at the two equilibrium points and compared, thus enabling evaluation of the impact of the shocks on households.

That the model is able to reproduce the original figures and be able to re-attain equilibrium after an initial shock completes the model development.



## **Chapter 5 Macroeconomic Impacts of the HIV/AIDS Epidemic on the Zambian Economy**

### **5.1 Introduction**

The HIV/AIDS impact on the quantity and quality of labour is expected to manifest itself in lower economic output at the macro level, especially in high prevalence countries. Loss of significant numbers of skilled workers to HIV/AIDS morbidity and mortality deprives producers of their most productive workers leading to reduced productivity as these workers are replaced by less skilled workers.

In the long-term, high mortality levels among skilled and experienced workers, coupled with reduced incentives among the young to invest much time accumulating human capital, due to fewer employment opportunities and reduced life expectancy, can be expected to reduce the levels of both skill and experience in the workforce. The threat to future economic growth and development prospects is a very real one under such conditions. Such conditions exist in Zambia where it has been shown earlier that HIV/AIDS prevalence is high among the educated and wealthy who also make up most of the skilled labour and saving proportion of the population. On average, about 265 people die of HIV/AIDS-related causes each day in Zambia (MOH & National AIDS Council, 2008). With no cure available, and ARVs not available to everyone who needs them, the current high morbidity and mortality rates can be expected to continue well into the future.<sup>30</sup> The adverse impacts of the HIV/AIDS epidemic will therefore be felt in Zambia for many years yet.

This chapter deals with the impact of various HIV/AIDS-related shocks on selected macroeconomic variables or indicators of the Zambia economy. The indicators selected are gross domestic product (GDP), investment, and the trade deficit.

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<sup>30</sup> The (MOH & National AIDS Council, 2008), report shows that 37 per cent of those requiring ARVs were estimated to be receiving them at the end of 2007.

## **5.2 The selected indicators**

### **5.2.1 The gross domestic product (GDP) indicator**

GDP measures the total market value of the output of a given economy over a specified period of time, typically over a year. It is thus a good indicator of whether an economy is growing or not. As a growing economy is a necessary condition for the improvement in the well-being of the majority of a growing population, it is a pre-requisite for economic development. A measure of the impact of HIV/AIDS on GDP thus gives an indication of whether despite the impact of HIV/AIDS, the economy is growing at a sufficiently high rate to be able to meet the economic needs of an increasing population.

GDP growth is influenced by among other factors, the productivity of the factors of production, both human and physical capital, production costs, and effective demand for the economy's output.

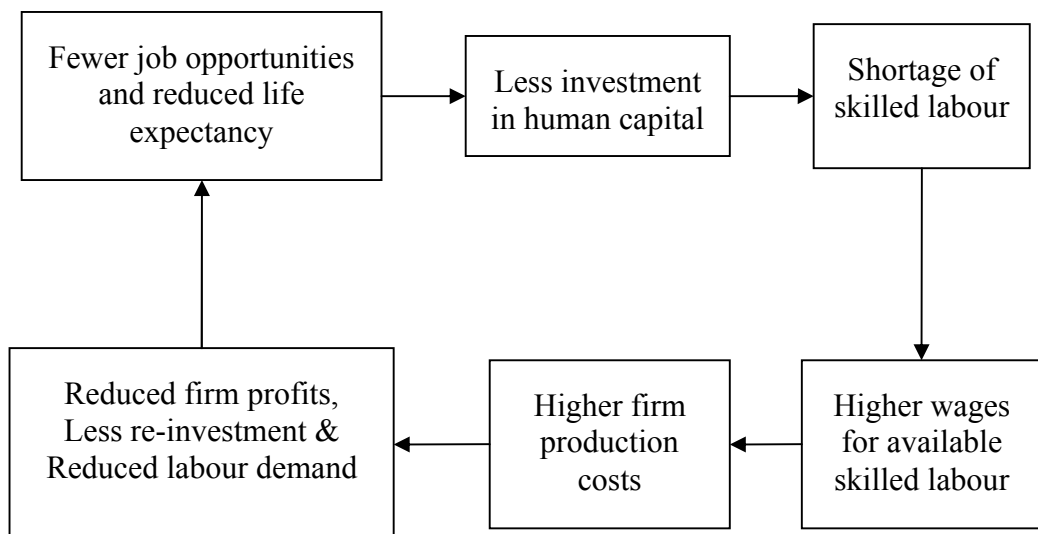
HIV/AIDS has been shown to affect the productivity of labour due to high morbidity and mortality among infected workers. The loss of unskilled labour does not pose a serious problem to employers due to the existence of a large surplus of unemployed unskilled labour. However, to the extent that HIV/AIDS affects skilled and experienced workers that complement physical capital, it reduces total factor productivity. The productivity of capital is reduced because of the reduced effectiveness of the labour that complements it. As technology advances, skilled workers become increasingly more important in production processes to manage, control, and maintain the increasingly more sophisticated physical capital. HIV/AIDS morbidity and mortality among skilled workers adversely affects this vital link between skilled labour and advancing technology by reducing the available quantity and quality of labour.

By creating a shortage of skilled labour, HIV/AIDS indirectly affects the level of physical capital growth in the economy. Due to the uncertainty in availability of skilled workers, investors are less likely to invest in new technology or expand existing operations. This might lead to an economy with less than the most efficient technologies available to it. Loss of competitiveness in world markets would most likely result when such an economy with outdated production technologies tried to compete against economies utilising newer and better production technologies (Bollinger, 2002). In this way, HIV/AIDS

adversely affects both human and physical capital, reducing their productivity, separately and jointly.

Production costs affect levels of output especially in competitive markets where price cannot easily be raised to cover rising costs. The literature suggests that HIV/AIDS increases production costs for most producers through increased labour-related costs. See, for example, (Bloom, Mahal, & River Path Associates, 2001; Forsythe, 2002; Luboobi & Mugisha, 2005; Muwanga, 2001; Rosen et al., 2004; The World Bank, 2001a; UNAIDS, 2001; UNFPA, 2003; Vass, 2005; Wobst & Arndt, 2004). In addition to the direct labour costs of medical treatment, funerals, recruitment and training, HIV/AIDS indirectly raises labour costs by increasing the wages of available skilled labour (BIDPA, 2000; CHGA, 2003; Haacker, 2002a; Kambou et al., 1992). The competition for skilled workers makes their wages higher than they would be in the absence of the HIV/AIDS-induced skilled labour shortage. Higher production costs, in the absence of offsetting price increases, lead to reduced firm profits and reduced incentives to re-invest or expand firm operations. Firms are therefore less likely to expand and create more job opportunities for the increasing population. The combination of reduced job opportunities and reduced life expectancy provide a strong disincentive for investment in human capital accumulation among young people (CHGA, 2003). This has the potential to create a vicious self-reinforcing cycle. Figure 1 below shows how this cycle might arise.

**Figure 10. Self-Reinforcing Vicious Cycle of HIV/AIDS Impact on Labour.**



This cycle has the potential, over the long-term, to diminish the skill level in the workforce primarily due to insufficient job opportunities combined with

reduced individual incentives to invest in accumulation of human capital. With an increasing population, there is need for the economy to keep growing in order to create more jobs for the new workers and produce enough output to cater for the expected increase in the demand for goods and services. The sequence outlined in Figure 10 reduces both the abilities of the economy to create more jobs and to produce more output to cater for increasing workers and consumers respectively. Thus control over production costs in competitive markets has significant implications for firm job creation and level of output. The HIV/AIDS' adverse impact on production costs thus threatens both job creation and availability of sufficient output to sustain growing populations in high prevalence countries like Zambia.

While Zambia's population is still increasing, albeit at a reduced rate, the impact of HIV/AIDS on household incomes suggests that most affected households are getting poorer due to the loss of prime-age working adults. Other households, on the other hand, are getting poorer too due to other factors such as loss of jobs as firms respond to increased production costs and reduced demand for their output. Increased dependency, as the number of orphaned children increases, is increasing effective family sizes and contributing to the impoverishment of households.

As households get poorer, effective demand for goods and services decreases. This effectively constitutes a reduction in potential domestic and regional markets for firms in the high prevalence Sub-Saharan African region. With shrinking domestic and regional markets for their output, firms are unlikely to expand their production or increase their employee numbers. Reduced effective demand thus contributes to reduced investment and reduced job creation. This reduced effective demand exacerbates the reduction in profits, reduced demand for labour and less re-investment part of the sequence in Figure 10.

Therefore, the impact of HIV/AIDS on GDP is clearly an adverse one under such conditions.

### **5.2.2 The investment indicator**

Although the model used in the simulations is a static one and investment has therefore no impact on output levels during the simulation period, the investment indicator was chosen because investment has important implications

for future economic growth. The level of savings after the simulation period indicates the expected level of resources available for investment in the following period. High levels of savings available for investment provide an indication that the economy is likely to grow because of the availability of investment resources. More output and increased job creation become realistic possibilities under such conditions. Thus the investment indicator gives a good indication of future growth prospects from the outcomes of current economic conditions.

Conceptually, HIV/AIDS affects investment through its effect on institutional savings. It is possible that HIV/AIDS might cause households to increase their savings as a precautionary measure should they need increased resources to mitigate its impact if the need arose. This scenario is highly unrealistic under prevailing conditions in Zambian households. Saving rates among Zambian households are extremely low and almost non-existent among the majority of rural households. Table 10 shows that benchmark savings rates are below 0.5 per cent of total income for all but one of the rural household types. Urban households fare no better with saving rates between 0.96 and 2.40 per cent of their total incomes.

**Table 10 Savings Rates among Zambian Households**

<b>Household type</b>	<b>Income (ZK bn)</b>	<b>Savings (ZK bn)</b>	<b>Savings Rate (%)</b>
H <sub>RRS</sub>	1279.6	1.5	0.12
H <sub>RRM</sub>	100.0	0.1	0.12
H <sub>RRN</sub>	140.6	0.3	0.24
H <sub>RS</sub>	1592.9	2.5	0.16
H <sub>RM</sub>	168.8	0.3	0.17
H <sub>RL</sub>	143.4	1.6	1.15
H <sub>RN</sub>	348.3	1.7	0.48
H <sub>USE</sub>	2763.8	26.4	0.96
H <sub>UPR</sub>	1522.7	20.4	1.34
H <sub>UPU</sub>	2798.6	33.3	1.19
H <sub>UEM</sub>	1113.3	26.7	2.40

Source: Calculated from the SAM (Thurlow et al., 2004)

Given increasing poverty levels, it is unlikely that many Zambian households would be increasing their precautionary savings. A more realistic

scenario is one where households draw on their savings to satisfy their increasing current expenditure needs. In this scenario, household savings decrease over time and reduce the amount available for productive investment. This argument has been made by numerous studies, for example, (Barnett & Whiteside, 2002; Brown, 2004; Casale & Whiteside, 2006; CHGA, 2003; Corrigan et al., 2005; Luboobi & Mugisha, 2005; Petty et al., 2004; Seaman, Petty, & Narangui, 2004; Shisana & Letlape, 2004; Whiteside, 2002).

Faced with reduced profits, due to reduced revenues and increased costs, firms are unlikely to be increasing their savings either (R. Baggaley et al., 1994; Connelly & Rosen, 2005; Forsythe, 2002; Rosen et al., 2004).

It is difficult to envisage government increasing its savings when it is faced with decreasing tax revenues but increased demand for public services. The only source of investment resources left is borrowing from the rest of the world. In the absence of resources from the rest of the world, prospects for economic growth are almost non-existent due to the dearth of domestic savings.

Whether available resources are sufficient to increase the physical capital and increase the capital-labour ratio in an economy crucially depends on the domestic savings rate, and on both the population growth and the capital depreciation rates. Zambia has a very low capital-labour ratio. Its savings rate is very low, as shown above. Its population is still increasing at a relatively high rate. Under such conditions, the prospects of an increased capital-labour ratio derived from Zambia's own resources are practically non-existent, unless savings were to increase to unprecedented high levels. This implies that Zambia is not in a position to increase domestic investment and create employment opportunities for its growing population using its own resources.

### **5.2.3 The trade deficit indicator**

The trade deficit was chosen as an indicator of how HIV/AIDS affects Zambia's performance in its economic interactions with the rest of the world. International trade has long been touted as an engine for economic growth because of its ability to serve as both an outlet for increased output, and as a source of inputs and new production technology.

However, the ability of international trade to serve this role is greatly diminished when a country is unable to produce or sell enough exports to pay for

its imports. HIV/AIDS potentially can affect both the ability to produce enough for export and the ability to compete effectively on world markets because it raises production costs that erode price competitiveness.

The trade deficit shows the shortfall in export earnings relative to payments for imports. It therefore is a good indicator of an economy's ability to pay for its imports. An increasing trade deficit becomes an indication that the economy is not producing or selling enough to pay for its imports. If imports are important inputs into productive processes, an inability to pay for them leads to reductions in domestic production and demand for domestic labour. The resulting output shortages could trigger the following potentially welfare-reducing sequence of events - increased domestic prices → reduced demand for output → reduced profit → reduced demand for labour → lower household incomes → reduced household welfare.

The trade deficit is therefore an important indicator that captures an economy's interactions with the rest of the world. These interactions, for many developing countries like Zambia, have important domestic welfare implications.

### **5.3 Results and discussion of simulation outcomes**

This section presents and discusses the results of the impact of HIV/AIDS and HIV/AIDS-induced shocks on the three macroeconomic indicators discussed above. Three shocks, the HIV/AIDS prevalence shock, the wage increase shock and the government expenditure reduction shock, are used in the simulations. As discussed previously, the prevalence shock assumes a 17 per cent prevalence rate, the wage increase shock a 5 per cent increase in wages, and the government expenditure reduction shock a 5 per cent reduction in government expenditure. Unless stated, results involving the prevalence shock assume a 1.25 co-worker impact value.

#### **5.3.1 HIV/AIDS impact on GDP**

A reduction in the quantity of labour employed lowers total output because of the reduction in factor value added that is combined with intermediate inputs to produce the final product. Table 11 shows the changes in the selected macro indicators as a result of the HIV/AIDS impact on the quantity and quality of labour.

**Table 11 The Impact of HIV/AIDS on Selected Macro-Indicators**

<b>Macro Indicators</b>	<b>% change with co-worker values of</b>		
	<b>1.25</b>	<b>1.5</b>	<b>2</b>
Real GDP	-6.83	-8.46	-12.09
Investment	-32.06	-40.88	-62.03
Trade Deficit	-35.26	-43.70	-62.43

Table 11 shows that GDP decreases by between 6 and 12 per cent as a result of the HIV/AIDS impact on the quantity and quality of labour. The larger the assumed co-worker value, the larger the decrease in GDP. Even without the co-worker impact, the change in GDP is still substantial at -6.42 per cent. These reductions in GDP arise because as labour is reduced, there is less value-added to combine with intermediate inputs to produce the final output. Reduced labour leads to reduction in firm output in all sectors of the economy as shown in Table 12. As all sectors of the economy experience reductions in the quantity and quality of their labour, their output falls and leads to a net reduction in GDP. As expected, the decrease in output is least in the capital-intensive mining sector compared to the labour-intensive agricultural, manufacturing and service sub-sectors.

**Table 12 HIV/AIDS Impact on Sectoral Output – 17% Prevalence Scenario**

Sector	Commodity	% Change with co-worker values of		
		1.25	1.5	2
Agriculture	C <sub>MAI</sub>	-5.54	-6.77	-9.35
	C <sub>STA</sub>	-3.95	-4.85	-6.78
	C <sub>GNT</sub>	-4.67	-5.70	-7.86
	C <sub>SUG</sub>	-7.57	-9.46	-13.72
	C <sub>COT</sub>	-6.75	-8.40	-12.11
	C <sub>TOB</sub>	-7.66	-9.50	-13.58
	C <sub>COF</sub>	-6.38	-7.96	-11.51
	C <sub>WHE</sub>	-8.37	-10.34	-14.66
	C <sub>HCR</sub>	-6.19	-7.66	-10.91
	C <sub>OCR</sub>	-5.23	-6.46	-9.13
	C <sub>LIV</sub>	-5.32	-6.50	-8.98
	C <sub>FIS</sub>	-6.23	-7.68	-10.84
	C <sub>FOY</sub>	-6.48	-8.04	-11.50
Mining	C <sub>MIN</sub>	-0.99	-1.25	-1.86
Manufacturing	C <sub>FBT</sub>	-6.59	-8.13	-11.49
	C <sub>TAG</sub>	-5.95	-7.36	-10.49
	C <sub>WAF</sub>	-7.41	-9.17	-13.08
	C <sub>FER</sub>	-6.73	-8.29	-11.67
	C <sub>OMA</sub>	-3.82	-4.85	-7.25
	C <sub>EAW</sub>	-2.08	-2.66	-4.06
	C <sub>CAG</sub>	-23.99	-29.81	-42.94
	C <sub>CON</sub>	-18.08	-22.50	-32.48
Services	C <sub>TSV</sub>	-8.30	-10.29	-14.74
	C <sub>TOU</sub>	-4.26	-5.26	-7.45
	C <sub>SER</sub>	-6.33	-7.85	-11.22
	C <sub>FIN</sub>	-6.89	-8.53	-12.19
	C <sub>PUB</sub>	-8.81	-10.91	-15.57

As all producing sectors' output decreases in response to the decrease in labour, it follows that the construction and capital goods sectors would experience the most changes in their output because of their extensive direct and indirect links with all other sectors in the economy.

Table 12 shows that these two sectors experience the largest changes in output of 18 and 24 per cent respectively, in the first scenario. These changes are by far the largest changes in output experienced by any of the productive sectors. The overall result of a decrease in total GDP in Table 11 is consistent with the finding of output decreases in all sectors as shown in Table 12.

### 5.3.2 Impact of Wage and Government expenditure shocks on GDP

Other HIV/AIDS-related shocks to the economy are changes in labour wages and changes in government expenditure. Wages, especially of skilled labour, tend to increase as the scarcity of skilled labour increases. HIV/AIDS prevalence has been shown to be higher among the well-educated and skilled in Zambia (CSO et al., 2009). It is therefore reasonable to assume also that HIV/AIDS-related mortality will be high among the educated and skilled workers. These factors will tend to lead to increased competition for the available skilled labour and an increase in its wages. The increase in wages, however, leads to a reduction in firms' demand for labour. Competitive firms will employ labour until its marginal value product equals its wage. With competitive product markets, it may not be possible to raise prices to compensate for increased labour costs. Without increased productivity, the higher wages paid to skilled workers reduce firms' profitability. The increases in wages of skilled labour therefore lead to reductions in the demand for semi-skilled and unskilled labour as firms respond to reduced profits. The total quantity of labour employed thus decreases as higher wages are paid to skilled labour. Simulation results of changes in labour demand as wages increase are shown in Table 13.

The simulation results show that there are significant labour changes associated with increases in wages.

**Table 13 Effect of Wage Increases on Demand for Labour**

<b>Wage Increase (%)</b>	<b>Change In Labour Demand (%)</b>
5	-3.7
10	-7.1
15	-10.3
20	-13.2

The significant decreases in firms' labour demand reduce the quantity of labour that can be combined with capital. This reduces the factor value added that can be combined with intermediate inputs to produce the final output. As a result, total output decreases when firm labour demand decreases.

Government expenditure, which includes government consumption of goods and services, and transfers to households and firms, has an impact on both production of goods and services and overall demand for goods and services. Transfers to firms help reduce costs to firms thus enabling them to produce more. Transfers to households, on the other hand, increase household incomes and households' ability to demand more goods and services. A reduction in these transfers should, theoretically, adversely affect both output production and output demand. The quantity of goods and services demanded and consumed by government can also be expected to decrease as government expenditure is reduced.

**Table 14 Impact of Changes in Government Expenditure – Various Government Expenditure Scenarios**

<b>Change in government expenditure (%)</b>	<b>Change in household transfers (%)</b>	<b>Change in household incomes (%)</b>	<b>Change in transfers to firms (%)</b>	<b>Change in firm incomes (%)</b>
-5	-1.02	-0.04	-1.02	-0.02
-10	-2.02	-0.07	-2.02	-0.03
-15	-3.01	-0.11	-3.01	-0.05
-20	-4.00	-0.15	-4.00	-0.07

Table 14 shows the changes in household and firm transfers associated with different changes in government expenditure. Reductions in government expenditure result in household and firm transfer reductions that are proportional to the reductions in government expenditure. In all simulations the changes in the transfers are approximately 20 per cent of the percentage reductions in government expenditure. Thus a 5 per cent reduction in government expenditure results in a 1.02 per cent reduction in government transfers to both households and firms.

The simulation results show also that government transfers have a very small impact on household incomes because the transfers make up a very small proportion of household incomes. At benchmark equilibrium, government transfers to households make up 3.78 per cent of total household incomes. After a 5 per cent reduction in government expenditure this percentage falls by 0.04 percentage points to 3.74 per cent. The very small percentage changes in household and firm incomes in response to changes in government expenditure show that government transfers do not contribute much to household demand for goods and services or to firms' decisions on output levels. The third and fifth columns of Table 14 show the changes in households and firm incomes respectively for the different percentage decreases in government expenditure. The results in these columns support the assertion that government transfers are a very small proportion of household and firm total incomes and have minimal impact on household consumption and firm output decisions.

### **5.3.3 Impact of the combined shock on GDP**

A combination of the HIV/AIDS prevalence, wage, and government expenditure shocks is expected to produce a larger negative impact on real output than that produced by each of the shocks applied separately. This result stems from the fact that each of the shocks has a negative impact on real output when applied separately. Combining the shocks should therefore amplify their combined effect on output. The magnitude of their combined impact is thus expected to be larger than that of their separate individual impacts. Because of the presence of interactions among the various institutions in the model, the combined effect of a number of shocks may be greater or less than the sum of the individual shocks' effects.

Table 15 shows the impacts of each of the three shocks as well as that of the combined shock. The combined shock is made up of the 17 per cent HIV/AIDS prevalence shock, a 5 per cent wage increase shock and a 5 per cent government expenditure reduction shock.

Compared with the result of the output change due to reduction in government expenditure, the impact of the wage shock is considerably larger. The wage increase shock results in a 1.73 per cent decrease in output. This result is attributed to the 3.7 per cent reduction in labour demand by firms, shown in

Table 13. This sizeable decrease in labour demand can be expected to lead to a sizeable decrease in output in the absence of increases in physical capital to compensate for the loss of labour in production.

**Table 15 Percentage Changes in Selected Macroeconomic Indicators by Shock**

<b>Indicator</b>	<b>HIV/AIDS Shock</b>	<b>Wage Shock</b>	<b>G Exp Shock</b>	<b>Combined Shock</b>
Real GDP	-6.83	-1.73	-0.27	-8.84
Investment	-32.06	-8.71	7.98	-34.09
Trade Deficit	-35.26	-10.17	3.51	-41.75

The combined shock elicits a larger decrease in output compared to each of the separate shocks. The results, however, show that the HIV/AIDS labour shock contributes the largest impact to the combined effect on output. Government expenditure reduction has the least impact on changes in output. Of the selected indicators in Table 15, real GDP is the only indicator for which all the three shocks have the same direction of impact. While the labour and wage shocks have the same sign for all the three indicators, government expenditure has positive impacts on all but the real GDP indicator.

#### **5.3.4 Impact of the combined shock on investment**

The negative impact on investment is considerable despite the substantial positive effect of the reduction in government expenditure shock. The much larger HIV/AIDS and wage shock effects dominate the positive government expenditure effect resulting in the 34 per cent reduction in investment in Table 15. Though this reduction in investment does not affect production decisions during the simulation period, it is clear that it will significantly affect both future production capability and future consumption possibilities. Over-time, the reduction in available investment resources slows down growth in the capital-labour ratio. This is especially so in Zambia given its relatively high population growth rate. The possibility of the capital-labour ratio declining in Zambia given such high decreases in investment resources is high. Real output decreases per worker are likely to result. The resulting decrease in worker productivity will inevitably affect the well-being of workers and their households through

reductions in their incomes and ability to afford welfare-enhancing consumption goods and services. So while the change in investment does not have immediate consequences on output, both its medium and long-term effects are potentially welfare-decreasing.

Also affecting the level of future investment, as noted in the introduction, is the effect of the reduced productivity of labour. As labour productivity decreases, it adversely affects the productivity of physical capital. This results in a reduction in the return to capital. The reduced return to capital in turn discourages re-investment or new investment in the economy. The level of investment and its growth can thus be reduced by the indirect impact of the productivity of labour. As HIV/AIDS reduces labour productivity, we can expect that the productivity of capital will also decrease in high HIV/AIDS prevalence countries. The resulting decreases in returns to capital discourage re-investment and new investment. Consequently the stock of capital will decline over time and adversely affect levels of production as the capital-labour ratio deteriorates. This is a very realistic scenario for Zambia given the heavy toll HIV/AIDS is having on labour and Zambia's relatively high population growth rate.

### **5.3.5 Impact of the combined shock on the trade deficit**

The trade deficit decreases when the three shocks are combined. As for investment, the HIV/AIDS and wage shocks reinforce each other with their negative effects while the government expenditure shock has a comparatively small positive effect. The overall impact of the combined shock is a 42 per cent decrease in the trade deficit. The HIV/AIDS and wage shocks, by reducing the demand for labour and reducing household incomes contribute to the reduction in household consumption of goods, including imported ones. Imports decrease by an overall 3.73 per cent compared to an export decrease of 0.06 per cent when wages increase by 5 per cent.

Table 16 shows the changes in exports and imports and the trade balance associated with each of the three shocks and the combined shock.

**Table 16 Changes in Exports, Imports and the Trade Deficit by Shock**

Shock	Change in Exports (%)	Change in Imports (%)	Change in Trade Deficit (%)
HIV/AIDS	-0.23	-12.95	-35.26
Wage	-0.06	-3.73	-10.17
Govt expenditure	-0.01	1.27	3.51
Combined shock	-0.24	-11.61	-41.75

For both the HIV/AIDS and wage shocks, the decrease in imports far exceeds the corresponding decrease in exports. As a result, the two shocks lead to reductions in the trade deficit. In contrast, the government expenditure shock leads to a slight decrease in exports but a relatively larger increase in imports. This results in deterioration of the trade deficit by 3.51 per cent. The combined shock, however, shows that the HIV/AIDS and wage effects dominate the government expenditure effect. With the combined effect, exports decline by 0.24 per cent while imports decline by a much larger 11.61 per cent leading to a significant reduction in the trade deficit of almost 42 per cent.

While these results may be desirable from the perspective of preventing foreign exchange crises due to import values exceeding export values, they may not be desirable from the microeconomic perspective of the welfare of households. The trade deficit decreases because of the significant reduction in domestic consumption, including consumption of imported goods and services. It must therefore be the case that household welfare, which is dependent on the consumption of goods and services, is decreasing as the trade deficit decreases.

The decrease in imports can become an impediment to development efforts if it leads to shortages of essential physical capital and access to newer and better production technologies. Less investment and reduced job creation can result, yet the population is increasing. Lack of job opportunities can lead to other socio-economic problems that reduce households' welfare. For technology-poor countries like Zambia, ability to pay for imports is vital to ensure the continued availability of imported intermediate inputs, and newer production technologies. A phenomenon, such as the HIV/AIDS epidemic, that serves to reduce access to imports, and thus development tools, is an impediment to both economic growth and development. Economic growth can be retarded also by reduced domestic

consumption which leads to smaller domestic markets which, in turn, hinder expansion of domestic industry. Without an adequate outlet for increased domestic production, there is no incentive for domestic producers to increase their levels of output or employ more labour.

The deficit in the current account, as shown in Table 15, improves as a result of the three shocks with the labour and wage shocks reinforcing each other and dominating the opposing effect of the government expenditure shock. The current account improves because of the significant improvement in the trade balance brought about by the significantly larger decreases in imports and relatively smaller decreases in exports.

The results in Table 16 are useful for testing the hypothesis that HIV/AIDS has a significant impact on an economy's external sector activity. The reduction in absorption results from reductions in private consumption, investment and government expenditure on goods and services. The second and third columns show that both exports and imports are also adversely affected. The net result is that all the components that make up national income are adversely affected by the effects of HIV/AIDS. From these results one can conclude that for Zambia, and possibly other high prevalence countries, HIV/AIDS has a significant negative impact not only on domestic sector economic activity but also on the external sector activity.

**Table 17 HIV/AIDS Impact on Exports and Imports**

	<b>Total Exports (ZK bn)</b>	<b>Total Imports (ZK bn)</b>
Benchmark	3759.6	5901.9
Simulation	3748.4	4996.3
% Δ	-0.30%	-15.34%

Though simulated total exports fall by 0.3 per cent from their benchmark value, imports decrease by a much larger 15.3 per cent as shown in Table 17. Overall the exports and imports decrease by a total of 9.5 per cent from their benchmark total. The figures in Table 17 show that in Zambia's case, HIV/AIDS affects the import sector significantly more than it affects the export sector. It is this difference that accounts for the improvement in the trade deficit. For Zambia,

the hypothesis that HIV/AIDS has a significant impact on the external sector of the economy is thus supported by the results in Table 17.

### 5.3.6 Impact of the combined shock on sectoral output

**Table 18 Sectoral Percentage Output Changes by Scenario**

<b>Commodity</b>	<b>HIV/AIDS (1.25)</b>	<b>Wage (+5%)</b>	<b>Govt Exp (-5%)</b>	<b>Combined Shock</b>
C <sub>MAI</sub>	-5.54	-1.14	-0.43	-7.14
C <sub>STA</sub>	-3.95	-0.92	-0.32	-5.21
C <sub>GNT</sub>	-4.67	-1.25	-0.22	-5.98
C <sub>SUG</sub>	-7.57	-0.74	-0.03	-8.42
C <sub>COT</sub>	-6.75	-1.38	-0.15	-8.21
C <sub>TOB</sub>	-7.66	-1.62	-0.19	-9.33
C <sub>COF</sub>	-6.38	-2.34	-0.21	-8.68
C <sub>WHE</sub>	-8.37	-1.76	-0.36	-10.40
C <sub>HCR</sub>	-6.19	-1.91	-0.29	-8.24
C <sub>OCR</sub>	-5.23	-1.52	-0.35	-7.05
C <sub>LIV</sub>	-5.32	-1.04	-0.37	-6.73
C <sub>FIS</sub>	-6.23	-1.49	-0.43	-8.16
C <sub>FOY</sub>	-6.48	-1.47	-0.05	-8.05
C <sub>MIN</sub>	-0.99	-0.1	0.00	-1.12
C <sub>FBT</sub>	-6.59	-1.61	-0.44	-8.64
C <sub>TAG</sub>	-5.95	-1.3	-0.19	-7.51
C <sub>WAF</sub>	-7.41	-1.56	-0.34	-9.40
C <sub>FER</sub>	-6.73	-1.42	-0.17	-8.29
C <sub>OMA</sub>	-3.82	-0.71	-0.03	-4.84
C <sub>EAW</sub>	-2.08	-0.31	-0.06	-2.60
C <sub>CAG</sub>	-23.99	-6.89	3.24	-27.35
C <sub>CON</sub>	-18.08	-5.02	0.84	-22.35
C <sub>TSV</sub>	-8.30	-2.14	0.32	-10.12
C <sub>TOU</sub>	-4.26	-2.04	0.02	-6.22
C <sub>SER</sub>	-6.33	-1.66	0.05	-7.92
C <sub>FIN</sub>	-6.89	-1.68	-0.02	-8.62
C <sub>PUB</sub>	-8.81	-2.32	-3.74	-15.01

The impact of the combined shock on sectoral output reflects the magnitudes of the impacts of the individual shocks. For all but a few sectors, all three shocks have negative impacts on output, with the HIV/AIDS labour and wage shocks having relatively larger effects than the government expenditure

shock. Table 18 shows the individual and combined shock impacts on output in each of the sub-sectors in the model.

Other than the mining sector which is not significantly affected by any of the three shocks, all other sub-sectors suffer output decreases ranging from 2.6 per cent in the electricity and water sub-sector to 27.4 in the capital goods sub-sector. The majority of sub-sectors, 20 out of 27, experience output decreases between 6 and 10 per cent. Given that the scenarios presented here are the conservative impact scenarios, the changes in output are rather substantial.

This simulation shows that all productive sectors of the Zambian economy are significantly affected by HIV/AIDS. The capital-intensive mining sector suffers the least in percentage terms. However, given the large size of the mining sector, the impact in absolute terms would be enormous and have large negative impacts on many households. The result that HIV/AIDS causes all sectors of the economy to contract has serious implications for efforts to mitigate the loss in output. Unlike other shocks, like droughts for example, that might adversely affect some sectors of the economy without much impact on others, HIV/AIDS affects all sectors at the same time. The HIV/AIDS impacts are felt throughout the economy and diminish the ability of some sectors making up for output losses in other sectors.

The impact of such output decreases in all sectors of the economy would inevitably result in reduced demand for labour by firms and, subsequently, loss of labour income by many households. With the interconnectedness of firms in general equilibrium models, reduced demand for inputs and output in some sub-sectors leads to reduced demand for inputs in other sub-sectors as well. The transmission of impacts among firms results in higher order impacts which would have been neglected in a partial equilibrium model. It is primarily because of the consideration of higher order impacts due to the interconnectedness of the economy that CGE models predict higher output changes compared to partial equilibrium modelling approaches.

### **5.3.7 Relative importance of each of the three shocks**

The results of the simulations in this section reveal the relative importance of each of the three shocks on economic activity. By isolating each shock from

the effects of the other shocks, we can determine each shock's relative importance in terms of its impact on economic activity.

The results show that the HIV/AIDS impact on labour has the largest effect on all the macro indicators. The direct effect of HIV/AIDS on the quantity and quality of labour elicits the largest reductions in real output, investment, and the trade deficits compared to the effects of wage increases or changes in government expenditure. This result is potentially useful for the development of HIV/AIDS mitigation policies. It is clear that a policy designed to minimise the loss of labour, due to either high morbidity or mortality, would lead to significantly less adverse impact on the economy. Reducing the HIV/AIDS prevalence rate by 5 percentage points, from 17 per cent to 12 per cent, for example, results in significantly reduced impacts on the macro indicators. Table 19 shows these changes.

**Table 19 The Impact of Reducing HIV/AIDS Prevalence**

<b>Indicator</b>	<b>Combined shock with 17% prevalence</b>	<b>Combined shock with 15% prevalence</b>	<b>Combined shock with 12% prevalence</b>
Real GDP	-8.84	-7.93	-6.62
Investment	-34.09	-29.14	-22.28
Trade deficit	-41.75	-37.06	-30.34

The results in Table 19 show that with the combined shock, a 5 percentage point reduction in HIV/AIDS prevalence from 17 per cent to 12 per cent reduces the real GDP decrease by just over 25 per cent. A 2 percentage point reduction in HIV/AIDS prevalence still results in a 10 per cent reduction in output decrease. These simulations show that policies designed to reduce HIV/AIDS prevalence have high payoffs in terms of protecting economic output. Such policies would not only positively impact economic output, but would also impact households directly by reducing the number of households losing their labour income as a result of HIV/AIDS-related morbidity and mortality, and loss of jobs as firms reduce their labour demand due to increases labour costs. This would have the effect of maintaining a larger number of households' ability to demand goods and services as firms' demand for labour would be relatively higher than in the higher prevalence scenarios.

The substantial decreases in investment reduction associated with HIV/AIDS prevalence-reducing policies are further evidence of the desirability of such policies. A 2 per cent reduction in prevalence reverses investment decrease by 5 percentage points while a 5 per cent reduction in prevalence reverses investment decline by almost 12 percentage points. With more resources available for investment, the likelihood of firms expanding, or new ones starting up, increases. Increases in job opportunities for households are likely under such conditions. With more job opportunities, there would be more incentives for young people to invest more in their human capital accumulation activities which raise productivity and labour incomes. This chain of events leads to a virtuous cycle that reverses most of the negative impacts associated with high HIV/AIDS prevalence.

HIV/AIDS prevalence-reducing policies, in addition to reducing the direct impact on labour, lead also to reduction in the co-worker impact which has previously been shown to exacerbate the effects of the HIV/AIDS labour shock. With reduced labour loss and reduced co-worker impact, productivity levels would not be as adversely affected as they are under conditions of high HIV/AIDS prevalence. Combined with policies designed to encourage young people to acquire more human capital, policies aimed at reducing loss of labour can ensure that a sufficiently trained and educated labour force was maintained.

Policies aimed at reducing labour loss also have the indirect effect of reducing the other HIV/AIDS impacts of wage increases and reductions in government expenditure. Maintaining a readily available skilled labour force minimises increases in wages of skilled labour that high HIV/AIDS prevalence tends to lead to. As there would be less competition for the skilled labour, there would be less upward pressure on wages. This would reduce the number of workers losing their jobs due to increased labour costs. Household incomes would not decrease as much as they do under conditions of high HIV/AIDS prevalence. Household demand and consumption of goods and services would be maintained at relatively higher levels. Reductions in household welfare would be minimised as a result.

## 5.4 Government response to decreasing revenue

The scenario painted so far is that of government facing falling revenue from taxes due to reduced firm output, and fewer tax-paying individuals. Demand, however, on government for public services may be increasing, especially so in the health and education sectors. To maintain provision of an adequate level of public services, in the absence of external funding, government has the option of raising taxes in order to boost its revenue. Production taxes on firms and income taxes on individuals can be raised to this end.

Increased taxes on firms are, however, likely to raise costs for firms and further reduce firms' profits. If taxes result in higher prices, firms' international competitiveness may suffer and international demand for local firms' output may decrease in response. With shrinking domestic markets and reduced international demand, local firms are likely to reduce not only their production of goods and services, but also their demand for labour. This chain of events is likely to lead to reductions in incomes of households whose main income source is earnings from employment in the production of traded goods and services.

The impacts of increasing production taxes on firms and income taxes on households are reported in this section. The simulation involves a 5 per cent increase in production taxes and a 5 per cent increase in household income taxes, in addition to the combined shock of HIV/AIDS on labour, wage increase, and government expenditure reduction reported earlier.

**Table 20 Impact of Increasing Firm Production and Household Income Taxes on Selected Macroeconomic Indicators**

<b>Indicator</b>	<b>Combined Shock only</b>	<b>Combined Shock plus 5% tax increase</b>	<b>Combined Shock plus 10% tax increase</b>
Real GDP	-8.84	-8.92	-9.01
Investment	-34.09	-29.48	-24.85
Trade deficit	-41.75	-39.99	-38.25

Simulations show that increasing firm and household income taxes in combination with the other three shocks has very little impact on real GDP. A 5 per cent increase in taxes results in a 0.08 percentage point increase in output reduction. Even with a 10 per cent increase in taxes, the decrease in output

increases by only 0.17 percentage points. These results show that increasing taxes on firms and households has very little impact on real GDP. This suggests that raising taxes might be a viable option for government to raise its revenue without serious adverse effects on real output. A comparison of the change in government revenue with the decrease in real output needs to be made to categorically decide whether this is indeed the case.

Table 21 shows the changes in government tax revenue associated with the 5 and 10 per cent increases in both production and household income taxes.

**Table 21 Impact of Tax Rate Increase on Tax Revenue and Government Surplus**

Shock	Tax revenue change (%)	Government surplus change (%)
Combined shock only	-8.63	43.15
CS plus 5% tax increase	-5.45	28.84
CS plus 10% tax increase	-2.28	14.60

Government tax revenue increases by 3.18 percentage points when tax rates are raised by 5 per cent, while a 10 per cent tax rate increase raises government revenue by 6.35 percentage points compared to the scenario with only the combined shock. The government surplus increases with the increase in revenue.<sup>31</sup> On the basis of these results, tax policy as modelled, appears to be a viable option for government to raise its revenue without a large detrimental effect on the level of real output.

However, the negative tax impact on household incomes leads naturally to changes in household consumption and utility. As household utility depends on the consumption of goods and services, a reduction in household income leading to a reduction in consumption of goods and services adversely affects household utility.

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<sup>31</sup> The government surplus is negative. Improvement in this surplus means its absolute value gets smaller.

**Table 22 Impact of a Tax Shock on Household Welfare**

<b>Household type</b>	<b>Welfare change due to combined shock only (%)</b>	<b>Welfare change due to combined shock + tax shock (%)</b>	<b>Welfare change due to tax shock (%)</b>
H <sub>RRS</sub>	-30.44	-32.39	-6.41
H <sub>RRM</sub>	-21.07	-23.03	-9.30
H <sub>RRN</sub>	-70.64	-71.51	-1.23
H <sub>RS</sub>	-30.04	-31.97	-6.42
H <sub>RM</sub>	-25.45	-27.27	-7.15
H <sub>RL</sub>	-36.69	-37.49	-2.18
H <sub>RN</sub>	-74.81	-75.57	-1.02
H <sub>USE</sub>	-59.94	-60.45	-0.85
H <sub>UPR</sub>	-27.71	-28.29	-2.09
H <sub>UPU</sub>	-34.44	-35.10	-1.92
H <sub>UEM</sub>	-26.71	-27.11	-1.50

While the contribution of the tax shock, especially the 5 per cent tax increase, to household welfare change is generally small, the figures in Table 22 show that remote rural and rural small and medium agricultural households experience the largest proportional changes in welfare. These households' welfare decreases by between 6.41 and 9.30 per cent when taxes are raised by 5 per cent. Large rural agricultural households, H<sub>RL</sub>, also have relatively large welfare reductions of 2.18 per cent. Rural non-agricultural households, H<sub>RRN</sub> and H<sub>RN</sub>, and the urban households have relatively smaller welfare changes.

An interesting feature of this result is that the SAM shows that the rural households, except for the rural large agricultural ones, do not pay any income tax, yet they experience the largest decrease in welfare when income tax and production taxes are raised. The apparently small reduction in output, see Table 20, and consequently labour demand that occurs after a tax increase proves to be large enough to cause substantial household real income decreases among the urban tax-paying households. The effects of lower real incomes among urban households are transmitted to rural households through inter-household transactions. A reduction in inter-household transactions causes the reductions in rural households' real incomes that lead to the welfare changes, noted above,

among the rural households. Table 23 shows the changes in household real incomes when a tax shock is added to the simulation with the other three shocks.

**Table 23 Household Real-Income Changes Due to Inclusion of Tax Shock**

<b>Households</b>	<b>Real-income change without tax shock (%)</b>	<b>Real-income changes with tax shock included (%)</b>	<b>Change due to inclusion of tax shock (%)</b>
H <sub>RRS</sub>	-4.76	-5.06	6.35
H <sub>RRM</sub>	-3.61	-3.95	9.21
H <sub>RRN</sub>	-11.41	-11.55	1.22
H <sub>RS</sub>	-4.69	-4.99	6.40
H <sub>RM</sub>	-4.04	-4.33	7.08
H <sub>RL</sub>	-10.14	-10.97	8.27
H <sub>RN</sub>	-12.01	-12.13	0.99
H <sub>USE</sub>	-12.93	-13.33	3.10
H <sub>UPR</sub>	-8.17	-9.14	11.98
H <sub>UPU</sub>	-8.77	-9.44	7.71
H <sub>UEM</sub>	-9.50	-10.94	15.19

The figures in Table 23, column 3, show that remote and rural agricultural households experience substantial decreases in their real incomes when income and production taxes are raised. The last column in Table 23 shows the change in the households' real incomes as a percentage of the change caused by the combined shock before introduction of the tax shock. This is the change in household real incomes attributable to the introduction of the tax shock in the presence of the labour, wage and government expenditure shocks discussed earlier.

This result is a particularly instructive one because it illustrates one of the advantages of general equilibrium analysis over partial equilibrium analysis. Without taking into account the interactions among the households as done in general equilibrium analysis, a partial equilibrium analysis of the impact of tax would most likely not have revealed this welfare impact on remote and rural households.

While the increase in production and income taxes raise government revenue relatively more than they reduce real output, it is shown here that they

lead to relatively higher welfare reductions among remote and rural households compared to urban households because of the significance of inter-household transactions to the welfare of remote and rural households.

In the absence of compensatory transfers to remote and rural households, production and income tax increases would lead to additional higher proportional reductions in the welfare of these households relative to urban households. Though urban households experience decreases in their real incomes, the reduction in their welfare, as shown earlier in Table 22, is not as severe as that experienced by remote and rural households.

As such, tax policy meant to increase government revenue, under the conditions of the simulation, seems to have undesirable welfare consequences for all households, but more so for remote and rural households despite their not paying income taxes.

Whether the undesirable consequences for remote and rural households can be ameliorated by government cannot be determined a priori. This can only be determined by what government decides to spend its additional revenues on. If the extra revenue is spent on services that lead to significantly higher benefits for remote and rural households in the longer term, then the raising of taxes may be “justified”. If, on the other hand, the extra revenue does not lead to generation of significantly more benefits for remote and rural households, it becomes difficult to justify the raising of taxes given the higher negative welfare changes it causes among the remote and rural households.

An alternative to raising government revenue through increased production and income taxes is an increase in productivity. With more output and higher incomes that result from increased productivity, more production and income taxes can be collected to boost government revenues without the negative impacts associated with trying to achieve the same result using higher production and income taxes.

This alternative is, however, generally not available to governments because one of the effects of HIV/AIDS is its negative impact on productivity of both labour and capital. Loss of experienced workers through high mortality and the reduced effectiveness of other workers through illness and stress seriously erode the productivity of labour. With reduced effectiveness of complementary labour, the effectiveness of physical capital is eroded too. Through this process,

total factor productivity is reduced. Increasing or maintaining a high level of productivity requires a reliable supply of skilled and experienced workers, and investment in physical capital. In the presence of HIV/AIDS both the supply of skilled workers and investment in physical capital are interrupted through among other factors reduced quality of education and skills training, reduced desire of individuals to invest in human capital accumulation, and reduced business profits.

Faced with falling revenues, another option for government to safeguard the quality of education and supply of skilled workers, in the absence of foreign funding, is re-allocation of available resources. Assuming the initial allocation of government resources was optimal, diversion of resources from some areas to others leads to a sub-optimal allocation, and creates problems in those areas from which resources are diverted. Thus trying to address HIV/AIDS-related issues, in the absence of foreign funding, poses significant problems for government because HIV/AIDS erodes the ability of the economy to generate sufficient resources with which to do so without at the same time creating other problems in other areas of government spending.

This result contrasts from those of (Young, 2005, 2007) which concluded that HIV/AIDS would lead to increases in the welfare of future South African generations because their economy would generate more than sufficient resources to both mitigate the impacts of HIV/AIDS and increase their welfare through higher per capita incomes. Young's results were, however, based on the simulations based on the opposing effects of reductions in human capital accumulations by orphans and reductions in fertility of the population. Young concluded that the fertility effect dominated the human capital accumulation effect resulting in a significant population growth slowdown but not as significant a reduction in capital accumulation. Output increased sufficiently to raise per capita incomes and provided extra resources with which to deal with the effects of the epidemic.

## **5.5 Conclusion**

This chapter has presented and discussed results of simulations of the impact of HIV/AIDS on selected macroeconomic indicators, and the impact of using tax policy to raise government revenue.

It's been shown that while the impact on labour alone is sufficient to reduce real output and investment, introducing the effects of wage increases and reductions in government expenditure exacerbates the reductions in these two macroeconomic indicators.

Real output in most sectors decreases by between 5 and 10 per cent as a result of the combined effect of the three shocks. While all sectors experience output reductions from the effects of the HIV/AIDS and wage shocks, a few sectors experience an increase in output as a result of reductions in government expenditure.<sup>32</sup> Such increases are, however, not large enough to completely offset the negative effects of the HIV/AIDS and wage shocks. Consequently, all sectors experience reductions in their real output when the three shocks are applied simultaneously with aggregate real output decreasing by 8.84 per cent.

Though the model is a static one, the decrease in investment during the simulation period is an indication of future decreases in levels of investment, possible job creation and household well-being. With an increasing population, a decrease in investment leads to a decrease in the capital-labour ratio and foreshadows future decreases in labour productivity and declining standards of living. Investment decreases by 34.09 per cent under the simulation conditions. Such a large decrease in investment points to a large reduction in the capital-labour ratio and future labour productivity.

Wage increases lead to reductions in labour demand that in turn lead to reductions in firms' real output. Reduced labour demand contributes to reductions in household incomes and consequently, household welfare.

Government transfers have been shown to have minimal impact on both household and firm incomes. Reductions in government expenditure, consequently have little adverse impact on real output. Government expenditure reduction has also been shown to have a positive impact on investment, the trade balance and the current account deficit. The trade balance improves, not because of an increase in exports, but because of the much larger reduction in imports and relatively much smaller decrease in exports. The decrease in imports is attributed

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<sup>32</sup> A logical explanation for this increase in output is that these sectors benefit from reduced government borrowing by being able to borrow at lower rates. Reduced government borrowing reduces the crowding-out effect to the benefit of these sectors.

to the decrease in household demand for consumption goods and services, and firm reduction in demand for imported inputs.

This chapter has, by isolating the impact of each shock, shown the relative importance of each of the three shocks. Simulations show that the HIV/AIDS prevalence impact on labour is the most important of the three shocks. Reductions in HIV/AIDS prevalence have been shown to have significant positive impacts on real output. This result points to the importance or the need for concerted efforts in HIV/AIDS prevention activities if the negatives impacts of the epidemic are to be minimised.

The use of tax policy to arrest decreases in government revenue, as a result of falling production and personal income tax-takes in the face of increasing demand for public services, has been explored. It has been shown that increases in tax rates while increasing government revenue, have a small negative impact on real output, and relatively higher negative impacts on remote and rural households' welfare. The negative impacts on output have been shown to be relatively smaller than the increases in government revenue. This makes tax policy an attractive option for increasing government revenue. However, the negative impact on household welfare, especially that of remote and rural households, introduces the interesting dilemma that depending on what government spends the extra revenue on, the use of tax policy can be desirable or undesirable. Expenditure on services that benefit the remote and rural households most, or compensatory transfers to these households would make the use of tax policy desirable from a welfare perspective. On the other hand, expenditure on services that mostly benefit urban households would lead to greater inequity between urban and rural households.

## **5.6 Contribution**

This chapter makes two main contributions to the literature on the impacts of HIV/AIDS. The first contribution is to add to the weight of evidence that suggests that HIV/AIDS's most adverse impact on the economy is through its impact on the quantity and quality of labour.

Of the three major economic shocks simulated, the impact of the HIV/AIDS shock on the quantity of labour produces the largest reductions in real GDP. Reductions in real GDP caused by the wages and the government

expenditure shocks are minor in comparison to those caused by the HIV/AIDS shock on labour. This result points to a possible policy target for not only mitigating the impacts of the HIV/AIDS epidemic but also for combating the epidemic itself. It is clear that desirable policies in the fight against the epidemic are those that promote infection prevention strategies to minimise the number of new infections in the population. Such policies reduce the number of infected future potential workers and ensure that the country will have an adequate labour-force that is capable of meeting the economy's labour needs.

Without an inadequate labour-force, foreign investment is not likely to flow into the country because of the uncertainty of the availability of a sufficiently productive labour-force that can adequately utilise the investment and produce sufficiently high returns for potential investors. Foreign investment is a crucial input into the economic recovery and development of an HIV/AIDS ravaged economy like the Zambian economy. Because HIV/AIDS impoverishes households and reduces household savings, it destroys the domestic sources of investment funds. This leaves foreign sources of investment as the only viable alternative sources of investment resources. However, in the absence of a sufficiently trained and skilled labour force, it is unlikely that foreign investors would invest in an economy where they could not be certain of getting adequate returns. Policies that reduce new infections provide hope that there will be an adequate labour-force in the future and are likely to encourage foreign investment inflow to make up for the non-availability of domestic investment funds.

Reducing new infections also reduces the other adverse impacts of the HIV/AIDS epidemic. With fewer new infections and high mortality among the infected, the HIV/AIDS-induced increased demand for public services would be reduced. HIV/AIDS treatment costs would over time diminish as fewer new infections occurred. Available scarce resources could be directed towards more long-term economically beneficial activities instead of short-term HIV/AIDS impact mitigation activities.

Prevention is thus a better policy target than treatment. Treatment is currently limited to merely dealing with the effects of the opportunistic infections that occur due to a diminished immune system, but not actually getting rid of the HIV infection. Treatment costs will thus continue to increase as long as new infections occur. Treatment has also the undesirable result of increasing the pool

of infected individuals in the population with the ability to infect others. This is likely to lead to increased HIV incidence and thus escalating treatment costs over time. Prevention, on the other hand, not only reduces new infections, but also prevents other HIV/AIDS impacts such as reduced skilled labour, higher skilled labour wages, reduced government revenue, and reduced institutional savings resulting in reduced investment.

The second insight from this chapter is the result that tax policy has much larger detrimental welfare impacts on remote rural and rural households than urban households though the former do not pay income taxes. The non-tax paying households feel the impact of tax increases through inter-household transactions. These transactions turn out to be sufficiently important to the well-being of remote rural and rural households that decreasing them leads to a much larger decrease in these households' welfare than that of the tax-paying urban households when income taxes are increased. Given the inevitable increases in demand for public services as a result of the impact of HIV/AIDS on the population, and the expected decreases in government revenue due to decreased taxable output and reduced tax base, the options available to government to raise its revenue are rather limited if raising taxes is ruled out because of its adverse impact on the welfare of remote rural and rural households.

As taxes are the major source of government revenue, it seems impractical that government could rule out the use of tax policy to raise its revenue. The simulation results, however, by highlighting the adverse welfare effects on remote rural and rural households can alert policy makers to take into account these adverse impacts on these households when considering tax increases and either provide compensatory transfers or introduce other measures that minimise these adverse effects.



## **Chapter 6 Impact of HIV/AIDS on households**

### **6.1 Introduction**

HIV/AIDS affects households' economic well-being through its impact on household members' ability to work and generate incomes (CHGA, 2003; ILO, 2003; Wiegers et al., 2006). As HIV infection progresses towards AIDS, infected individuals suffer increasing episodes of illness which require treatment and cause the sick individuals to take time off work. As illnesses become increasingly more severe, individuals become weaker, less able to work, and less productive. This is especially so for individuals involved in demanding physical manual work. In the final stages of the illness, infected individuals become bedridden for several months and are unable to work and generate incomes. Eventually, such individuals die as their weakened bodies succumb to opportunistic infections.

The impact of increasing morbidity and increasing physical weakness is reduced ability to work. For the majority of households that are involved in agricultural activities and labouring work, this leads to reductions in their incomes. Individuals may resort to working fewer hours, or taking on less demanding and less paying jobs than they would have done in the absence of illness. Consequently, their incomes decrease and their command over consumption goods and services decreases. For subsistence farmers, an inability to work leads to reduced household labour which can affect the household's food consumption and food security. Food crop production may decrease and leave the household without sufficient food to live on. Child malnutrition increases in such households and, in extreme cases, the household may dissolve as children are fostered out to relatively better-off households to be taken care of.

As HIV/AIDS is predominantly sexually transmitted in Zambia, it tends to cluster in households. Infection of a spouse often leads to infection of the other spouse. Therefore an affected household is more likely to have both adults infected and suffering the debilitating effects of HIV/AIDS infection. For subsistence farming households, this means a reduction in the productivity of both adult members of the household. The result in such cases is severely diminished crop production with severe adverse consequences for the nutritional well-being of the household. Malnourishment may hasten the progression of the sick

individuals to death, and also the dissolution of the household. The impact on dissolved households is immeasurable because such households no longer exist.

In a general equilibrium context, the impact on households is interlinked with the impacts on the other institutions - government and firms in the economy. The HIV/AIDS effect on individual productivity, for example, leads to reduced government revenue because of the erosion of the tax base and the resulting reduction in firm taxes as firm output declines. As a result, government transfers and social services to households deteriorate, as exemplified by the deteriorating standards of public education and healthcare services, for example. Government ability to fund basic infrastructure required for rural development is also diminished by declining government revenues. A vicious cycle whereby declining government revenues reduce household well-being and falling household well-being leads to reduced government revenues develops. The root cause of this vicious cycle is the negative effect of HIV/AIDS on individuals who make up the output-consuming households, the tax paying population, and the labour force which produces all output.

A reduction in demand for firms' output, as a result of a shrinking consumer base, and increased output prices, lead to reductions in firms' demand for labour. Unemployed labour loses its income and command over the quantity and quality of goods and services previously consumed. Deterioration in affected households' welfare can be expected from such a sequence of events.

Also contributing to the reduction in household welfare is the reduction in the level of inter- and intra-household type transactions as households become poorer. Inter- and intra-household type transfers decrease as household output and incomes fall.

## **6.2 Description of the scenarios to be modelled**

Four scenarios will be modelled in this chapter. The description of each of the scenarios is as follows:

Scenario 1 – This scenario is made up of an HIV/AIDS prevalence of 17 per cent unless stated otherwise. It also includes a co-worker impact value of 1.25. For some sensitivity tests, however, other values of the co-worker impact will be considered and indicated as such.

Scenario 2 – This scenario is made up of a 5 per cent increase in wages. This scenario models the widely held view that HIV/AIDS causes an increase in the wages of labour. The hypothesis is that high mortality increases the scarcity of skilled labour. As employers compete for the available labour they offer higher wages. The end result is that wages of skilled labour increase while there is a reduction in the demand for less skilled labour.

Scenario 3 – Scenario 3 is made up of a 5 per cent reduction in government expenditure. This scenario models what would happen if government, as a result of an HIV/AIDS-induced reduction in its revenues, reduced its spending on transfers to households and firms, and consumption of goods and services.

Scenario 4 – This scenario combines the first three scenarios into one. It is thus made up of a 17 per cent HIV/AIDS prevalence rate, a 1.25 co-worker impact value, a 5 per cent wage increase, and a 5 per cent reduction in government expenditure. This is the scenario that is most likely to occur in reality. It is more likely that the three scenarios will be operating at the same time than one at a time in a country that's had a generalised HIV/AIDS epidemic for a long time.

However, the analysis of the impacts of HIV/AIDS on households starts with the impacts of each of the first three scenarios.

### **6.3 The labour impact of HIV/AIDS on households – scenario 1**

The results of the labour impact simulation are crucially dependent on the assumptions made about the HIV/AIDS prevalence rate and the level of the impact on co-workers. A high prevalence rate is a sign of reduced healthiness of the workforce and indication of reduced labour productivity which lead to reduced economic output. The co-worker effect, as described in Chapter 4, is a measure of how many equivalent workers are adversely affected by having an infected co-worker. The stress related to having a sick co-worker reduces the productivity of the infected worker's colleagues. The more co-workers that are adversely affected by having an infected or sick co-worker, the higher the reduction in those workers' productivity. This idea was introduced in (Cuddington & Hancock, 1994)). Therefore the higher the prevalence rate and assumed co-worker impact, the higher is the HIV/AIDS total impact on government, firms and households.

Three scenarios with different co-worker impacts are simulated and reported in Table 24.

The results in Table 24, based on an adult HIV/AIDS prevalence rate of 17 per cent, show that the labour impact of HIV/AIDS on households is an adverse one. The negative changes in household real incomes increase with larger values of the co-worker impact.

**Table 24 Changes in Household Real Incomes – Scenario 1**

Households	Household real income % changes with co-worker values of		
	1.25	1.5	2
H <sub>RRS</sub>	-3.75	-4.58	-6.31
H <sub>RRM</sub>	-2.62	-3.15	-4.17
H <sub>RRN</sub>	-8.81	-10.88	-15.45
H <sub>RS</sub>	-3.53	-4.31	-5.91
H <sub>RM</sub>	-3.15	-3.82	-5.14
H <sub>RL</sub>	-7.31	-9.12	-13.18
H <sub>RN</sub>	-9.33	-11.54	-16.40
H <sub>USE</sub>	-10.02	-12.40	-17.69
H <sub>UPR</sub>	-6.20	-7.67	-10.89
H <sub>UPU</sub>	-6.62	-8.21	-11.71
H <sub>UEM</sub>	-7.20	-8.92	-12.75

The magnitudes of the changes in real incomes are, however, much higher in urban (H<sub>USE</sub>, H<sub>UPR</sub>, H<sub>UPU</sub>, H<sub>UEM</sub>), rural large-scale (H<sub>RL</sub>), and rural non-agricultural (H<sub>RRN</sub>, H<sub>RN</sub>) households. While the rural agricultural households' incomes decrease by between 2.6 and 3.75 per cent, the other households' incomes decrease by between 6.2 and 10 per cent, in the “conservative” scenario with a co-worker value of 1.25. On average, the changes in rural agricultural households' incomes are about two and one half times lower than the other households'.

This is a significant difference in the income changes of the rural agricultural households and the rest of the households. This difference can be explained in terms of the households' income sources. The majority of agricultural households are predominantly subsistence farmers working less than 10 hectares of land. Such households tend to consume most of their output with

little or nothing left-over for sale. For such households, their direct connection to the market economy is very limited. Adverse changes in economic activity resulting in lower incomes do not therefore have a large direct impact on the incomes of such households. Near “self-sufficiency” cushions these households from the full impact of adverse market economic conditions.

Large farming households ( $H_{RL}$ ) are involved in commercial farming. Such households, like the non-agricultural urban household-types, are heavily dependent on prevailing economic conditions for their incomes. HIV/AIDS impact on skilled and experienced farm workers reduces productivity on commercial farms. The impact on experienced farm workers leads also to increased farm production costs due to replacement and training costs of new workers. Incomes of commercial farms may therefore decrease due to reduced production, or due to increased labour-associated costs.

As economic conditions deteriorate due to HIV/AIDS effects, incomes of commercial farming households decrease. This decrease results due to reduced demand for labour in other sectors of the economy which leads to reduced demand for marketed output as more households experience reductions in their incomes. The combination of reduced farm production, increased farm costs and reduced demand for farm output ensures that large-scale farming households’ incomes decrease due to the effects of HIV/AIDS.

For non-agricultural urban households, provision of labour is the main source of income. Inability to work due to HIV/AIDS-related morbidity or mortality reduces such households’ incomes. Reduced household incomes for urban household-types contribute to the reduction in demand for firms’ output, including commercial farming output. The much higher income percentage changes for urban, rural non-agricultural and rural large scale household-types in Table 24 reflect these household-types’ strong reliance on labour income, and the sale of their output respectively.

The results in Table 24 show also the importance of the co-worker impact. As the value of the co-worker impact increases, so does the adverse change in households’ real incomes. The co-worker impact captures the fact that HIV/AIDS affects not only the infected worker, but also has an adverse impact on the infected worker’s co-workers’ productivity. Co-workers’ productivity falls due to work-related and emotional stress resulting from picking up extra duties to cover

for sick and absent colleagues, and from frequent attendance of workmates', friends' and relatives' funerals. The impact of HIV/AIDS on an HIV/AIDS infected employee is thus not limited to that employee's household only, but is transmitted to other households through the "co-worker effect". The impact on one sick employee, therefore, gets magnified through its impact on that worker's colleagues. As prevalence and mortality increase, the co-worker effect will increase too, as will productivity declines. The decreases in labour productivity and increased production costs, given competitive labour markets, lead to decreases in demand for labour and therefore also to reduced incomes for labour-supply-dependent households.

### 6.3.1 HIV/AIDS impact on household consumption

Household consumption of goods and services depends on the level of households' incomes. As shown in Table 24, the HIV/AIDS labour impact reduces incomes for all household-types. Household consumption changes are expected to reflect the observed changes in income levels.

Table 25 shows the percentage changes in household consumption for each of the three values of the co-worker impact. The changes in household consumption are almost identical to the changes in real income shown in Table 24.

**Table 25 Household Consumption Changes – Scenario 1**

Households	% Change with co-worker values of		
	1.25	1.5	2
H <sub>RRS</sub>	-3.74	-4.57	-6.30
H <sub>R RM</sub>	-2.61	-3.14	-4.13
H <sub>R RN</sub>	-8.81	-10.89	-15.48
H <sub>RS</sub>	-3.53	-4.30	-5.90
H <sub>RM</sub>	-3.13	-3.79	-5.09
H <sub>RL</sub>	-7.32	-9.13	-13.24
H <sub>RN</sub>	-9.36	-11.58	-16.51
H <sub>USE</sub>	-10.02	-12.42	-17.77
H <sub>UPR</sub>	-6.18	-7.64	-10.85
H <sub>UPU</sub>	-6.60	-8.18	-11.68
H <sub>UEM</sub>	-7.15	-8.86	-12.65

The almost identical nature of the values in the two tables reflects the fact that household consumption is a function of household income. The fact that Table 24 reports real income changes also influences the relationship with consumption changes in Table 25 because by definition real income represents the quantity of goods and services that nominal money income can purchase. In this sense the figures in the two tables should be as close as they are.

It follows therefore that we can conclude that rural agricultural households' consumption of goods and services changes the least as a result of the impact of HIV/AIDS on labour. This result is consistent with the observation that rural agricultural households rely less on labour income for their consumption.

On the other hand, the labour-wage dependent rural non-agricultural and urban households experience larger decreases in their consumption relative to the rural agricultural households. Like the income changes, the consumption changes are also driven by the household income sources. Households most reliant on labour income experience the largest change in consumption as a result of reduced labour productivity which reduces the quantity of effective labour in use. As wages are a function of productivity, the fall in productivity results in reduced wages. Households that experience frequent worker morbidity or HIV/AIDS related mortality tend to experience reduced household incomes. Overall, the impact of HIV/AIDS on labour leads to varying changes in household incomes because of the differences in households' reliance on labour income.

Table 26 shows price changes for each of the three scenarios considered separately and in a combination. The HIV/AIDS and wage shocks have the most impact on commodity consumer price changes in the mostly labour intensive sub-sectors of the economy. This reflects increased labour costs in these sub-sectors. Capital intensive sub-sector prices, however, decrease. This result can be explained by reduced demand for these sectors' output as consumer incomes decrease and larger proportions of incomes are allocated to agricultural food products needed for survival.

Table 26 shows also that the HIV/AIDS and wage shocks reinforce each other. They have the same sign for each of the commodities.

**Table 26 Commodity Consumer Price % Changes for Each of the 4 scenarios**

<b>Commodity</b>	<b>HIV/AIDS (1.25) (scenario 1)</b>	<b>Wage (+5%) (scenario 2)</b>	<b>G Exp (-5%) (scenario 3)</b>	<b>Combined Shock (scenario 4)</b>
C <sub>MAI</sub>	7.34	2.03	-0.12	9.17
C <sub>STA</sub>	4.62	2.85	0.04	7.54
C <sub>GNT</sub>	10.45	3.23	-0.06	13.75
C <sub>SUG</sub>	4.91	0.32	-0.04	5.29
C <sub>COT</sub>	4.01	0.75	0.05	4.77
C <sub>TOB</sub>	6.92	1.25	-0.04	8.08
C <sub>COF</sub>	3.34	1.43	0.04	4.71
C <sub>WHE</sub>	3.76	0.4	-0.10	3.96
C <sub>HCR</sub>	5.06	2.25	-0.03	7.19
C <sub>OCR</sub>	2.44	2.77	0.06	5.24
C <sub>LIV</sub>	9.56	1.37	-0.15	10.65
C <sub>FIS</sub>	0.86	-0.16	0.06	0.71
C <sub>FOY</sub>	6.21	1.41	0.03	7.62
C <sub>MIN</sub>	-0.01	-0.19	0.04	-0.16
C <sub>FBT</sub>	2.73	0.65	0.02	3.35
C <sub>TAG</sub>	1.18	-0.21	-0.11	0.88
C <sub>WAF</sub>	1.18	-0.29	-0.29	0.58
C <sub>FER</sub>	0.85	0.05	0.04	0.93
C <sub>OMA</sub>	-2.12	-0.82	0.00	-2.77
C <sub>EAW</sub>	-11.23	-3.76	-1.07	-15.19
C <sub>CAG</sub>	-1.32	-0.44	0.50	-1.28
C <sub>CON</sub>	-3.18	-1.33	0.31	-4.07
C <sub>TSV</sub>	-0.35	-0.06	0.32	-0.16
C <sub>TOU</sub>	5.95	3.45	0.01	9.61
C <sub>SER</sub>	2.11	3.03	-0.06	5.24
C <sub>FIN</sub>	-2.41	-0.87	0.00	-3.37
C <sub>PUB</sub>	0.73	0.95	-1.02	0.43

Household consumption is reduced also by the impact of rising consumer prices. The combination of decreasing incomes and increasing consumer prices reduces households' ability to maintain their initial consumption levels.

A comparison of the first three scenarios in Table 26 shows that for most commodities, scenarios 1 and 2's impacts move in the same direction. These scenarios reinforce each other's impact. For most commodities these scenarios raise the consumer prices. The impact of a reduction in government expenditure on the other hand is less clear. However, it is clear that reduced government expenditure has very little or no effect on consumer commodity prices. For most commodities the government expenditure reduction impact on consumer prices is an increase of less than 0.06 per cent. The small values of government transfers to households account for this result. As households get very little in the way of government transfers, reductions in these transfers have correspondingly little effect on household incomes, consumption, and therefore contribute very little to changes in consumer prices.

While reduced government transfers to households contribute little to changes in consumer prices, the substantial consumer price increases for agricultural and food commodities contribute significantly to reductions in household consumption of goods and services.

### **6.3.2 Impact of the HIV/AIDS shock on household welfare**

#### **6.3.2.1 Household Utility**

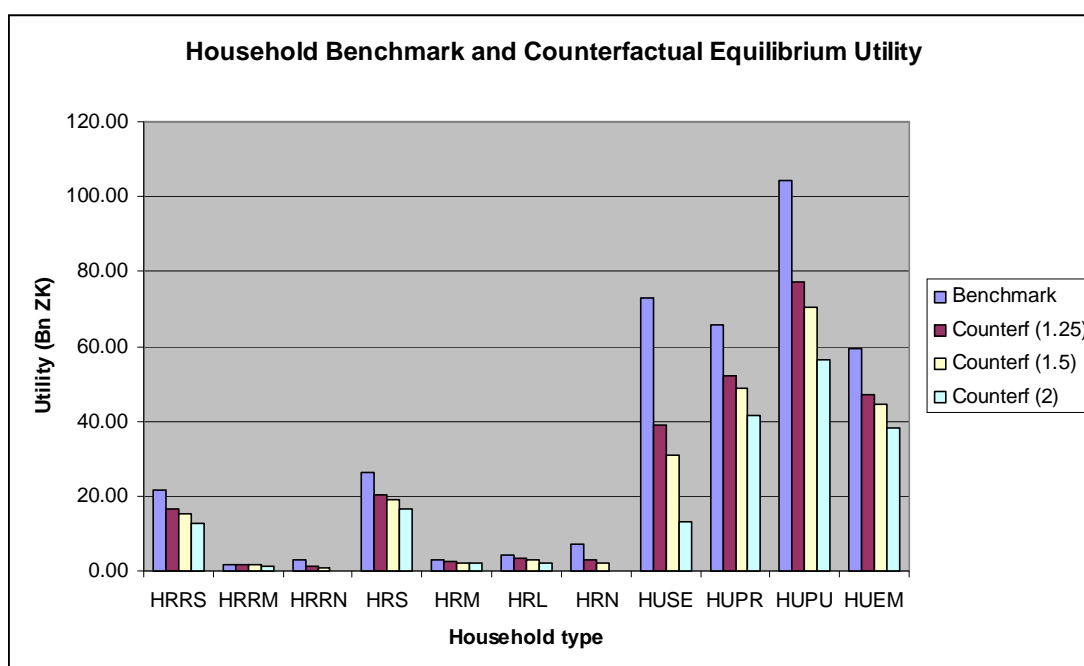
As described in Chapter 4, households are assumed to maximise a Stone Geary type utility function. Using this utility function, household utility changes in response to the different scenarios can be calculated. In this utility function, household utility is dependent on the quantity of goods and services that households consume and the proportion of the marginal budget spent on each commodity consumed. This utility is calculated through an indirect utility function and compared at the benchmark and counterfactual equilibria. Compensating and equivalent variation measures are then calculated from the utility and income levels.

Figure 11 charts household utility at the benchmark and counterfactual equilibria at each of the three assumed co-worker impact levels for scenario 1. Figure 11 shows that for each household type, utility progressively decreases as the assumed co-worker impact value increases from 1.25 to 2. This result is consistent with the fact that an increase in the co-worker impact increases the number of people affected by HIV/AIDS and therefore the total household income

decrease is larger. As utility is a function of the level of income, it should be the case that as more people are affected by HIV/AIDS and total household income falls, the level of household utility should decrease as well.

Figure 11 shows that urban households have a much higher level of utility at benchmark equilibrium relative to rural households. This result reflects the fact that urban households have larger incomes that enable them to purchase more consumption goods and services that determine household utility<sup>33</sup>

**Figure 11 Household Utility at Benchmark and Scenario 1 Counterfactual Equilibria at Different Co-Worker Impact Values**



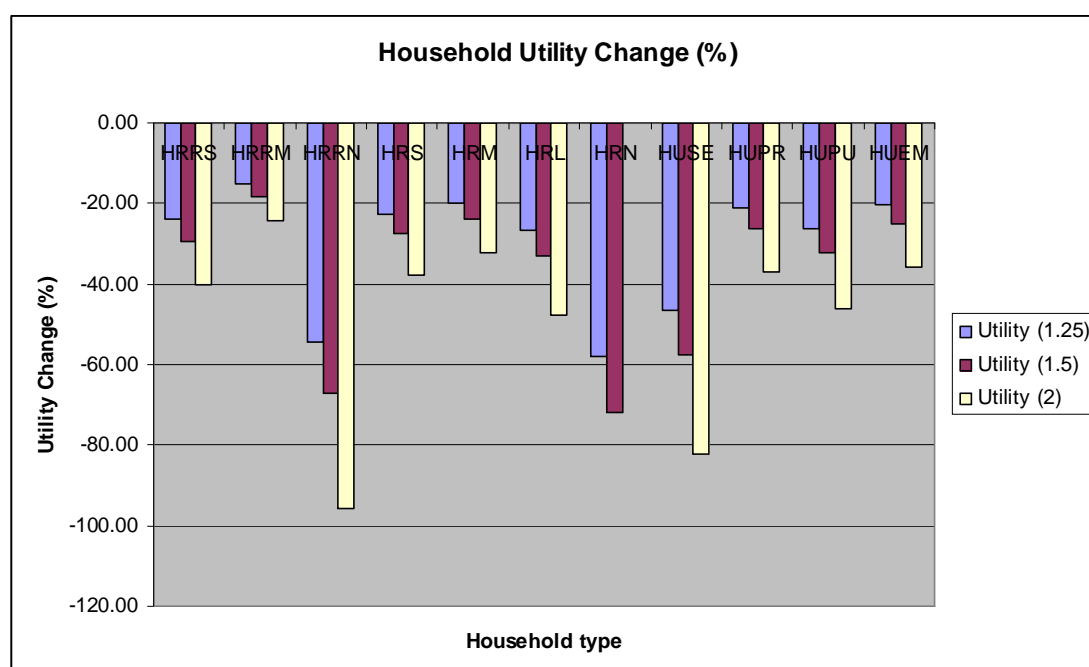
The graph in Figure 11 shows that there are significant changes in utility for most households when the AIDS shock is introduced. While it may seem from Figure 11 that rural households exhibit minor changes in utility, the fact that their initial utility is relatively low means even small changes turn out to have significant adverse effects on their welfare. This is more clearly illustrated in Figure 12 which shows the percentage changes in utility after the AIDS shock.

Figure 12 show the changes in household utility observed in Figure 11 expressed in terms of percentage changes from their benchmark equilibrium

<sup>33</sup> It is possible here that the utility function used to measure household utility underestimates the rural households' utility because these households are nearly self sufficient and consume most of their own production rather than purchase it through earned income.

values. It is clear from Figure 12 that all households experience utility changes between 15 and 58 per cent in scenario 1. All, but 3, household types in this scenario, however, experience utility changes between 15 and 26.5 per cent. The percentage changes in utility increase with increasing values of the co-worker impact. When the co-worker value is increased to 2, the majority of households experience utility changes between 24 and 48 per cent. Two households experience 82 and 96 per cent changes while utility for one household ( $H_{RN}$ ) could not be calculated. These very large changes in utility are consistent with the fact that the loss of a single worker is associated with the equivalent loss of two workers through the co-worker impact.

**Figure 12 Household Utility Percentage Changes – Scenario 1 with Different Co-Worker Impact Values**



Despite having smaller initial incomes, rural households experience changes in utility no less than that experienced by urban households. This result is consistent with the generally accepted view that the marginal utility from an extra unit of income is much higher for a person on a lower income than it is for a person on a much higher one. We would therefore expect that despite having smaller incomes and smaller absolute changes in incomes, the changes in utility for rural households would be significant, because of their higher marginal utility of income.

These results illustrate how the macroeconomic impacts of the AIDS shock on real GDP, sectoral output and prices are manifested at the microeconomic level of the household. The seemingly small 6.83 per cent fall in real GDP is shown here to result in significantly larger (15 to 58 per cent) utility reductions for most households in scenario 1. While the macro impacts do not appear to be large, the resulting impacts on household well-being are significantly larger.

### **6.3.2.2 Compensating Variation values**

Table 27 shows the compensating variation (CV) values associated with scenario 1 at different values of the co-worker impact. The CV is calculated as the ratio of the difference between the counterfactual and benchmark equilibrium utilities, and counterfactual utility multiplied by the level of income at counterfactual equilibrium. In this formulation, given that utility declines as a result of the shock, the change in utility should be negative, as should be the consequent CV value. The calculated CV values in Table 27 are all negative indicating that household welfare has declined as a result of the AIDS shock on labour.

Among the rural agricultural households, the smaller households ( $H_{RRS}$  and  $H_{RS}$ ) need significantly more income to be as well-off as they were before the shock than the other rural agricultural households. This result suggests that the welfare impact of HIV/AIDS is more severe in the smaller rural households than in the larger ones. The loss of an adult severely diminishes the amount of labour available to a small household and severely reduces its agricultural output capability. Its income-generating ability is thus severely diminished. Given their initial situation of having very little, the loss of a prime-age adult might tip such households over the edge into extreme poverty. This results in the smaller rural households needing significantly more compensation to attain their pre-shock levels of utility.

Compared with rural households, urban households require higher levels of compensation. The results are consistent with the previous results showing that urban households experience greater changes in their labour-incomes and commodity consumption as a result of the AIDS shock. This naturally leads to higher compensating variation amounts for urban households.

The figures in Table 27 show also that self-employed urban households ( $H_{USE}$ ) are the worst affected by the AIDS shock. This is consistent with the fact that informal self-employment income-generating activities tend to be dependent on particular skills and abilities of the individual owners. The demise of such owners tends to spell the demise of the enterprise as well leaving the dependent households with no income source. For such households, the impact of the AIDS shock will be greater as they tend to be characterised also by a lack of paid sick leave, no pension or social security payments, or any other terminal benefits that formally employed individuals get.

**Table 27. Compensating Variation measures (ZK bn)**

Households	co-worker 1.25	co-worker 1.5	co-worker 2
	CV	CV	CV
$H_{RRS}$	-387.46	-504.22	-809.88
$H_{RRM}$	-17.53	-21.73	-30.56
$H_{RRN}$	-153.29	-257.96	-2614.23
$H_{RS}$	-449.08	-580.41	-911.82
$H_{RM}$	-40.50	-51.36	-76.39
$H_{RL}$	-42.01	-56.38	-99.82
$H_{RN}$	-436.36	-783.87	NC
$H_{USE}$	-2018.00	-3067.45	-9804.45
$H_{UPR}$	-325.07	-421.95	-676.35
$H_{UPU}$	-828.48	-1101.19	-1892.82
$H_{UEM}$	-205.34	-265.45	-422.18

Thus both the owner's and dependent households simply lose their income source on the demise of the income-generating enterprise.

The negative compensating variation measures are further evidence of the adverse impact of the AIDS shock on household well-being. The results show that while all households are adversely affected by the AIDS shock, the magnitudes of the effects vary according to household type.

The foregoing results are driven by losses in income-generating ability of households due to significant AIDS related morbidity or AIDS-induced mortality of their prime-age working household members. This suggests that economic impact mitigation strategies that target the protection of livelihoods can have a

significant impact on reducing the adverse economic impacts of HIV/AIDS on households.

Rural households depend on agricultural production. Loss of farming knowledge through deaths of the household heads diminishes the households' ability to produce enough to sustain themselves. This suggests that efforts such as agricultural extension work, access to credit and agricultural inputs such as fertilisers that improve yields would go a long way in cushioning the economic impact of AIDS on agricultural households. Reciprocal labour arrangements among rural agricultural households can be encouraged to compensate for the loss of labour in these households, as can the increased use of animal draught power.

Urban households' consumption is affected by price increases brought about by HIV/AIDS-induced production cost increases. Measures that ensure the availability of a sufficiently skilled workforce would minimise some of the worker-related increases in production costs. Workers' medical costs can be minimised by provision of medical services through the public health system. HIV/AIDS programmes targeted at minimising new infections are among workers would help to keep worker-related costs from increasing in the long run.

## **6.4 Impacts of other shocks on household income, consumption and welfare**

### **6.4.1 The wage shock – Scenario 2**

In the absence of other shocks, an increase in the wage rate is expected to lead to higher production costs, reduced firm profitability and a consequent reduction in demand for labour. The reduced demand for labour results in fewer households with labour incomes. With reduced labour incomes a reduction in demand for consumption goods and services is inevitable. Total household well-being is likely to deteriorate due to reduced consumption of good and services among the households that lose their labour income and the associated flow-on effects that ensue.

Table 28 shows the percentage changes in household real incomes due to scenario 2. For comparative purposes, the percentage changes due to scenario 1 are also shown in the table. Table 28 shows that the labour effect (scenario 1) is much larger than the wage effect (scenario 2). It shows also that the wage effect is very minimal on rural agricultural households whose incomes change by

between -0.27 to -0.58 per cent. Incomes for the urban, large rural and rural non-agricultural households on the other hand are comparatively more affected by the wage change effect.

The small changes in rural agricultural,  $H_{RRN}$ ,  $H_{RRM}$ ,  $H_{RS}$  and  $H_{RM}$ , households' incomes show that these households are not as reliant on wages for their incomes as are the urban, ( $H_{USE}$ ,  $H_{UPR}$ ,  $H_{UPU}$ , and  $H_{UEM}$ ), large rural,  $H_{RL}$ , and rural non-agricultural households,  $H_{RRN}$  and  $H_{RN}$ .

**Table 28 Household Income Percentage Changes due to scenarios 2 and 1**

Households	Wage shock (scenario 2)	Labour shock (scenario 1)	Combined Wage and Labour shocks
$H_{RRS}$	-0.47	-3.75	-4.19
$H_{RRM}$	-0.40	-2.62	-3.01
$H_{RRN}$	-2.35	-8.81	-10.94
$H_{RS}$	-0.58	-3.53	-4.07
$H_{RM}$	-0.27	-3.15	-3.43
$H_{RL}$	-1.79	-7.31	-9.05
$H_{RN}$	-2.56	-9.33	-11.68
$H_{USE}$	-2.86	-10.02	-12.68
$H_{UPR}$	-1.38	-6.20	-7.54
$H_{UPU}$	-1.56	-6.62	-8.13
$H_{UEM}$	-2.15	-7.20	-9.28

The wage and labour shocks, however, reinforce each other. When applied simultaneously, the resulting change in household income is greater than the impact of each shock applied in isolation. The wage scenario thus contributes to worsening household incomes among all household types in the presence of HIV/AIDS although its effects are significantly less on remote and rural agricultural households.

As with its effect on household real incomes, the wage shock has only a very small negative effect on rural agricultural household consumption. Table 29 shows that rural agricultural households' consumption decreases, albeit by small percentages, when the wage shock is applied in the absence of HIV/AIDS. This

result is further confirmation that rural agricultural households' consumption, and therefore well-being, is not significantly wage-income dependent.

However, urban, large rural and rural non-agricultural households' consumption decreases significantly more than that of rural agricultural households when the wage shock is applied. These households' consumption is therefore relatively more wage-dependent. Decrease in their incomes lead to significant decreases in their consumption of goods and services.

**Table 29 Household Consumption Changes due to Scenarios 2 and 1**

<b>Households</b>	<b>Wage shock (Scenario 2)</b>	<b>Labour shock (Scenario 1)</b>	<b>Combined Wage and Labour shocks</b>
H <sub>RRS</sub>	-0.47	-3.74	-4.18
H <sub>RRM</sub>	-0.40	-2.61	-3.00
H <sub>RRN</sub>	-2.35	-8.81	-10.95
H <sub>RS</sub>	-0.58	-3.53	-4.06
H <sub>RM</sub>	-0.27	-3.13	-3.40
H <sub>RL</sub>	-1.79	-7.32	-9.05
H <sub>RN</sub>	-2.56	-9.36	-11.70
H <sub>USE</sub>	-2.86	-10.02	-12.67
H <sub>UPR</sub>	-1.38	-6.18	-7.49
H <sub>UPU</sub>	-1.56	-6.60	-8.08
H <sub>UEM</sub>	-2.14	-7.15	-9.19

The relatively smaller changes in rural agricultural households' consumption are explained by the effects of both the wages and labour shocks on inter- and intra-household transactions. These transactions combined with household direct consumption of goods and services make up total household consumption. Both the wage and labour shocks have positive effects on rural agricultural households' inter- and intra-household transactions, while having a negative effect on that of urban, large rural agricultural and rural non-agricultural households. The simulation results are shown in Table 30.

The increase in inter- and intra-household transactions for rural agricultural households boosts these households' consumption and cushions them from the full negative effect of the shocks on consumption that the other households experience.

The increases in rural agricultural households' inter- and intra-household transactions, shown in Table 30, help to reduce the full impact that falling incomes have on the consumption of these households. For the strongly income-dependent households, falling incomes lead to reduced inter- and intra-household transactions too. The net result for these households is larger decreases in their consumption.

**Table 30 Percentage changes in inter- and intra-household transactions**

Households	Wage shock (Scenario 2)	Labour shock (Scenario 1)	Combined Wage and Labour shocks
H <sub>RRS</sub>	1.00	1.08	2.09
H <sub>RRM</sub>	0.90	1.46	2.38
H <sub>RRN</sub>	-1.37	-6.10	-7.39
H <sub>RS</sub>	0.93	0.80	1.74
H <sub>RM</sub>	0.60	0.17	0.77
H <sub>RL</sub>	-0.90	-5.38	-6.28
H <sub>RN</sub>	-1.69	-6.89	-8.49
H <sub>USE</sub>	-2.26	-8.40	-10.54
H <sub>UPR</sub>	-0.98	-5.10	-6.05
H <sub>UPU</sub>	-1.10	-5.42	-6.48
H <sub>UEM</sub>	-1.94	-6.92	-8.76

#### 6.4.2 Government expenditure shock – Scenario 3

The government expenditure shock involves a reduction in government expenditure. Because government expenditure includes transfers to households and firms, as well as government consumption of goods and services, a reduction in government expenditure is expected to reduce household incomes and firm revenues. Reduced household incomes lead to reduction in household consumption of goods and services that leads to reduced household well-being.

At benchmark equilibrium, government transfers make up varying proportions of household total incomes ranging from 0 among large rural agricultural households, H<sub>RL</sub>, to 8.72 per cent among remote rural non-agricultural households, H<sub>RRN</sub>. For the majority of household types, government transfers make up less than 5 per cent of their total incomes. These figures are shown in Table 31. Table 31 shows also that an expenditure shock that reduces government

expenditure by 5 per cent results in a uniform 1.02 per cent reduction in government transfers to all household types that receive the transfers.

The small value of the percentage changes in government transfers to households after the government expenditure shock leads to the conclusion that small changes in government expenditure will have very little impact on household consumption of goods and services even in the absence of HIV/AIDS.

**Table 31 Effect of Government Expenditure Shock (scenario 3) on Government Transfers to Households**

Households	Benchmark total income	Govt transfers	Transfers as % of total income	Transfers after Govt Exp shock	%Δ in Income after shock	% Δ in transfers after shock
H <sub>RRS</sub>	1279.59	42.49	3.32	42.06	-0.38	-1.02
H <sub>RRM</sub>	99.99	4.55	4.55	4.50	-0.38	-1.02
H <sub>RRN</sub>	140.59	12.26	8.72	12.14	-0.37	-1.02
H <sub>RS</sub>	1592.94	127.42	8.00	126.13	-0.42	-1.02
H <sub>RM</sub>	168.78	7.09	4.20	7.02	-0.39	-1.02
H <sub>RL</sub>	126.00	0.00	0.00	0.00	-0.86	0.00
H <sub>RN</sub>	348.32	20.30	5.83	20.10	-0.25	-1.02
H <sub>USE</sub>	2589.20	53.38	1.93	52.84	-0.18	-1.02
H <sub>UPR</sub>	1295.34	56.09	3.68	55.52	-0.46	-1.02
H <sub>UPU</sub>	2518.34	116.29	4.16	115.11	-0.48	-1.02
H <sub>UEM</sub>	865.96	12.93	1.16	12.80	-0.16	-1.02

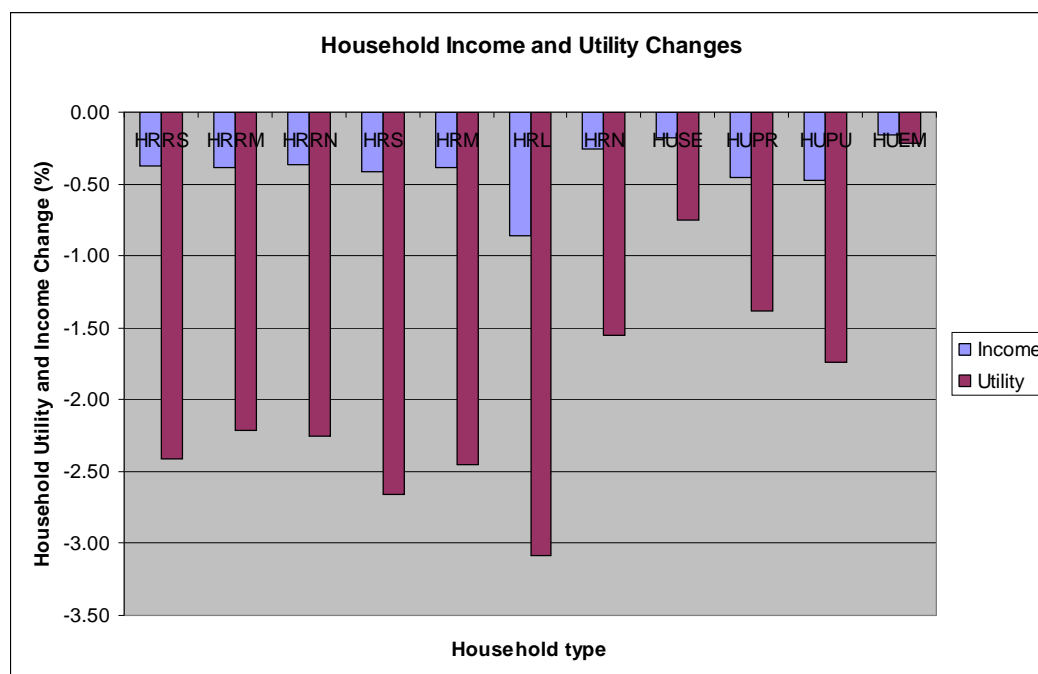
This conclusion is strongly supported by the even smaller total income percentage changes for all household types. With the exception of the large rural agricultural households whose income change is -0.86 per cent, the rest of the household types' income changes are less than -0.5 per cent. With such small changes in household total income, very small changes in household consumption and utility can be expected. The corresponding household income and utility changes that result are shown in Figure 13.

As expected, the changes in household utility are low, ranging from -0.22 per cent to -3.10 per cent.

In the presence of the HIV/AIDS shock, however, though the government transfer reduction of 0.51 per cent is less than that without the HIV/AIDS shock,

the household income changes are much higher for all household types. Remote rural, and, small and medium rural households experience changes in their total incomes of between -3.17 and -4.27 per cent.

**Figure 13 Household Income and Utility Changes After Government Expenditure Shock (scenario 3)**



The rest of the household types experience higher income changes. The income changes range from -6.78 per cent among the urban private sector household types to -10.24 per cent among the urban self-employed household types. The results of this simulation are shown in Table 32.

With the higher total income changes, when the government expenditure shock and HIV/AIDS shock are applied simultaneously, household consumption and household utility are expected to decrease by much larger percentages.

**Table 32 Effect of combined HIV/AIDS and govt expenditure shocks on govt transfers to households**

<b>Households</b>	<b>Benchmark Total Income</b>	<b>Income after combined shock</b>	<b>Transfers after combined shock</b>	<b>%Δ in total income</b>	<b>% Δ in transfers after shock</b>
H <sub>RRS</sub>	1279.59	1224.99	42.28	-4.27	-0.51
H <sub>RRM</sub>	99.99	96.82	4.52	-3.17	-0.51
H <sub>RRN</sub>	140.59	127.60	12.20	-9.24	-0.51
H <sub>RS</sub>	1592.94	1527.64	126.77	-4.10	-0.51
H <sub>RM</sub>	168.78	162.54	7.06	-3.70	-0.51
H <sub>RL</sub>	126.00	115.50	0.00	-8.33	0.00
H <sub>RN</sub>	348.32	314.75	20.20	-9.64	-0.51
H <sub>USE</sub>	2589.20	2324.17	53.11	-10.24	-0.51
H <sub>UPR</sub>	1295.34	1207.56	55.80	-6.78	-0.51
H <sub>UPU</sub>	2518.34	2336.88	115.69	-7.21	-0.51
H <sub>UEM</sub>	865.96	801.93	12.86	-7.39	-0.51

Table 33 presents the results of the simulation with the three shocks applied simultaneously. It shows that when the 3 shocks are applied simultaneously, government transfers to households increase uniformly across households by 0.43 per cent. This is a reversal of the results in Table 31 and Table 32 where the transfers to households decreased when the govt expenditure shock and the combination of the government expenditure and HIV/AIDS shocks respectively were applied. Inclusion of the wage shock leads to increased government transfers but exacerbates the changes in total household incomes.

Despite the increase in government transfers to all households, all household types experience significant decreases in their total incomes ranging from -3.62 per cent to -12.93 per cent. The income changes are relatively lower among the remote rural and the small and medium rural households.

As this combination of shocks leads to higher household income reductions, it leads also to more severe household consumption and utility decreases.

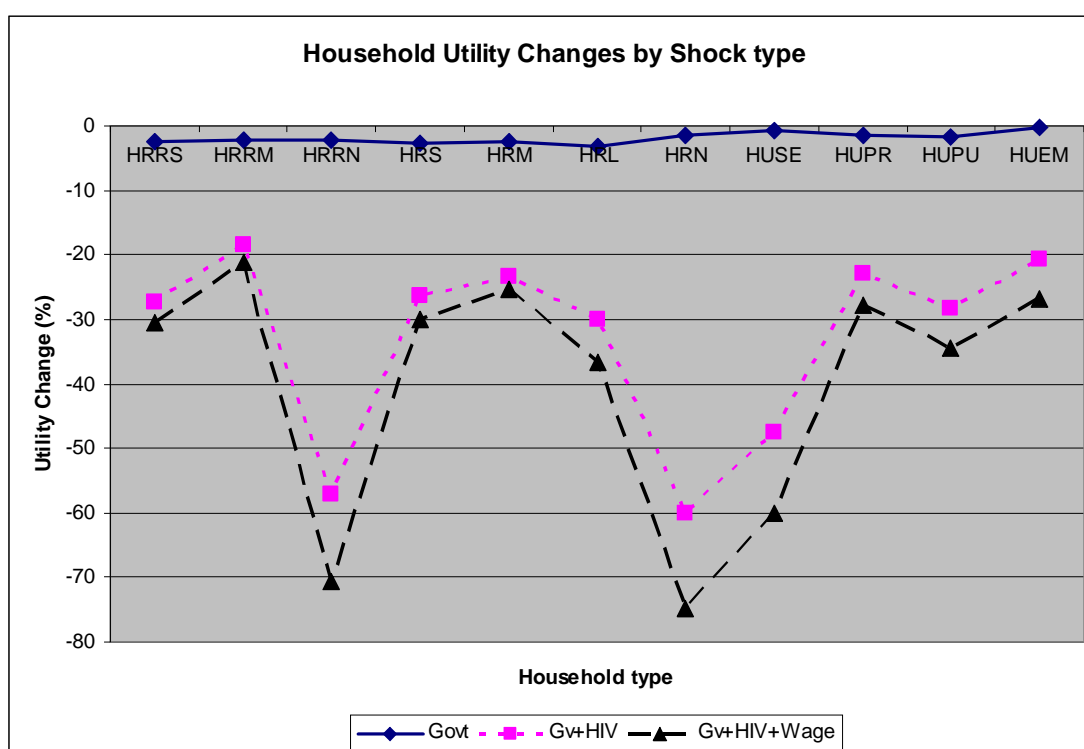
Figure 14 shows the household utility changes for the three shocks discussed.

**Table 33 Effect of the combined shock on government transfers and household incomes**

Households	Benchmark Total Income	Income after combined shock	Transfers after combined shock	%Δ in total income after shock	% Δ in transfers after shock
H <sub>RRS</sub>	1279.59	1218.66	42.68	-4.76	0.43
H <sub>RRM</sub>	99.99	96.37	4.57	-3.62	0.43
H <sub>RRN</sub>	140.59	124.55	12.32	-11.41	0.43
H <sub>RS</sub>	1592.94	1518.25	127.97	-4.69	0.43
H <sub>RM</sub>	168.78	161.97	7.12	-4.04	0.43
H <sub>RL</sub>	126.00	113.22	0.00	-10.14	0.00
H <sub>RN</sub>	348.32	306.47	20.39	-12.01	0.43
H <sub>USE</sub>	2589.20	2254.53	53.61	-12.93	0.43
H <sub>UPR</sub>	1295.34	1189.56	56.33	-8.17	0.43
H <sub>UPU</sub>	2518.34	2297.58	116.79	-8.77	0.43
H <sub>UEM</sub>	865.96	783.69	12.98	-9.50	0.43

Figure 14 shows that while the government expenditure shock alone has very little impact on household utility, the addition of the HIV/AIDS and wages shocks results in significant reductions in household utility across all households. Even in the absence of the wage shock, household utility changes are still high between -18 and -60 per cent. With the wage shock the utility changes range from -21 to -75 per cent.

**Figure 14 Plot of Household Utility Changes For the Three Shocks**



A logical conclusion from these results is that given the three shocks acting simultaneously, household income decreases lead to significant decreases in household consumption and utility. The effect of each of the three shocks on households is unambiguously welfare-reducing. Addition of other shocks compounds the welfare-reduction among households.

Overall, the effect of the government expenditure reduction shock in combination with the other shocks (the HIV/AIDS shock on labour and the wage increase shock) is a small contribution to the decrease in the total incomes of all households.

## 6.5 Conclusion

The main conclusion of this chapter is that the overall impact of HIV/AIDS on household welfare is negative. The three shocks applied simultaneously cause significant welfare losses of between 21 and 75 per cent among the various household types. The majority, eight out of eleven, of households experience welfare losses between 21 and 38 per cent. The other three households experience welfare losses between 60 and 75 per cent. Though each of the shocks is welfare-reducing, even when applied in isolation, the most important welfare-reducing shock is the HIV/AIDS shock on labour.

Table 34 presents a summary of each of the shock's impacts on household incomes. It shows that the HIV/AIDS shock has the largest impact on household incomes. The government expenditure shock has the least impact on all households. Generally, the HIV/AIDS and wage shocks have the least impact on remote rural and rural small and medium agricultural households' incomes. This has been attributed to the minimal reliance of these households on labour income. Their near self-sufficiency cushions them somewhat from the income-reducing effects of the HIV/AIDS and wage shocks.

The government expenditure shock has a more uniform impact among all households. Its impact is an income reduction of less than 1 per cent for all households. This result arises from the fact that government transfers to households make up small proportions of the households' total incomes. A 5 per cent reduction in government expenditure results in a uniform 1.02 per cent reduction in transfers to households and less than 1 per cent reduction in household total incomes (see Table 31). Remote rural and rural agricultural households experience similar income reductions as do urban households.

**Table 34 Changes in Household Incomes by Scenario**

<b>Households</b>	<b>HIV/AIDS Shock (scenario 1)</b>	<b>Wage Shock (scenario 2)</b>	<b>G Exp Shock (scenario 4)</b>	<b>Combined Shock (scenario 4)</b>
H <sub>RRS</sub>	-3.75	-0.47	-0.38	-4.76
H <sub>RRM</sub>	-2.62	-0.4	-0.38	-3.62
H <sub>RRN</sub>	-8.81	-2.35	-0.37	-11.41
H <sub>RS</sub>	-3.53	-0.58	-0.42	-4.69
H <sub>RM</sub>	-3.15	-0.27	-0.39	-4.04
H <sub>RL</sub>	-7.31	-1.79	-0.86	-10.14
H <sub>RN</sub>	-9.33	-2.56	-0.25	-12.01
H <sub>USE</sub>	-10.02	-2.86	-0.18	-12.93
H <sub>UPR</sub>	-6.20	-1.38	-0.46	-8.17
H <sub>UPU</sub>	-6.62	-1.56	-0.48	-8.77
H <sub>UEM</sub>	-7.20	-2.14	-0.16	-9.50

Table 34 and Figure 14 show that the higher the household income reduction, the higher is the reduction in household utility. This result is consistent with the fact that household utility is an increasing function of household income.

Higher incomes enable higher consumption which in-turn raises household utility. Reductions in household incomes naturally lead to reduced household consumption and reduced household utility.

This chapter concludes also that the wage shock by itself has very little impact on the well-being of remote and rural agricultural households. The simulated 5 per cent wage increase shock leads to real wage and consumption reductions of between -0.27 and -0.58 per cent for remote and rural agricultural households. Other households experience relatively higher decreases between -1.38 and -2.86 per cent. The wage shock's positive impact on the remote and rural agricultural households' inter- and intra-household transactions explains the relatively smaller income decreases for these households. The welfare impact of the wage shock on all households is thus expected to be small.

Like the wage shock, the government expenditure shock does not have a significant impact on household incomes. Government transfers to households make up a very small proportion on household total incomes. The simulated 5 per cent reduction in government expenditure results in a 1.02 per cent reduction in government transfers to households resulting in household income reductions between 0.16 and 0.86 per cent. All, but one, households experience income reductions of less than 0.5 per cent. Associated utility changes are between -0.22 and -3.10 per cent.

The HIV/AIDS shock accounts for most of the household income and utility reduction. Remote and rural household's incomes decrease by between 2.62 and 3.75 per cent as a result of the HIV/AIDS shock. Other households' incomes decrease by between 6.20 and 10.02 per cent. By comparison the HIV/AIDS shock has a much bigger impact on the urban and large rural agricultural households than on the remote and rural small and medium agricultural households. There is therefore a similar pattern of impact by the three shocks. All three shocks, in isolation, affect urban, rural non-agricultural, and rural large agricultural households more than they affect the remote and rural small and medium households.

Household utility changes associated with the HIV/AIDS shock are correspondingly high, ranging from 15 to 26 per cent for eight of the eleven household types, and between 46 and 58 per cent for the other three.

The combined shock exhibits similar characteristics to its component shocks in its impact on household incomes. Its impact is relatively greater among urban and large rural agricultural households with income decreases ranging from 8.17 to 12.93 per cent. In comparison, income decreases among remote and rural agricultural households range between 3.62 and 4.76 per cent.

This chapter concludes also that the impact of the HIV/AIDS epidemic as modelled through the various scenarios affects different households in different ways. The importance of this observation is that it suggests that development of successful mitigation strategies needs to take into account the different impacts on different households. A one-size-fits-all type of strategy is not likely to meet the different needs of the different households. HIV/AIDS mitigation strategies therefore need to be specific and targeted at particular households if they are to be successful.

## **6.6 Contribution**

This chapter has presented the first results of the HIV/AIDS impact on disaggregated households in a general equilibrium framework. Existing CGE studies of HIV/AIDS impacts have been largely limited to the impact of HIV/AIDS on per capita GDP and overall growth in GDP, see for example (Arndt, 2006; Arndt & Lewis, 2000, 2001; Kambou et al., 1992).

This study has taken advantage of the CGE framework's ability to disaggregate household types while maintaining their links with other institutions in the economy to simulate how HIV/AIDS impacts on their well-being. This framework, by taking into account the economic interactions among the different economic institutions, enables us to explicitly take account of the important linkages and feedback effects that affect their interactions. The results are thus richer in the sense that they are based on a lot more information than if a partial equilibrium analysis framework had been used.

By quantifying the changes in incomes and utility of the households in the model, a clearer picture of the various extents of household-welfare loss is obtained. Such information can be utilised in the formation of mitigation strategies. It can also be valuable in helping to prioritise the expenditure of scarce impact mitigation resources.

Quantifying the impacts of each of the shocks helps to identify which shocks are relatively more important. Knowledge of this information can help in targeting particular strategies for promotion.

The results of this chapter are also the first results of a CGE study that focuses on the impact of HIV/AIDS on Zambian households. Other studies have documented the impact of HIV/AIDS on Zambian households using other methodologies (see for example (Nampanya-Serpell, 2000, 2001; Wiegers et al., 2006)).

Both Nampanya-Serpell's studies were based on retrospective data collected from households in which one or both parents had died from AIDS between 1991 and 1995. Though data were collected from both urban and rural areas, the two locations from which the data were collected were hardly representative of the urban and rural areas and the existing extent of the HIV/AIDS situation. The Wiegers et. al. study was conducted in the Northern Province of Zambia. The data for this study was qualitative information from interviews with 231 households and quantitative data obtained from 508 households. The generalisation of the results of these studies is thus limited by the study designs, especially that of being based on data from a very specific area of the country. The Northern Province of Zambia is one of two provinces with the lowest HIV/AIDS prevalence rates in the country.

In contrast to the studies mentioned above, this study's data is not specific to any parts of the country and takes into account all household types regardless of whether they have had an AIDS-related death or not. The effects of HIV/AIDS-related mortality, as noted earlier, are not limited to households that have experienced an HIV/AIDS-related death. The impacts of HIV/AIDS affect all households either directly or indirectly through among other ways higher commodity prices, reduced quality public sector services, loss of income-providing jobs, or fostering orphans from HIV/AIDS affected homes. This study acknowledges that no household is spared the impact of HIV/AIDS, but at the same time acknowledges that impacts will be household specific because of the different initial conditions in different households that affect their ability to deal with the adverse impacts of the epidemic.

## **Chapter 7 HIV/AIDS and Its Impact on Rural Public Sector Workers**

### **7.1 Introduction**

Some authors have suggested that HIV/AIDS would have a devastating impact on the economic development of rural areas because of its impact on the willingness of public sector workers to live and work in rural areas. They have argued that skilled public sector workers would be less willing to live and work in rural areas because access to adequate HIV/AIDS-related healthcare services was not readily available in rural areas.

The presence of skilled public sector workers is seen as a vital ingredient in the implementation of government efforts to improve the economic well-being of rural populations. Provision of essential public services such as education and healthcare require the presence of skilled workers. The prevalence of HIV/AIDS among teachers and medical personnel in Zambia is as high as it is in the general population. Access to life-prolonging ARVs is thus vital to the survival of such infected workers. It is conceivable that if access to life-prolonging drugs is difficult in rural areas, workers that need them would not want to live and work in rural areas. Overstaffing in some urban government institutions has been attributed to the public sector practice of placing sick workers in areas where they can be close to medical care (Kamwanga et al., 2003; M.J. Kelly, 2000). It is clear that given the high HIV/AIDS prevalence rate, this practice would lead to understaffing in rural areas where healthcare services are not readily available and, overstaffing in urban areas.

### **7.2 Some salient rural Zambian issues**

Kelly argues that there are many vacancies in rural public schools because HIV-positive teachers don't want to be posted to rural areas where they would have difficulty accessing appropriate medical services. The issue is compounded by other factors such as transport services which are severely lacking in most rural areas. It is not uncommon for public sector workers in remote rural areas to walk for several hours to get to where they can find public transport. When available, transport in remote rural areas tends to be significantly more costly than it is in

urban areas. Thus transport costs are also a barrier to access to essential services for remote and rural-based public sector workers.

The issue of travel for many rural-based public sector workers results in their spending significant amounts of time away from their work. This results in a lot of productive work-time being lost as it is spent on travelling long distances to access essential services. The effectiveness of such workers is thus compromised due to the reduced amount of time they spend on their work. The effects of such workers' absence may be transmitted to their workmates who have to pick up extra duties to cover for them. With many people infected, the amount of productive time lost in this way is significant and severely diminishes the effectiveness of the services such workers are meant to provide. An example to illustrate this point is that of teachers. Teachers in remote rural areas travel long distances to collect their monthly salaries. The travel takes place during teaching time because banks are closed on weekends when teachers are not teaching. If these teachers have to travel similar distances to access life-saving medical services, then more teaching time is lost. The quality of education for children in their areas diminishes considerably due to significant loss of contact time between teachers and students. (Das, Dercon, Habyarimana, & Krishna, 2005), have estimated that a 5 per cent increase in teacher absenteeism reduces learning achievement by between 4 and 8 per cent in English and Mathematics for that academic year. As education is probably the most important factor in the improvement of rural children's future lives, the decreasing quality of education they are getting reduces their chances of advancing to higher education and getting better paying jobs in the future.

When essential medical services are available in rural areas, problems associated with stigma and confidentiality arise. It is argued that because population size tends to be small in rural areas, the identities of those accessing HIV/AIDS-related services quickly and easily become widely known in their communities. Blame for this state of affairs has been partly attributed to indiscretion among the service providers. This lack of confidentiality causes people who need HIV/AIDS-related services to travel and access the services in other locations where they may not be known. This, however, means that they incur significant travel costs which could be avoided if they lived in urban areas

which have larger populations and offer anonymity to users of these essential services.

Stigma and discrimination are still major issues that people living with HIV/AIDS face. These issues tend to be more prevalent in rural areas where the populations may not be as well informed about HIV/AIDS. Individuals with HIV/AIDS may thus wish to avoid living and working in an area where their condition would be revealed, and they and their families would be stigmatised and discriminated against. These issues can, to some extent, be avoided by living in urban areas where there are many access points to vital medical services that offer individuals anonymity.

If these factors adversely affect the willingness of public sector workers to live and work in rural areas, then HIV/AIDS can be said to have an adverse effect on the implementation of government efforts to provide good quality public services that enhance rural populations' lives. In this way HIV/AIDS can be said to have an adverse effect on the economic development of rural areas.

### **7.3 Survey of rural-based public sector workers**

To ascertain whether HIV/AIDS adversely affects the willingness of public sector workers to live in rural areas, I carried out a survey among rural-based public sector workers in the Western and Southern Provinces of Zambia. With adult HIV/AIDS prevalence rates of 15.2 and 14.5 per cent respectively, these provinces have among the highest prevalence rates in the country (CSO et al., 2009).

In the Western Province, the survey was conducted in Kaoma, Mongu and Senanga districts. In the Southern Province, Mazabuka, Monze, Gwembe and Choma districts were surveyed. Kaoma and Senanga districts have estimated adult prevalence rates of 10 per cent each while Mongu has a prevalence rate of 22.2 per cent. In the Southern Province Mazabuka has 22.5 per cent, Monze and Choma 19.2, and Gwembe 7.5 per cent (CSO, 2005a).

The survey was conducted among public sector workers whose geographical location was several kilometres distant from the administrative centres of the selected districts. As a result, most respondents were either basic school teachers or healthcare workers. Other respondents included police officers, agricultural and veterinary extension officers, secondary school teachers, and

judiciary and court officials. Basic school teachers, however, made up the majority of respondents.<sup>34</sup>

The survey was voluntary, anonymous and self-administered. It collected participants' demographic and socio-economic data in addition to HIV/AIDS-knowledge and impact data. The purpose of the survey was explained to potential participants at their places of work, after which they were given the opportunity to ask questions and decide whether they wanted to participate or not. Questionnaires were left with those that agreed to participate and picked up a day later, in some cases two days later. Out of 520 questionnaires that were handed out, a total of 402 completed ones were picked up. The response rate was 77.3 per cent. The survey was carried out from mid-January to early March 2010.

The choice of public sector institutions visited and surveyed was determined in consultation with the District heads of departments to which those institutions belonged. The overriding criteria were that the institution be in a rural location and be accessible by car. Institutions deemed inaccessible were not considered.<sup>35</sup>

The survey was granted ethical approval by the Ethics Committee of the Waikato Management School, University of Waikato. Approval to conduct the survey among public sector workers in Zambia was granted by the Secretary to the Cabinet of the Zambian government. Additionally, permission was sought from and granted by the District Commissioners and district heads of the departments who kindly provided letters of introduction.

#### **7.4 Modelling the probability of willingness to live in rural areas**

The data collected were used to model whether HIV/AIDS-related variables had a significant impact on the willingness of public sector workers to live and work in rural areas. A binary variable for willingness to live in rural areas was created with values 1 for willing and 0 for unwilling to live in a rural area. This variable was created from the survey question that asked respondents

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<sup>34</sup> Basic schools provide the first seven years of primary school education and the first two years of junior secondary school education.

<sup>35</sup> The survey was carried out during the rainy season. During this season some roads deteriorate so much that some areas are accessible only by large vehicles.

to indicate their willingness on a scale of 0 to 10, with 0 indicating unwillingness, 5 indifference, and 10 willingness. All values less than 5 were taken as indicating unwillingness and all values greater than 5 were taken as indicating willingness. Those with a value of 5 indicating indifference were omitted from the regression analysis. A total of 207 observations were used in the regression analysis.

As the dependent variable, willingness, was a binary variable, probit regression was used to model the probability of willingness to live in rural areas.

To test the hypothesis that HIV/AIDS affects the willingness of public sector workers to live and work in rural areas, several econometric models based on the survey data were estimated. While it was hypothesised that willingness to live and work in rural areas would be affected by not only HIV/AIDS-related factors, but also by demographic, and socio-economic factors, models with variables of one type only were initially estimated to establish the impact of each type of variable.

#### **7.4.1 Description of the variables**

##### **7.4.1.1 Demographic variables**

Table 35 shows the demographic variables that were considered and their expected direction of influence on Willingness.

**Table 35 Demographic variables and their expected signs**

<b>Variable</b>	<b>Expected direction of impact</b>
Gender (dummy, 1 if female, 0 otherwise)	(-) for females, (+) for males
Age (years, midpoint of age-group)	(+)
Marital status (dummy, 1 if married, 0 otherwise)	(+)
Household size (number of people)	(+)
Educational attainment (years)	(-)

##### **7.4.1.1.1 Gender**

The difficulties associated with rural life were postulated to have a larger negative impact on female employees' probability of willingness to live in rural areas compared to males'. Among these difficulties are issues related to lack of transport services, unavailability of adequate healthcare services, and difficult access to consumption goods and services. Males might be better able to cope with these difficulties than females because they can either cycle or walk long

distances, and generally tend to cope better without adequate healthcare services and without a lot of consumption goods and services.

#### **7.4.1.1.2 Age**

Younger workers were postulated to not want to be based in rural areas compared to older workers. Older workers who were more established in their jobs might be more likely to have developed coping mechanisms and be content to be in rural areas where they would be able to engage in other income generating activities.

#### **7.4.1.1.3 Marital status**

Married couples might be expected to be more willing to live in rural areas because of the lower cost of living which makes it cheaper to raise children in rural areas than in urban areas. The ability to engage in other income generating activities adds to the attractiveness of rural areas for married workers. Unmarried individuals on the other hand are unlikely to want to be based in a rural area because of the difficulties associated with managing both work and household activities under difficult circumstances.

#### **7.4.1.1.4 Household size**

Workers with larger families might find it easier to raise their families in rural areas than in urban areas. The lower cost of living in rural areas and ability to engage in some forms of agricultural activities reduce food costs for workers with large families. Rural areas are thus an attractive option for these workers.

#### **7.4.1.1.5 Educational attainment**

Workers with more years of education, especially those with college (14 years) and university education (16 years or more), were less likely to live in rural areas. In the education sector, for example, there are hardly any teachers with university education teaching in primary or basic schools. Only a handful of head-teachers have a university level education. Most teachers with a university level education teach in secondary schools which are generally not situated in rural or remote locations. There were, however, four high schools, three in what may be termed rural settings and the other in a remote setting, that were included in the survey. More years of educational attainment are thus largely associated with a reduced likelihood of living and working in a rural area.

#### 7.4.1.2 Socio-economic variables

**Table 36 Socio-economic variables and their expected signs**

Variable	Expected direction of impact
Income (from formal employment, ZK millions)	(-)
Extra Income (from other activities, ZK millions)	(+)
Distance to hospital or clinic (Km)	(-)
Distance to school (Km)	(-)
Time in job (years)	(+)
Time in location (years)	(+)

##### 7.4.1.2.1 Income

Higher income is associated with higher educational attainment which is in turn associated with less probability of being located in rural or remote areas. Increasing income levels are thus expected to have a negative impact on willingness to live in rural areas.

##### 7.4.1.2.2 Extra income

Ability to engage in other income generating activities like farming is associated with being in rural areas where land for farming is readily available. Those able to supplement their formal employment incomes with earnings from such small-scale income generating activities are thus more willing to live in rural areas where they are able to do so.

##### 7.4.1.2.3 Distance to hospital

Unavailability of medical services within a reasonably distance was expected to have a negative effect on the willingness of female employees, employees with young families, and those in need of regular medical services for their well-being.

##### 7.4.1.2.4 Distance to school

Distance to school was expected to have a negative impact on willingness of most workers with school-age children to live in rural areas where schools were not located in close proximity. However, as most respondents were teachers who tended to be accommodated near their schools, this variable is not expected to have a significant negative impact on the modelling results.

#### **7.4.1.2.5 Time in job**

The longer an employee had been in their job the more established they would be and the more likely that they would have developed coping mechanisms for wherever they were located. Time in employment is important also for seniority at work. The more senior employees got the more content they were to be in rural areas where their seniority accorded them access to more work resources. This variable was thus expected to have a positive impact on willingness to be located in rural areas.

#### **7.4.1.2.6 Time in location**

The longer employees had been in a particular location, the more they would have been able to develop coping mechanisms to deal with whatever challenges they faced in their locations. This variable was thus expected to have a positive impact on willingness to live in rural areas the longer one had already been based there.

#### **7.4.1.3 HIV/AIDS-related variables**

HIV/AIDS-related variables included variables about individuals' general knowledge of HIV/AIDS, transmission of the virus, whether there was a cure for AIDS, whether individuals had been tested for HIV/AIDS, whether they were aware of the extent of the epidemic in the country and whether they were personally affected by HIV/AIDS at work. Other HIV/AIDS variables were about knowledge of workplace HIV/AIDS policies and whether knowledge of the difference between the urban and rural prevalence rates affected their willingness to live in rural areas.

The expected direction of influence of each of these variables is shown in Table 37.

**Table 37 HIV/AIDS-Related Variables and Their Expected Signs**

Variable	Expected Sign
Awareness of extent of HIV/AIDS (dummy)	?
General knowledge of HIV/AIDS	?
Tested for HIV (dummy, 1 if tested, 0 otherwise)	?
Knowledge of treatment methods	?
Knowledge of infection modes	?
Considered HIV/AIDS serious issue at work	(-)
Whether affected by HIV/AIDS at work (dummy)	(-)
Aware of workplace HIV/AIDS policy (dummy)	(-)
Urban-Rural prevalence difference (dummy)	(+)

#### **7.4.1.3.1 Awareness of the extent of HIV/AIDS**

Awareness of the extent of the HIV/AIDS epidemic can have either a positive or negative impact on the probability of willingness. The smaller populations in rural areas reduce the likelihood of engaging in multiple concurrent sexual relationships which are among the main modes through which HIV is spread. This should make rural areas more attractive. On the other hand awareness of the extent of the epidemic might be correlated with awareness of availability of treatment and care services. This would encourage individuals to want to stay in urban areas where these services are easier to access. Therefore, a priori, it is not clear what the impact of awareness is.

#### **7.4.1.3.2 General knowledge, treatment and infection modes of HIV/AIDS**

The directions of influence of these variables are not clear. While one would have expected that individuals with more education would be less likely to be infected, in Zambia HIV/AIDS prevalence increases with the level of education.<sup>36</sup> It seems that contrary to expectation, better knowledge of HIV/AIDS

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<sup>36</sup> The 2007 Zambia Demographic and Health Survey found prevalence rates of 10 per cent among the uneducated, 13.7 per cent among those with primary school education, 15.1 per cent among those with secondary school education and 19.3 per cent among those with more than secondary school education.

which is associated with higher educational attainment does not, in Zambia, offer much protection against infection by modifying individuals' sexual behaviour.

#### **7.4.1.3.3 Tested for HIV**

Knowledge of one's HIV status is considered an important factor for behaviour change. It helps HIV negative individuals make decisions that reduce the risk of infection and encourages safer sex practices. It also provides an important link to treatment and care services for those that test positive. Other than women tested while accessing maternity services, the majority of Zambians have not been tested for HIV and do not know their sero-status.<sup>37</sup> One would expect that those that have voluntarily been tested and found to be HIV negative would want to protect their sero-status by being in areas with lower prevalence that also offer fewer opportunities for infection. On the other hand, those that test positive may want to be located where they can easily access medical care. Therefore the direction of influence of this variable is also not clear a priori.

#### **7.4.1.3.4 Consider HIV/AIDS serious issue at work**

This variable is expected to reduce the willingness of workers to live in rural areas. If HIV/AIDS is a serious issue at work, it is more likely that there will be significant staff shortages and therefore extra burden on available workers. Replacement workers are harder to get in rural areas than in urban areas. Thus rural-based workers are more likely to be burdened by the high mortality or morbidity among their fellow workers than urban-based workers

#### **7.4.1.3.5 Whether affected by HIV/AIDS at work**

Like the previous variable, this variable is expected to have a negative impact on the willingness of workers to be based in rural areas. The burden associated with staff shortages and extra duties covering for colleagues will be a disincentive for being in a rural area where it is not easy to find replacement staff.

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<sup>37</sup> Of those tested during the 2007 ZDHS, 49 and 69 per cent of females and males that tested positive had never been tested before. Corresponding figures for those that tested negative were 62 and 79 per cent. An estimated 15 per cent of the population has gone for voluntary counseling and testing (VCT).

#### **7.4.1.3.6 Awareness of workplace HIV/AIDS policy**

This variable is expected to reduce the willingness of workers to live and work in rural areas. The public sector is committed to providing medical care to all HIV/AIDS affected employees (G.R.Z, 2006; MOH et al., 2006). However, it is more difficult for employees in rural and remote places to take advantage of this policy than it is for urban-based employees. Employees who are aware of this policy and in need of treatment are therefore expected to prefer being based in urban areas.

#### **7.4.1.3.7 Urban and rural prevalence difference**

This variable is expected to have a positive impact on the willingness of workers to live in rural areas. The lower rural prevalence lowers the likelihood of being infected if one were based in a rural area. Access to commercial sex services, and opportunities for multiple sexual relationships are relatively limited in rural areas compared to urban areas. These factors, to some extent, offer protection to rural-based workers and should encourage workers to stay in rural areas.

#### **7.4.1.4 Modelling results**

Probit regressions, with the binary variable Willingness as the dependent variable, were used to model the probability of willingness to live in a rural area. With probit models, the values of the individual coefficients do not have the marginal effect interpretation that OLS estimates have. Rather, it's the signs of the coefficients and the predicted probability that are important. The coefficient sign provides an indication of the direction of influence of the variable on the probability of the dependent variable. The values of the coefficients are used to calculate the z value which is then used to find the probability from the cumulative standard normal distribution. The general probit regression model with multiple explanatory variables (X's) and binary dependent variable Y is thus

$$\Pr (Y = 1 | X_1, \dots, X_k) = \Phi (\beta_0 + \beta_1 X_1 + \dots + \beta_k X_k),$$

where  $\Phi$  is the cumulative standard normal distribution function. The model thus calculates the probability that the dependent variable Y is equal to 1, given the explanatory variables  $X_1$  to  $X_k$ . The application of the cumulative standard normal distribution function to the value calculated by the term in brackets on the

right hand side of the equation converts the linear looking equation into a non-linear one and converts the predicted values to probabilities with values in the range 0 to 1.

Probit regressions are estimated using maximum likelihood estimation. Maximum likelihood estimation involves an iterative process for selecting coefficients that maximise the likelihood of getting the observed values of the dependent variable in the sample. (Stock & Watson, 2003) and (Dougherty, 2002) show that the probability that  $Y_i = 1$ , conditional on  $X_{1i}, \dots, X_{ki}$ , is

$$p_i = \Phi(\beta_0 + \beta_1 X_{1i} + \dots + \beta_k X_{ki})$$

and that the conditional probability distribution for the  $i^{\text{th}}$  observation is

$$\Pr(Y_i = y_i | X_{1i}, \dots, X_{ki}) = p_i^{y_i} (1 - p_i)^{1-y_i}.$$

The joint probability distribution of all the  $Y$  values  $Y_1, \dots, Y_n$ , conditional on the observed explanatory variables,  $X$ 's, is thus the product of each observation's conditional probability distribution and is written as

$$\begin{aligned} \Pr(Y_1 = y_1, \dots, Y_n = y_n | X_{1i}, \dots, X_{ki}, i = 1, \dots, n) = \\ \Pr(Y_1 = y_1 | X_{1i}, \dots, X_{ki}) * \dots * \Pr(Y_n = y_n | X_{1n}, \dots, X_{kn}) = \\ p_1^{y_1} (1 - p_1)^{1-y_1} * \dots * p_n^{y_n} (1 - p_n)^{1-y_n}. \end{aligned}$$

The likelihood function is the joint probability distribution treated as a function of the unknown coefficients. Taking the logarithm of the likelihood function gives the log likelihood function written as

$$\begin{aligned} \text{Ln}[f_{\text{probit}}(\beta_0, \dots, \beta_k; Y_1, \dots, Y_n | X_{1i}, \dots, X_{ki}, i = 1, \dots, n)] = \\ \sum_{i=1}^n Y_i \text{Ln}[\Phi(\beta_0 + \beta_1 X_{1i} + \dots + \beta_k X_{ki})] \\ + \sum_{i=1}^n (1 - Y_i) \text{Ln}[1 - \Phi(\beta_0 + \beta_1 X_{1i} + \dots + \beta_k X_{ki})] \end{aligned}$$

Maximum likelihood estimation chooses values of the unknown coefficients that maximise the likelihood (or log likelihood) function. This is accomplished through numerical algorithms on computers. Most econometric software programmes compute and provide the likelihood and log likelihood values with probit regression output.

Goodness-of-fit measures include the percentage of correctly predicted values of the dependent variable and the log-likelihood ratio test. High percentages of correctly predicted values are desirable. However, the quality of prediction is determined by the model being able to correctly predict both values of the dependent variable in reasonable proportions. The log-likelihood ratio test can be used to test the explanatory power of the model via the likelihood ratio statistic calculated as

$$2 \ln \left( \frac{L}{L_0} \right) = 2 (\ln(L) - \ln(L_0))$$

where  $L$  is the likelihood of the unrestricted model and  $L_0$  is the likelihood of the model with no explanatory variables except for the constant (Ramanathan, 1992). This statistic is distributed as a chi-square statistic with  $k$  degrees of freedom, where  $k$  is the number of explanatory variables, under the null hypothesis that the coefficients of the variables are all jointly equal to 0.

Probit regression does not have the equivalent of an OLS R-squared statistic for testing the explanatory power of the model. A pseudo-R-squared, McFadden's pseudo-R-squared, is given by most regression software. This R-squared statistic compares the value of the maximised likelihood function with all the regressors to the value of the likelihood with none. It is clear from this that it does not measure the explained variation in the dependent variable as does the OLS R-squared statistic.

However, the probit standard errors from maximum likelihood estimation are robust and can be used for statistical inference in the same manner as the standard errors from ordinary linear regression. Thus  $t$ -statistics can be used to infer the significance of a coefficient.  $F$ -statistics can be used for joint tests of coefficient significance as can the chi-square statistic. Identical inferences result because of the following relationship between the  $F$  and chi-square statistics

$$\chi_q^2 = q * F$$

where  $q$  is the number of restrictions being tested. In large samples the  $F$  statistic has a chi-square distribution. The difference between the two statistics is therefore simply that one is multiplied by  $q$ , or that the other is divided by  $q$  (Halcoussis, 2005; Stock & Watson, 2003).

In this study the dependent variable is willingness to live in rural areas,  $W$ , while the explanatory variables are a combination of demographic, socio-economic and HIV/AIDS-related variables. The model is thus

$$\Pr(W = 1 | \text{demographic, socio-economic, HIV/AIDS-related variables}) = \Phi(\alpha + \beta_i(\text{demographic variables}) + \delta_i(\text{socioeconomic variables}) + \gamma_i(\text{HIV/AIDS variables})).$$

A preliminary investigation was carried out to estimate the effect of each of the variable sub-groups on willingness. The probability of  $W$  was evaluated at the mean values of all the variables. The results of all regressions estimated are presented in Table 44.

#### **7.4.1.4.1 Impact of the demographic variables**

Of the demographic variables, only the Age and HouseholdSize variables had positive impacts on the probability of willingness. The other three variables, Gender, MaritalStatus and EducationalAttainment had negative impacts. This means that married females with more educational attainment will have a reduced willingness, than both single and married males with similar educational attainment, to live in rural areas. The predicted probability of willingness for females is 0.65 compared to 0.70 for males. These predicted probabilities indicate that both females and males have a high probability of willingness to be in rural areas. However, none of the demographic variables were statistically significant even at the 10 per cent significance level. Model 1 in Table 44 presents the complete results for this regression.

Despite being able to correctly predict 65.2 per cent of the dependent variable observations, the model does not correctly predict any of the zero values of willingness. The quality of prediction of this model is thus poor. The likelihood ratio test has a chi-square statistic of 3.57 with a p-value of 0.613. This statistic suggests that the explanatory variables jointly have no explanatory power. The null hypothesis of the coefficients jointly being zero cannot be rejected given these statistics even at the 50 per cent significance level. The other goodness of fit measure, the McFadden pseudo-R-squared is also very low at 0.013. This statistic indicates that the model is not much better than the model without any explanatory variables.

All but one of the variables had the expected signs. Only MaritalStatus did not have the expected positive sign. Its negative sign may be a signal that females had a stronger influence than males on where married couples lived. This sign, however, changes as other variables are added to the regression equation.

By themselves, the demographic variables thus do not give a reliable prediction of the probability of willingness.

#### **7.4.1.4.2 Impact of the socio-economic variables**

As expected, income from formal employment and distance from hospital were found to have a negative impact on willingness (model 2 in Table 44). Extra income, time in job, stay at location, and distance from school all had a positive effect on willingness. Other than distance from school all variables had the expected direction of influence. Both distance variables and time in job have very low coefficient and t-statistic values indicating that they are probably not important factors in determining the probability of willingness.

Like the demographic model, the socio-economic variables model has very low predictive power. The number of cases correctly predicted at 136 (65.7%) is almost the same as the 65.2 per cent of the demographic variables model. The joint coefficient test, however, rejects the hypothesis that the coefficients are jointly equal to 0. This reflects the fact that the ExtraIncome variable is significant at the 5 per cent level of significance. The McFadden pseudo-R-squared is slightly better at 0.039. The three model selection criteria for the socio-economic variables are all better than the corresponding ones for the demographic variables model suggesting that this model is slightly better than the demographic variables model.

The results of this model suggest that the two income variables and the time in location variable, all with t-statistics greater than 1, may be useful in predicting the probability of willingness. However, like the demographic variables, the socio-economic variables by themselves are not reliable predictors of the probability of willingness because of the poor quality of prediction. These variables correctly predict 5.6 per cent of the zero values of the dependent variable compared to 97.8 per cent of the one values.

The predicted probability of willingness at the mean values of the variables is 0.663 for both females and males. Like the demographic variables,

the socio-economic variables also predict a high probability of willingness to live in rural areas. Model 2 in Table 44 presents the full results of this regression model.

#### **7.4.1.4.3 HIV/AIDS-related variables**

Though the predictive power of the HIV/AIDS-related variables is slightly lower at 65 per cent of cases, the quality of prediction is slightly better than that of either the demographic or socio-economic variables. The HIV/AIDS-related variables correctly predict slightly more zero values of willingness than the demographic or socio-economic variables. 9.72 per cent of the zero values are correctly predicted compared with 92.6 per cent of the one values. However, two of the three model selection criteria for this model (model 3 in Table 44) are worse than those of models 1 and 2.

Two of the HIV/AIDS knowledge variables, the GeneralKnowledge and TransmissionKnowledge variables, have negative signs while the third, the InfectionKnowledge variable, has a positive sign. This would suggest that a high general knowledge of HIV/AIDS and knowledge of transmission of HIV/AIDS reduces willingness to live in rural areas. This is reinforced by the negative sign of the Awareness variable which measures whether individuals were aware of the extent of the epidemic in the country. While the general knowledge and transmission variables are not statistically significant, the awareness variable, with a t-statistic of -41.76, is statistically significant at the 5 per cent significance level. These results make sense when looked at in combination with the finding that educational attainment was also found to have a negative sign. As knowledge of HIV/AIDS is associated with higher educational attainment which is associated with a reduced willingness to live in rural areas, it makes sense that the HIV/AIDS knowledge variables would also have a negative sign. This, however, does not explain why the third knowledge variable has a positive sign. A plausible explanation for this negative sign is that awareness of infection modes might be correlated with treatment knowledge. As treatment is easier to access in urban areas than in rural areas, this would reduce willingness to live in rural areas. Other variables with t-statistics greater than 1 include the transmission knowledge, the Serious and the Rural-Urban prevalence rate variables.

This model predicts a probability of willingness of 0.718. This result suggests that despite the presence of HIV/AIDS, public sector workers'

probability of willingness to live in rural areas is still high. The combination of the very low pseudo-R-square of 0.031 and worsening model selection criteria suggests, however, that this model, like models 1 and 2, is not a very good predictor of the probability of willingness. The likelihood ratio chi-square value of 8.07 with a p-value of 0.56 fails to reject the null hypothesis that the coefficients of the variables are jointly equal to 0.

It is clear from the low goodness-of-fit statistics and poor quality of prediction of these three models that they do not give reliable estimates of the probability of willingness to live in rural areas. It is most unlikely that only one category of variables would be taken into account when an individual was deciding where they wanted to live. Combinations of demographic, socioeconomic and HIV/AIDS variables are more likely to give a better fit to the data and better quality of prediction and therefore more reliable estimates of the probability of willingness.

#### **7.4.1.4.4 Combination of demographic and HIV/AIDS variables**

A combination of demographic and HIV/AIDS variables is likely to be a better combination of factors that affect individuals' willingness to live in rural areas because the impact of HIV/AIDS is felt differently by individuals in different age-groups and at different stages in their lives. For example, young people who are just starting out in their jobs may be more willing to work wherever they are posted because they may be grateful to just have a job, while older experienced workers may have more bargaining power with their employers and therefore be more selective of where they would be willing to be based. Demographic and socio-economic characteristics may therefore play significant roles in decisions about where individuals are willing to live.

The model with HIV/AIDS and demographic variables where, as previously defined, Y is the dependent variable, Willingness, and the X's are the explanatory variables, is thus

$$\Pr(Y=1|X_1, X_2, \dots, X_{17}) = \Phi(\beta_0 + \beta_1 \text{GenderD} + \beta_2 \text{Age} + \beta_3 \text{MaritalD} + \beta_4 \text{HHSIZE} + \beta_5 \text{Educ} + \gamma_1 \text{Awareness} + \gamma_2 \text{GeneralKnwldg} + \gamma_3 \text{TestedD} + \gamma_4 \text{TrnsmttnKnwldg} + \gamma_5 \text{InfectionKnwldg} + \gamma_6 \text{SeriousD} + \gamma_7 \text{AffctWrkD} + \gamma_8 \text{WrkPlcyD} + \gamma_9 \text{RrlUrbRateD} + \lambda_1 \text{Age} * \text{HHSIZE} + \lambda_2 \text{MaritalD} * \text{GeneralKnwldg} + \lambda_3 \text{MaritalD} * \text{TestedD}).$$

This model includes three interaction variables between Age and Household size, Marital status and HIV/AIDS General knowledge, and Marital status and having been Tested for HIV/AIDS. It seems plausible that age and household size would interact because older individuals tend to have larger households as they assume more extended family responsibilities compared to younger individuals. Therefore household size will be affected by age. Marital status and general HIV/AIDS knowledge interact because married individuals are more likely to discuss HIV/AIDS issues with their spouses than unmarried individuals. Marital status interacts with being tested because females attending ante-natal services are routinely tested. This however tends to make some men refrain from being tested because they assume that if their spouses tested negative (or positive) then they too would be negative (or positive). So while being married makes more women get tested, it also reduces the number of men who voluntarily go for sero-testing. Marital status also has a negative impact on women being voluntarily tested outside of their ante-natal services. Being voluntarily tested could be interpreted as a signal of one's infidelity or lack of trust of one's partner. Many married women thus avoid voluntary testing to avoid the likely unpleasant repercussions from their spouses if they did so (National HIV/AIDS/STI/TB Council, 2004; Sibanda, 2008).

The estimated equation is

$$\begin{aligned} \text{Pr}(\text{Willingness} = 1 | \text{demographic \& HIV/AIDS variables}) = & \Phi(4.06 - \\ & 0.18 * \text{GenderD} + 0.06 * \text{Age} + 0.91 * \text{MaritalD} + 0.26 * \text{HHSIZE} - 0.02 * \text{Educ} - \\ & 5.94 * \text{Awareness} + 0.32 * \text{GeneralKnwldg} + 0.29 * \text{TestedD} - 0.30 * \text{TrnsmttnKnwldg} \\ & + 0.09 * \text{InfectionKnwldg} + 0.26 * \text{SeriousD} + 0.13 * \text{AffctWrkD} - 0.16 * \text{WrkPolicyD} \\ & + 0.27 * \text{RrlUrbRateD} - 0.01 * \text{Age} * \text{HHSIZE} - 0.59 * \text{MaritalD} * \text{GeneralKnwldg} - \\ & 0.13 * \text{MaritalD} * \text{TestedD}). \end{aligned}$$

The predicted probabilities of willingness for females and males are 0.9982 and 0.9986 respectively. This combination of demographic and HIV/AIDS-related variables predicts that the probability of individuals' preference for rural areas is almost 1 for both females and males given the demographic and HIV/AIDS variables included in the estimation. The results of this model are shown as model 4 in Table 44.

The number of cases correctly predicted for this equation is 144 (70.9 per cent). Its log-likelihood is slightly higher than the first three equations estimated.

Though all the three model selection criteria are worse than those of the earlier equations, the quality of prediction of this model is significantly better in terms of its being able to correctly predict significantly more of the zero values (32 per cent) of the dependent variable. This equation is thus a significant improvement over the first three equations.

Most variables in this estimated equation have the expected directions of influence on the probability of willingness. As in model 3, Awareness of the extent of the epidemic has a negative sign in model 4. The negative sign suggests that being aware of the extent of the epidemic in the country would reduce the willingness of individuals to live and work in rural areas. Another possible explanation for this sign is that as the rates of voluntary testing are very low many individuals are not aware of their sero-status. They would, as a precautionary measure, thus prefer to be in urban areas where they could take advantage of the public sector policy of providing free HIV/AIDS healthcare services to infected workers and easily access life-prolonging drugs should they turn out to be infected.

The GeneralKnowledge variable coefficient changes sign from negative in model 3 to positive in this model. However, the coefficient is statistically insignificant. Other unexpected signs are the positive signs of the Serious and AffectedAtWork variables. It was postulated that the difficulty of getting extra staff in rural areas would discourage individuals from being based in rural areas if they thought HIV/AIDS was a serious issue in their line of work or if they were significantly affected by the impact of HIV/AIDS at work. However, the positive sign of these variables suggests that they increase the probability of individuals wanting to be based in rural areas. A possible explanation could be that such individuals want to get away from the stress associated with the higher mortality and morbidity of colleagues and friends in urban areas. With fewer workmates and lower HIV/AIDS prevalence in rural areas, there is the possibility of reduced HIV/AIDS-related stress among rural-based workers. This is supported by the observation that the Rural-Urban prevalence rate variable also has a positive sign. This variable suggests that individuals who are aware of the difference between the urban and rural prevalence rates are more likely to want to be in rural areas.

Though this combination of variables suggests a strong likelihood of individuals preferring to live in rural areas it does not include socio-economic

variables which should add more richness to the data and information that individuals would take into account when deciding where they wanted to live. Addition of socio-economic variables should therefore provide a more complete model for estimation of the probability of willingness to live in rural areas.

#### **7.4.1.4.5 Combining demographic, socio-economic and HIV/AIDS-related variables**

Results of model 5 with a combination of all demographic, socio-economic and HIV/AIDS variables are shown in Table 44. Though this model has the highest log-likelihood ratio (-113.031) and the highest pseudo-R-squared (12.7 per cent), it has a low prediction percentage of 68 per cent of the dependent variable observations. The dependent variable prediction quality is good at 33.3 and 84.4 per cent of the zero and one values, respectively. The model selection criteria are, however, worse than those of all previous models.

Most of the variables in this model are statistically insignificant, with only the two income variables out of the six socio-economic variables having t-statistics greater than 1. Of the nine HIV/AIDS-related variables, two variables, Awareness and Serious, have a t-statistics greater than 1. High multicollinearity associated with interaction variables is responsible for the low variable t-statistics in this model. Table 45 shows the variance inflation factors of the coefficients in this model and indicates the presence of high levels of multicollinearity. Though the results suggest that most of the variables have little or no explanatory power, this may be purely due to the high collinearity which affects the standard errors and therefore the t-statistics, but not the estimated coefficients.

The model's predicted probabilities are shown in Table 38. These probabilities suggest that marital status does not make a significant difference to the probability of willingness whether individuals have been tested for HIV/AIDS or not. However, holding marital status constant, having been tested for HIV/AIDS increases the probability of willingness considerably. This means that the probability of willingness of tested individuals is slightly higher than that of untested individuals irrespective of their marital status. Though being tested was statistically insignificant, these results suggest that it is an important factor in determining probability of willingness.

**Table 38 Predicted probabilities of willingness for model 5**

Gender	Tested for HIV/AIDS		Not Tested for HIV/AIDS	
	Married	Unmarried	Married	Unmarried
Female	0.7424	0.7325	0.7087	0.6983
Male	0.7619	0.7524	0.7296	0.7194

Table 39 shows the changes in probability of willingness when each of the HIV/AIDS variables is given a coefficient value of zero while holding all the other variables constant at their estimated values.

**Table 39 Impact of HIV/AIDS variables on probability of willingness for married individuals (Model 5)**

Variable	Prob <sub>F</sub>	Prob <sub>M</sub>	%ΔProb <sub>F</sub>	%ΔProb <sub>M</sub>
AwarenessD	1.00	1.00	34.7	31.3
TestedD	0.7087	0.7296	-4.6	-4.2
General Knwl	0.6097	0.6332	-17.9	-16.9
TransmKnwl	0.833	0.848	12.2	11.3
InfectionKnwl	0.6617	0.684	-10.9	-10.2
SeriousD	0.658	0.6804	-11.4	-10.7
AffetWrkD	0.7282	0.7483	-1.9	-1.8
WrkPlcyD	0.7733	0.7915	4.1	3.9
R/UrateD	0.7313	0.7513	-1.5	-1.4

Prob<sub>F</sub> and Prob<sub>M</sub> represent females' and males' probabilities of willingness.

The results in Table 39 show that of the HIV/AIDS-related variables, change in the awareness variable causes the largest change in the probability of willingness for both females and males. Holding all other variables constant a change in awareness increases the probability of willingness to 1.0 for both females and males from their estimated values of 0.7425 and 0.7619 respectively. The transmission knowledge and work policy variables, like the awareness variable, also have positive impacts on the probability of willingness though the magnitudes of change are considerably smaller. Of the variables reducing the probability of willingness, the general knowledge, serious, and the infection knowledge variables have the largest impacts. The magnitudes of the changes caused by each of these variables suggest that each variable has a considerable impact on the probability of willingness through their coefficients.

The statistical insignificance of most variables in this model may be explained by the presence of multicollinearity among the variables associated with the inclusion of the interaction variables. Table 45 presents the variance inflation factors associated with all the variables in this model. It is clear from this table that the multicollinearity is to be expected because the interaction variables are linear combinations of other variables within the model. The multicollinearity is therefore not a problem because it does not affect the variable coefficients and we are not interested in forming coefficient confidence intervals.

Models 6, 7 and 8 exclude various statistically insignificant socio-economic, HIV/AIDS-related, and interaction variables. Their predictions and quality of prediction of the values of the dependent variable are almost the same. The models correctly predict 69.5, 69 and 70 per cent of the values of the dependent variable respectively. The log-likelihood values of the three models are also similar, as are the pseudo-R-squared values. All three model selection criteria of model 7 are, however, better than those of the other two models. The log-likelihood ratio test also suggests that model 7's combination of explanatory variables is more likely to have produced the observed values of the dependent variable than those of models 6 and 8.

Model 7 is also more parsimonious than models 6 and 8. This feature combined with the better model selection criteria makes Model 7 a better model than models 6 and 8 despite the other similarities between the models.

A common feature of these models is that all the HIV/AIDS-related variable coefficients have the same signs across the three models. This consistency of coefficient signs gives confidence about the estimated directions of the variables' influence on the dependent variable.

Table 40 shows the changes in the predicted probabilities of willingness from the predicted values of 0.674 for females and 0.706 for males when the coefficients of each of the HIV/AIDS-related variables in model 7 are changed to zero holding all the other variables' coefficients constant. This test shows that probability of willingness of those that did not consider HIV/AIDS a serious issue at work and those lacking general knowledge of HIV/AIDS decreased the most. Not being tested, closely followed by a lack of knowledge about infection modes also have significant negative impacts on the probability of willingness. A lack of

knowledge of workplace HIV/AIDS policy, however, has a positive impact on the probability of willingness for both females and males.

**Table 40 Impact of HIV/AIDS variables on probability of willingness of married individuals (Model 7)**

Variable	Prob <sub>F</sub>	Prob <sub>M</sub>	%ΔProb <sub>F</sub>	%ΔProb <sub>M</sub>
TestedD	0.6284	0.6613	-6.8	-6.3
General Knwl	0.5992	0.6330	-11.1	-10.3
InfectionKnwl	0.6399	0.6724	-5.1	-4.7
SeriousD	0.5910	0.6249	-12.4	-11.4
AffetWrkD	0.6561	0.6880	-2.7	-2.5
WrkPlcyD	0.7084	0.7380	5.1	4.6
R/UrateD	0.6629	0.6945	-1.7	-1.6

The results in Table 40 show that none of the HIV/AIDS-related variables have a large enough impact to reduce the probability of willingness below 0.5 for either females or males. The significance of this observation is that none of the HIV/AIDS variables has enough impact on individuals to make them want to leave rural areas for urban areas. The changed probabilities still show a preference for rural areas to urban areas.

The corresponding figures for unmarried individuals are presented in Table 41.

**Table 41 Impact of HIV/AIDS variables on probability of willingness of unmarried individuals (Model 7)**

Variable	Prob <sub>F</sub>	Prob <sub>M</sub>	%ΔProb <sub>F</sub>	%ΔProb <sub>M</sub>
TestedD	0.6169	0.6502	-7.0%	-6.5%
General Knwl	0.5875	0.6216	-11.4%	-10.6%
InfectionKnwl	0.6285	0.6614	-5.3%	-4.8%
SeriousD	0.5792	0.6134	-12.7%	-11.7%
AffetWrkD	0.6449	0.6772	-2.8%	-2.6%
WrkPlcyD	0.6980	0.7281	5.2%	4.8%
R/UrateD	0.6518	0.6839	-1.7%	-1.6%

The changes for unmarried individuals are similar in magnitude to those of married individuals. As previously observed, marital status does not seem to have a significant impact on the probability of willingness.

Using Model 7, the overall impact of the absence of the HIV/AIDS variables on the probability of willingness is to reduce the probabilities from 0.6634 and 0.6950 for unmarried females and males respectively to 0.4193 and 0.4541. For married females and males the corresponding figures are increases from 0.6743 and 0.7055 to 0.7048 and 0.7346 respectively. The probabilities of married individuals were 1.6 and 1.5 per cent higher than those of unmarried females and males respectively before the change in HIV/AIDS coefficient values. After the change, however, the differences increase significantly to 68.1 and 61.8 per cent respectively. The presence or absence of the HIV/AIDS variables therefore has a significant impact on the probabilities of willingness.

In this model, removing the HIV/AIDS variables reduces the willingness below 0.5 for the unmarried. This means that unmarried individuals would be unwilling to live in rural areas in the absence of HIV/AIDS. Including the HIV/AIDS variables reverses this result. This suggests that instead of reducing the willingness of unmarried individuals to live in rural areas, HIV/AIDS increases their willingness to do so. This result is contrary to what has been previously stated about the impact of HIV/AIDS on individuals' willingness to live in rural areas. For married individuals, the result is different. The absence of HIV/AIDS increases their willingness to live in rural areas by 4.5 per cent for females and 4.1 per cent for males.

A better fitting model, model 9, though it excludes most HIV/AIDS-related variables, is presented in Table 44. The only HIV/AIDS-related variables in this model are the Serious variable and the GeneralKnowledge interaction with MaritalStatus variable. All but two of the 13 variables are statistically significant at either the 5 or 10 per cent significance levels. The model correctly predicts 69 per cent of the dependent variable values. The quality of prediction at 30 and 90 per cent of the zero and one values of the dependent variable is also good. The log-likelihood ratio, Chi-square(13) value of 29.3403 with a p-value of 0.005856 is the best of all the models considered. This model also has some of the lowest values of the three model selection criteria values among all the models presented in Table 44.

This model with additional interaction variables is

$$\Pr(W = 1|X_1, X_2, \dots, X_{13}) = \Phi(\beta_0 + \beta_1 \text{GenderD} + \beta_2 \text{Age} + \beta_3 \text{MaritalD} + \beta_4 \text{HHSIZE} + \beta_5 \text{Educ} + \delta_1 \text{Income} + \delta_2 \text{ExtrIncome} + \gamma_1 \text{SeriousD} + \lambda_1(\text{Age} * \text{HHSIZE}) + \lambda_2(\text{Age} * \text{ExtrIncome}) + \lambda_3(\text{Age} * \text{LocYrs}) + \lambda_4(\text{MaritalD} * \text{GeneralKnwldg}) + \lambda_5(\text{Educ} * \text{Income}))$$

This model's estimated coefficients, their standard errors and t-statistics are reported in Table 42.

**Table 42 Estimated coefficients of the Model 9**

Variable	Coefficient	Std Error	t statistic
constant	2.111	2.660	0.794
GenderD	-0.194	0.203	-0.955
AgeYrs	0.056**	0.029	1.955
MaritalD	0.755**	0.457	1.653
HHSIZE	0.236**	0.134	1.769
EducYrs	-0.270	0.169	-1.591
Income	-2.943*	1.432	-2.056
ExtrIncome	2.684*	0.833	3.222
SeriousD	0.409*	0.200	2.042
Age*HHSIZE	-0.006**	0.003	-1.842
Age*ExtrIncome	-0.062*	0.023	-2.692
Age*Loc	0.001*	0.001	2.288
MaritalD*GeneralKnwldg	-0.413**	0.233	-1.774
Educ*Inc	0.187**	0.098	1.912

\* and \*\* individual coefficients statistically significant at the 5 and 10 per cent significance levels respectively.

While this model better fits the data, it isn't particularly helpful for the analysis of the impact of HIV/AIDS on the probability of willingness because it excludes most of the HIV/AIDS variables. It is, however, considered here for comparative purposes. Its predicted probabilities of willingness for married females and males are 0.681 and 0.713 respectively. For the unmarried, the corresponding probabilities are 0.665 and 0.698. Removing the HIV/AIDS-related variables in this model, results in predicted probabilities of 0.766 and 0.793 for married females and males respectively. The corresponding figures for unmarried females and males are 0.579 and 0.615 respectively.

Table 43 shows the percentage changes in the probability of willingness resulting from removing the impact of the HIV/AIDS variables. It shows that for married individuals the probability of willingness increases by 12.5 and 11.2 per cent for females and males respectively. On the other hand, for the unmarried, the probability of willingness decreases by 12.9 and 11.8 per cent for females and males respectively.

**Table 43 Impact of removing HIV/AIDS variables (model 9)**

	<b>Female<sub>m</sub></b>	<b>Male<sub>m</sub></b>	<b>Female<sub>u</sub></b>	<b>Male<sub>u</sub></b>
<b>Predicted Prob</b>	0.766	0.793	0.579	0.615
<b>Prob %Δ</b>	12.5	11.2	-12.9	-11.8

The subscripts m and u stand for married and unmarried respectively.

These results show that, though there are only two HIV/AIDS variables in this model, their impact on the probability of willingness is considerable and is similar for both married and unmarried individuals though in opposite directions. However, because the changes for married and unmarried individuals are in opposite directions, this opens up significant differences in the probabilities of willingness between the married and unmarried individuals when the impact of HIV/AIDS is removed. From being 2.4 per cent higher, the probability of willingness for married females ends up being 32.2 per cent higher than that of unmarried females, while that of married men increases from being 2.2 per cent higher to being 28.9 per cent higher than that of unmarried men.

The absence of the HIV/AIDS variables has resulted in an increase in the probabilities of willingness of married individuals and a reduction in the willingness of unmarried individuals. While marital status did not cause a significant difference in probability of willingness, the change in the values of the coefficients of the HIV/AIDS variables has caused the large differences referred to the previous paragraph.

## 7.5 Discussion

The pattern of the results of model 9, with fewer HIV/AIDS variables, is the same as that of model 7 above. In both models, absence of the HIV/AIDS variables reduces probability of willingness of unmarried individuals but increases that of married individuals.

The results of all the models considered point to a higher probability of willingness to live in rural areas regardless of marital status. It is interesting to note though that this result holds only as long as HIV/AIDS variables are included in the regression. When the HIV/AIDS variables are excluded, however, marital status becomes a significant determinant of the probability of willingness.

Table 40 and Table 41 show that of the HIV/AIDS variables, the general knowledge and serious variables have the most adverse impact on the probability of willingness for both married and unmarried individuals. The tables show also that the changes in probabilities, while not too dissimilar, are consistently slightly higher for females than for males for all the HIV/AIDS variables.

The calculated probabilities are similar for both genders though the male probabilities are slightly higher in all cases. This suggests that the impact of gender on the probability of willingness is minimal. This is consistent with the fact that the gender coefficient is statistically insignificant even at the 10 per cent significance level in both models 7 and 9, and all the other models presented.

Of the statistically significant variables, awareness of the extent of the epidemic has the largest impact on probability of willingness to live in rural areas. Irrespective of gender, marital status, having been tested or not, or the other HIV/AIDS variables, not being aware of the extent of the epidemic leads to a probability of willingness to live in rural areas of 1.0. Being aware, on the other hand, is associated with reduced probabilities of 0.74 for females and 0.76 for males (see model 5). Awareness of the epidemic is expected to be associated with educational levels. The higher the educational attainment level, the higher the level of awareness of the epidemic is expected to be. With higher educational levels associated with reduced probability of willingness, the expectation is that awareness will also have a negative impact on the probability of willingness. Both variables have the expected negative sign though the coefficient of education is statistically insignificant at the 10 per cent significance level. Given the high levels of HIV/AIDS awareness and relatively high levels of educational attainment among rural public sector workers in Zambia<sup>38</sup>, a high predicted

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<sup>38</sup> 97 per cent of survey respondents reported being aware of the extent of the HIV/AIDS epidemic in the country, and 93 per cent of respondents had at least a college education.

probability of willingness suggests that HIV/AIDS does not have a strong adverse effect on individuals' willingness to live in rural areas.

Other statistically significant variables include income from formal employment and income from other than formal employment. Income from formal employment is associated with educational attainment and has a negative impact on probability of willingness as expected. This may be explained by the association of high incomes and educational attainment levels with senior positions in employment of which there may not be many available in rural areas.

Living in rural areas affords individuals the chance to engage in other income generating activities like farming because of the easy availability of land in rural areas. The second income variable is thus expected to have a positive impact on the probability of willingness. This variable proves to be statistically significant and with the expected sign. The importance of this variable is underlined by the fact that if its coefficient is changed to zero, the predicted probabilities of willingness for females and males decrease from 0.74 and 0.76 to 0.47 and 0.50 respectively. The changes indicate a change from willingness to live in rural areas to unwillingness or indifference. Extra income may be important for rural workers who may be on lower formal employment incomes because of their relatively lower educational attainment levels. For example, the salaries of primary school teachers in rural areas are significantly lower than those of secondary school teachers in non-rural areas who have higher educational attainment levels. Senior education sector managers are rarely based in rural areas. As suitable employment for individuals with higher educational attainment is not available in rural areas, it is not surprising that their willingness to live in rural areas would be low.

Age and household size coefficients are significant at the 5 per cent and 10 per cent significant levels respectively (see models 4, 6, 7, 8 & 9). These variables have a significant positive correlation of 0.49.<sup>39</sup> As expected these variables have a positive impact on probability of willingness. Sixty-six per cent of survey respondents had households of between 5 and 10 people, while another seven per cent had households of between 11 and 16 people. Thus the majority of respondents had relatively large households. It would seem that living in rural

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<sup>39</sup> The 5% two-tailed critical value for  $n = 207$  is 0.1364

areas which afforded them the chance to engage in other income generating activities would be attractive to such individuals with relatively lower formal employment incomes but large households to support.

With increasing age comes extra extended family responsibilities which tend to increase household size. The relationship between age and household size tends to be significant as is the age-household interaction variable in models 4 and 5. Unexpectedly, this interaction variable has a negative sign suggesting a reduced probability in willingness to live in rural areas. Also unexpected is the negative sign of the interaction between age and extra income. A positive sign was expected as both age and extra income have positive impacts on the probability of willingness. This variable is statistically significant at the 5 per cent significance level suggesting that it has significant explanatory power.

The interaction between age and duration of location in a particular area also has a significant coefficient at the 5 per cent significance level in model 9. As expected this variable has a positive impact on the probability of willingness. The older an individual is and the longer they had been in a particular rural area, the higher their probability of willingness is expected to be. It is expected that the older an individual is and the longer they have been in a rural area, the better they are able to cope with the challenges of rural life.

The models explored in this chapter have included demographic, socio-economic and HIV/AIDS-related variables. Models with combinations of the different types of variables have a better quality of correctly predicting the values of the dependent variable. This is to be expected because all types of variables are taken into account in individuals' decision-making processes.

A common thread among all the models explored is that they predict a high probability of willingness to live in rural areas. Estimated probabilities in most cases exceed 0.6. Only in the extreme case of absence of all HIV/AIDS variables for unmarried people do we find predictions of low probabilities suggesting unwillingness. This scenario however is highly unlikely given the generalised epidemic in Zambia and government efforts to disseminate HIV/AIDS information among public sector workers. All public sector places of work have numerous HIV/AIDS posters on office walls and notice boards. In most schools, some classroom exterior walls are painted with various HIV/AIDS messages. It is therefore highly unlikely that there would be public sector workers who were not

aware of the seriousness of the HIV/AIDS epidemic in Zambia. We can probably justifiably dismiss this scenario as highly improbable. The more probable scenario is one of individuals being aware of the extent of the epidemic.

In this likely scenario, the various models explored all predict a high probability of willingness. Most of the HIV/AIDS-related variables in these models have positive signs, indicating that they increase the likelihood of willingness to live in rural areas rather than reduce it. This is apparent too in model 3 with HIV/AIDS variables only and which predicts a probability of willingness of 0.72. From the results of these models, there does not seem to be any evidence to support the assertion that the presence of HIV/AIDS reduces the willingness of public sector workers to live and work in rural areas.



Anti-HIV/AIDS message. A typical sight at most schools in Zambia.

### 7.5.1 Likely influences on the results

There are a number of factors that could have had a strong influence on the results of the models presented.

#### 7.5.1.1 Self-selection bias

The first such factor is the type of individuals that made up the sample from which the regression data were obtained. There maybe a case for self-selection bias in the sense that the individuals who are still in rural areas are the

ones who want to be in rural areas and that those who don't want to be in rural areas have already left and were therefore not in the sample. If this were the case the predicted probabilities would reflect the views of only those who already want to be based in rural areas regardless of the HIV/AIDS situation. The survey data, however, shows that of the 152 respondents who had requested transfers from their current rural locations, 59 per cent had requested to be transferred to urban areas. With a larger sample size, it is likely that more such respondents would have been surveyed. This, to some extent allays the fears of self-selection bias in the sample.

#### **7.5.1.2 Lack of choice of where to live**

Many public sector workers do not have a choice of where they are based. New teachers, for example, are simply allocated schools where they will teach. These schools tend to be in the provinces in which they did their teacher training. Due to a shortage of jobs, such new teachers have no option but to accept their allocated locations if they want to be employed. The fact that such individuals do not have a choice of where they live and work may have influenced their survey responses. Their responses may be a reflection of their acceptance of where they are, rather than where they want to be. If this were the case, the results would be biased towards willingness to stay in rural areas because that is where they are and have no other option but to be located there.

#### **7.5.1.3 Desensitisation of individuals to HIV/AIDS issues**

Another possible influence on results is that there has been so much death and misery in Zambia caused by HIV/AIDS that people have become desensitised to the problem. HIV/AIDS has been a problem in Zambia since its identification in the mid 1980s. Since then associated morbidity and mortality have increased making HIV/AIDS one of the leading causes of death across all strata of Zambian society. It is possible that people have learned to live with HIV/AIDS and no longer consider it an especially significant factor in decisions such as where they might want to live, for example. If this is the case, then HIV/AIDS is no longer a significant shock that it influences people's significant life choices. In this case, there would be no reason for HIV/AIDS to have an impact on individuals' decisions about where they were based. Survey results may lend some credence to this line of thought. Of the 356 respondents who answered the question

whether HIV/AIDS influenced their decision to be where they were, 68 per cent responded that it did not, and 74 per cent of 354 respondents said the difference in the urban and rural prevalence rates did not influence their decisions to be based in rural areas.

#### **7.5.1.4 Age composition of the survey respondents**

Closely related to the previous factor is the issue of the ages of the respondents. 70 per cent of the survey respondents were between the ages of 20 and 39. It can be argued that these individuals were mostly born during the HIV/AIDS era. They have grown up with HIV/AIDS and the high morbidity and mortality associated with it. Such individuals may not appreciate the seriousness of the epidemic because the current situation is the “norm” for them. For such individuals, it is probably unlikely that HIV/AIDS would impact their decision-making much. In this case the survey sample would have consisted of mostly individuals who did not consider HIV/AIDS a serious enough issue to affect their choice of whether they lived in rural or urban areas. However, given the abundance of HIV/AIDS information in public sector workplaces, it seems improbable that a significant proportion of public sector workers would not consider HIV/AIDS a serious issue regardless of their ages. The survey shows that of the 338 who responded to the question about the seriousness of the HIV/AIDS epidemic, 61 per cent thought HIV/AIDS was a serious problem in the country.

#### **7.5.1.5 Composition of the sample data**

The composition of the sample data may also have had an influence on the results of the model. In particular the proportion of unwillingness, ie zeros, in the values of the dependent variable was probably not sufficiently large. Of the 207 observations used in the regression analyses, there were only 72 (or 35 per cent) zero compared with 135 one observations of the dependent variable. This low proportion of zero observations may well have had an impact on the model results.

### **7.6 Conclusion**

A significant proportion of the survey respondents considered HIV/AIDS a serious problem in Zambia. Whether this problem affects the willingness of

public sector workers to be based in rural areas cannot be divorced from other equally important factors such as demographic and socio-economic factors.

The models explored in this chapter have included some demographic and socio-economic variables in modelling the probability of willingness to live in rural areas. In all models presented, the predicted probability of willingness to live in rural areas has been high. The results obtained do not support the argument that the presence of HIV/AIDS adversely affects the willingness of public sector workers to live in rural areas.

The results of models 7 and 9 show that the absence of HIV/AIDS variables reduces the probability of willingness of unmarried individuals to live in rural areas while increasing that of married individuals. The presence of HIV/AIDS variables, on the other hand, increases the probability of willingness of unmarried individuals while slightly reducing that of married individuals.

We can conclude from these results that the adverse impact of HIV/AIDS on rural development is not through its direct impact on the willingness of public sector workers to live in rural areas. The survey results show that although rural public sector workers are mostly aware of the extent of the HIV/AIDS epidemic in the country and most consider it a serious problem, it does not affect their willingness to be based in rural areas as has been suggested by some authors.

That HIV/AIDS has an adverse impact on rural development is without doubt. What the modelling results in this chapter have shown is that the channel through which HIV/AIDS adversely affects rural development is not through unwillingness of public sector workers to be based in rural areas where they are required for implementation of government rural economic development plans. Other explanations are clearly required.

### **7.6.1 Other channels through which HIV/AIDS affects rural economic development**

#### **7.6.1.1 Loss of personnel through high HIV/AIDS-related mortality**

One such other explanation concerns the loss of experienced personnel through high HIV/AIDS-related mortality and the loss of considerable work-time

through high HIV/AIDS-related morbidity.<sup>40</sup> Some senior district department managers lamented the increasing losses of senior and experienced staff to HIV/AIDS-related mortality. The difficulty of finding similarly experienced staff meant that less experienced staff were often the only option available. Inefficiency is thus introduced into the planning and management of public sector institutions when this occurs. This, they suggested was contributing to the deteriorating quality of some public services like primary school education.

#### **7.6.1.2 Loss of work-time through high HIV/AIDS-related morbidity**

In addition to loss of experienced staff, high morbidity means that a lot of work-time is lost as sick individuals seek treatment or are bedridden for considerable periods of time. Inadequate funding precludes the hiring of temporary staff to cover for the sick ones with the result that colleagues have to pick up the extra work.<sup>41</sup> Over time the quality of work deteriorates as the illness continues and the extra duties exact their toll on those picking them up. In the teaching sector, this has contributed to deteriorating education standards and has manifested itself in the fact that the majority of rural primary school children are failing to progress beyond primary school level in many rural schools.<sup>42</sup>

#### **7.6.1.3 Inadequate funding of rural infrastructure and existing services**

HIV/AIDS affects rural development also through its impact on government revenues. To the extent that it reduces government revenues, as shown from the modelling on macroeconomic impacts, HIV/AIDS reduces the amount that government has to spend on rural infrastructure and funding of existing services. For example, in some schools that we visited during the survey, some teachers were carrying out the equivalent of work for two teachers each day

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<sup>40</sup> This discussion is based on personal communication with the District Education Board Secretaries in Mongu and Senanga districts in early February 2010. Similar sentiments were expressed by many of the head-teachers at the schools that we visited.

<sup>41</sup> This situation is compounded by a failure to enforce government regulations regarding long-term illness. This issue is discussed in the policy recommendations chapter.

<sup>42</sup> Passing a national exam is required for progression from Year 7 to Year 8. In several rural schools that we visited, no more than one or two students out of an average of about 45 students each year had passed the Year 7 exams and progressed to Year 8 over the last 10 years or so.

– one class in the mornings and another class in the afternoons. Though an extra duty allowance was paid to such teachers, the workload over time left them with little time to adequately prepare for their classes. The teaching quality deteriorates the longer this situation goes on. This situation has arisen because government cannot afford to employ the required number of teachers. Overcrowding in classrooms, the result of inadequate infrastructure funding, was evident in most schools. If HIV/AIDS reduces government revenues further, it is likely that such occurrences will become more widespread with adverse consequences for the quality of teaching and quality of students going through the education system. This raises issues about the quality of the labour force and the implications for future economic development. Other studies have found similar effects of inadequate government funding. (Kamwanga et al., 2003), for example, found that inadequate funding had led to “inadequate equipment, teaching materials and maintenance; overcrowding; dilapidated educational infrastructure; unattractive conditions of service, and an exodus of teachers.”

#### **7.6.1.4 Piece-meal provision of services**

While government efforts to take services, such as healthcare and education closer to the people are admirable, in many cases they have not been accompanied by other services such as provision of clean water, electricity and accessible roads. Some locations are very remote and far from administrative centres where services such as banking services can be accessed. Distances to adequate healthcare may be substantial. This creates a problem for public sector workers who are forced to spend a lot of time travelling, at significant cost, to collect their monthly salaries, or access healthcare services, for example. The effectiveness of provided services is thus reduced by the lack of complementary services in close proximity. Considerable work-time is thus lost as a result of poor infrastructure that makes it difficult for rural based workers to get on with their daily work. Such issues are not likely to get any better if the HIV/AIDS epidemic's adverse impact on government revenues is not arrested. The impact on rural development in this case is thus through the loss of considerable working time brought about by government's inability to fund a comprehensive package of complementary services in remote and rural areas. HIV/AIDS, through its negative impact on government revenue, and impact on management and planning personnel contributes to this government inability.

## **7.7 Contribution**

This chapter set out to test the assertion that the presence of HIV/AIDS reduces the willingness of public sector workers to live and work in rural areas. It had been argued that since the presence of public sector workers was essential for the implementation of government plans to raise the economic well-being of rural populations, their absence in rural areas would undermine and retard this goal.

The analysis and modelling of data from a survey carried out in Zambia in this chapter has found that there is no evidence to support this assertion. On the contrary, the presence of HIV/AIDS has been found to increase the probability of willingness to live in rural areas for both females and males regardless of marital status.

By dispelling this assertion, attention can be focussed on other channels through which HIV/AIDS affects rural economic development. A number of such channels have been explored.

## **7.8 APPENDIX**

**Table 44. Probit Regression Results. Dependent Variable: Willingness**

Regressor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Intercept	0.471 (1.235)	0.269 (0.246)	6.609* (0.496)	4.057* (1.800)	5.841* (4.477)	6.346* (2.827)	1.396 (2.855)	1.144 (2.983)	2.111 (2.660)
GenderD	-0.261 (0.188)			-0.179 (0.207)	-0.131 (0.236)	-0.130 (0.219)	-0.187 (0.209)	-0.172 (0.218)	-0.194 (0.203)
AgeYrs	0.008 (0.011)			0.057* (0.027)	0.082** (0.044)	0.098* (0.041)	0.065* (0.029)	0.086* (0.043)	0.056** (0.029)
MaritalD	-0.053 (0.205)			0.907 (0.790)	1.225 (0.847)	1.030 (0.792)	1.066 (0.789)	1.171 (0.846)	0.755** (0.457)
HHSize	0.018 (0.038)			0.264** (0.134)	0.225 (0.170)	0.272** (0.141)	0.226 (0.137)	0.237 (0.168)	0.237** (0.134)
EducYrs	-0.023 (0.087)			-0.021 (0.093)	-0.200 (0.291)	-0.261 (0.176)	-0.263 (0.174)	-0.304 (0.190)	-0.270 (0.169)
Income		-0.132 (0.115)			-2.835** (1.625)	-2.325 (1.421)	- (1.551)	- (1.557)	-2.943* (1.432)
Income2		0.487* (0.218)			2.552* (0.859)	2.304* (0.841)	2.445* (0.828)	2.383* (0.832)	2.684* (0.833)
HospKm		-0.004 (0.011)			-0.001 (0.011)				
SchlKm		0.006 (0.010)			0.010 (0.011)				
JobYrs		0.004 (0.013)			0.038 (0.081)			0.025 (0.079)	
LocYrs		0.034			-0.010		0.047*	-0.006	

Regressor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
	(0.022)				(0.076)		(0.022)	(0.077)	
AwarenessD		-6.086*	-5.943*	-6.040*	-5.988*				
		(0.146)	(0.292)	(0.509)	(0.383)				
PrevKnwldg		-0.096	0.316	0.219	0.244	0.118	0.151		
		(0.239)	(0.356)	(0.353)	(0.357)	(0.353)	(0.357)		
TestedD		0.114	0.290	2.061	0.125	0.200	0.136		
		(0.192)	(0.367)	(3.549)	(0.213)	(0.207)	(0.389)		
TrnsmKnwldg		-0.300	-0.297	-0.189	-0.217				
		(0.245)	(0.259)	(0.279)	(0.272)				
InfectnKnwldg		0.096	0.091	0.100	0.082	0.040	0.052		
		(0.134)	(0.139)	(0.148)	(0.145)	(0.134)	(0.137)		
SeriousD		0.300	0.261	0.443**	0.422**	0.403**	0.434**	0.409*	
		(0.198)	(0.205)	(0.228)	(0.222)	(0.215)	(0.223)	(0.200)	
AffctWrkD		0.089	0.127	0.080	0.078	0.093	0.108		
		(0.203)	(0.206)	(0.222)	(0.217)	(0.211)	(0.214)		
WrkPlcyD		-0.100	-0.158	-0.159	-0.184	-0.155	-0.175		
		(0.194)	(0.195)	(0.210)	(0.202)	(0.200)	(0.202)		
RrlUrbRateD		0.253	0.271	0.130	0.164	0.121	0.127		
		(0.213)	(0.223)	(0.232)	(0.228)	(0.226)	(0.229)		
AgeYrs * HHSize			-0.007	-0.006	-0.007	-0.006	-0.006	-0.006**	
			(0.034)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	
AgeYrs * Income				-0.009	-0.016		-0.013		
				(0.016)	(0.016)		(0.016)		
AgeYrs * Income2				-0.058*	-0.052*	-0.056*	-0.055*	-0.062*	
				(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	
AgeYrs * JobYrs				-0.001			-0.001		

Regressor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
					(0.002)			(0.002)	
AgeYrs * LocYrs					0.001 (0.002)			0.001 (0.002)	0.001* (0.001)
MaritalD * TrnsmKnwldg				-0.588 (0.423)	-0.706 (0.446)	-0.628 (0.438)	-0.611 (0.437)	-0.699 (0.449)	-0.413** (0.233)
MaritalD * TestedD				-0.127 (0.430)	0.0002 (0.455)			0.076 (0.441)	
EducYrs * Income					0.202** (0.120)	0.186** (0.108)	0.183** (0.106)	0.206** (0.117)	0.187** (0.098)
EducYrs * TestedD					-0.134 (0.242)				
<b>Diagnostics</b>									
Number of cases correctly predicted	135 (65.2%)	136 (65.7%)	132 (65%)	144 (70.9%)	138 (68%)	141 (69.5%)	140 (69%)	142 (70%)	142 (68.9%)
0's correctly predicted (72)	0	4	7	23	24	25	23	25	21
1's correctly predicted (135)	135	132	125	121	114	116	117	117	121
McFadden's pseudo-R-squared	0.013	0.039	0.031	0.060	0.127	0.108	0.106	0.111	0.111
Log-likelihood	-131.96	-128.50	-125.41	-121.69	-113.03	-115.44	-115.74	-115.02	-118.01
Likelihood ratio test									
chi-square	3.570	10.486	8.072	15.509	32.822	28.015	27.398	28.843	29.340
p-value	0.613	0.106	0.527	0.559	0.285	0.175	0.096	0.226	0.006
Predicted probability		0.663	0.718						

<b>Regressor</b>	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>	<b>Model 5</b>	<b>Model 6</b>	<b>Model 7</b>	<b>Model 8</b>	<b>Model 9</b>
Female	0.654			0.998	0.742	0.627	0.674	0.864	0.681
Male	0.699			0.999	0.762	0.755	0.706	0.881	0.713
Akaike information criterion (AIC)	275.911	270.995	270.813	279.376	286.062	276.87	271.486	280.042	264.02
Schwarz Bayesian criterion (BIC)	295.908	294.324	303.945	339.013	385.458	353.074	337.75	362.872	310.61
Hannan-Quinn criterion (HQC)	283.998	280.429	284.217	303.503	326.276	307.699	298.294	313.552	282.863

Standard errors below coefficients values in brackets. \* and \*\* individual coefficients significant at the 5 and 10 per cent significance levels respectively.

**Table 45 Variance inflation factors for model 5**

<b>Variable</b>	<b>V. I. F</b>
GenderD	1.37
AgeYrs	17.74
MaritalD	19.07
HHSIZE	29.20
EducYrs	10.97
Income	135.83
Income2	23.92
HospKm	1.46
SchlKm	1.46
JobYrs	51.44
LocYrs	17.53
AwarenessD	1.17
GeneralKnwldg	4.15
TestedD	352.21
Trnsmttn	1.85
Infection	1.77
SeriousD	1.38
AffctWrkD	1.35
WrkPlcyD	1.10
RrlUrbRateD	1.17
Age*HHSIZE	49.97
Age*Inc	33.73
Age*Inc2	23.60
Age*Job	63.84
AgeLoc	20.53
Marital*GeneralKnwl	18.28
Marital*Tstd	5.71
Educ*Inc	163.55
Educ*Tstd	338.43

Variance inflation factors > 10 may indicate a collinearity problem.



## **Chapter 8 Policy Recommendations and Conclusions**

### **8.1 Introduction**

This chapter presents policy recommendations based on the main findings of the impacts of HIV/AIDS on the macro-economy, household welfare, and on willingness of public sector workers to live in rural areas discussed in Chapters 5, 6 and 7 respectively.

### **8.2 HIV/AIDS and the macroeconomy**

The CGE modelling in Chapter 5 has shown that a high HIV/AIDS prevalence rate has significant adverse effects on national output. Sectoral output decreases leading to reduced labour demand, and consequently reduced overall household incomes and welfare. Government revenue is reduced due to reduced taxable output and a shrinking tax base. Further increases in the prevalence rate, result in more pronounced output and welfare losses. Decreases in the prevalence rate, on the other hand, lead to improvements in labour demand, increased sectoral output, government revenue, household incomes and ultimately household welfare.

The Zambian government has committed to providing free ARV treatment to all who need it. ARV treatment, however, does not eliminate the virus from an infected individual's body. ARVs prolong infected individuals' lives by slowing down the progression to full-blown AIDS. Eventually, however, individuals on ARVs will succumb to opportunistic infections due to their weakened immune systems. Thus while ARV treatment helps infected individuals to live longer, and possibly productive lives, it is not a complete cure for HIV/AIDS. ARV treatment has a perverse impact on the prevalence of HIV/AIDS. The prevalence rate is likely to increase over time as the number of infected individuals who live longer than they would have in the absence of the treatment increases. As ARV treatment must be provided to such individuals for as long as they live, the costs of the treatment will continue to increase as long as new HIV infections continue to occur. It is clear that in a poor country like Zambia, government provision of free ARV treatment to all is unaffordable in the long-run.

The impact of HIV/AIDS on government revenue has been shown to be negative, yet HIV/AIDS causes an increase in the demand for health services

requiring increased government funding. Given all the other health challenges the country faces, the financial demands on government for meeting the need for ARV treatment are simply unaffordable as more people get infected and need the treatment. The financial problems associated with continued treatment are already clear. Since the Zambian government committed to providing free ARV treatment to all, the percentage of adults receiving ARV treatment has increased dramatically from 11 per cent in 2005, 38.9 per cent in 2007 and 69 per cent of the estimated 420,000 adults in need of the treatment by 2009 (G.R.Z, 2010). In addition, an estimated 62 per cent of the 34,000 children in need of ARV treatment are receiving treatment. With an estimated 82,500 new infections per year, the total number of people requiring ARV treatment will continue to increase. The G.R.Z. (2010) report shows that of the US\$207.9m spent on HIV/AIDS programmes in 2006, the latest year for which figures are available, the Zambian government contributed 23.3 per cent with the rest being from international sources. It is clear that Zambia does not have the means to support the treatment programme that it has committed to providing without substantial international support. Budgetary and human resource constraints continue to hinder the achievement of universal coverage of those who currently need the treatment. The likelihood of overcoming these constraints in the near future is almost non-existent as more people get infected and the population of infected people needing treatment increases. There is therefore need for a shift in government policy.

### **8.2.1 Policy recommendation and rationale**

Government policy needs to shift away from a focus on provision of free universal HIV/AIDS treatment to a focus on a broad-based prevention strategy.

Infection is the source of all the adverse issues associated with HIV/AIDS. Reducing new infections addresses the problem at its source. Through prevention of new infections, the stock of people who will need treatment in the future is reduced, and it is only through prevention of new infections that there can be hope of reversing the negative effects of HIV/AIDS on the economy and society as a whole.

The high mortality associated with HIV/AIDS is costly to the country as thousands of potentially productive workers are lost each year. Many of these workers would have been educated and trained at public expense. Their loss

constitutes a waste of public resources invested in them. Without a concerted effort to reduce new infections, this waste of public resources will continue for many more years to come.

The nature of HIV/AIDS treatment is such that it must be provided for the rest of an infected individual's lifetime. While infected individuals are on treatment, they still need treatment for opportunistic infections that may afflict them. In effect, the true cost of the HIV/AIDS treatment is substantially more than the cost of providing ARTs. Additional costs of treating opportunistic infections need to be added to the cost of providing ARTs. For example, the reported nearly five-fold increase in TB prevalence from 100 to 500 per 100,000 population has been attributed to weakened immune systems due to HIV/AIDS (MOH, 2005). The costs of treating such TB cases are really indirect costs of HIV/AIDS which should be added to the cost of providing HIV/AIDS treatment in order to get a true reflection of cost of HIV/AIDS treatment.

Some individuals need nutritional support for the HIV/AIDS treatment to be effective. The need for nutritional support, especially among the poor raises questions about the effectiveness of the treatment if such individuals cannot afford the required nutrition to realise the efficacy of the treatment. The cost of nutritional support, for some individuals, is also an indirect cost of HIV/AIDS treatment and raises the true cost of HIV/AIDS treatment.

Zambia lacks the ability to implement a universal HIV/AIDS treatment programme because of a shortage of skilled health personnel. (Kombe & Smith, 2003) estimate that to treat 330,000 HIV/AIDS patients would require an additional 429 physicians (about 50 per cent of Zambia's current physician workforce) and 1,043 technicians (more than twice the number of technicians in Zambia). Thus in order to be able to implement an effective treatment programme, there needs to be significant investment in both human resources and physical infrastructure with which to deliver the treatment.

The shortage of skilled labour to administer the HIV/AIDS treatment not only reduces the treatment programme's effectiveness but has had the unintended consequence of drawing away skilled health personnel from the management of other health-related conditions. This has resulted in reduced ability to effectively manage these conditions than had been the case pre-HIV/AIDS. Ineffective management of previously well-managed conditions has the potential to make

these conditions more virulent and their effects potentially fatal. The need to address HIV/AIDS thus creates or exacerbates problems in the management of other health conditions that do not have as high a profile as HIV/AIDS. To some extent, the good that government resources expended on HIV/AIDS treatment generates is undone by the harm caused by consequent ineffectual management of other conditions. The net benefit of the HIV/AIDS treatment programme is therefore not clear at all when the issue is looked at in a broader context.

A prevention strategy that recognises the needs of all the different sections of the population offers the best hope for minimising the adverse effects of HIV/AIDS on households, government revenues, and the economy. Such a strategy needs to include:

- comprehensive HIV/AIDS education in schools
- comprehensive information targeting young people approaching sexual maturity
- comprehensive information targeting young people who are already sexually active
- comprehensive information aimed at single young adults
- comprehensive information targeted at married couples
- comprehensive information targeted at people living with HIV/AIDS
- encouraging individuals to get tested for HIV/AIDS.

#### **8.2.1.1 Comprehensive HIV/AIDS education in schools**

A significant majority of school children, especially at the primary level, are not HIV positive and not sexually active. Teaching them about HIV/AIDS transmission, its effects, and how they can protect themselves from getting infected should be done as early as possible to enable them to make informed choices when they decide to become sexually active. Children growing up with knowledge of how to protect themselves are more likely to delay their sexual debut or to use appropriate means of protection when they do (Corno & de Walque, 2007; de Walque, 2007). Given the right information, at the earliest possible time, these children need not ever become infected with HIV/AIDS. As argued by the World Bank, a good basic education ranks among the most effective

– and cost effective – means of HIV prevention (World Bank, 2002). Prevention through education eliminates the need for costly ongoing treatment.

A significant advantage of prevention through education is that it need not cost significantly more to implement it. All it would take is the incorporation of HIV/AIDS education into the existing school curricula. Schools provide an important environment where the myths and untruths surrounding HIV/AIDS can be discussed and dispelled. Such information gained from schools is also likely to filter beyond classroom walls into homes and benefit the wider community. As sexual matters are not, as a matter of course, discussed by parents and their children in their homes, education can fill this information gap.

The need for HIV/AIDS education in primary schools is underlined by the fact that a significant proportion of students do not progress beyond primary school level education.<sup>43</sup> Leaving the introduction of HIV/AIDS education until secondary school would be denying this sizable proportion of the population knowledge that would help them protect themselves and their families.

#### **8.2.1.2 Targeted information for young adults and people living with HIV/AIDS**

For young adults, information about the dangers of intergenerational sexual relationships is vital. The prevalence of intergenerational sexual relationships has been cited as one of the main reasons for the high HIV/AIDS prevalence rate among young women (MOH & National AIDS Council, 2008). Information that empowers young people to avoid sexual relationships with older partners or enables them to negotiate for safer sex would help prevent new infections among young adults and reduce the need for costly treatment later on.

Targeting adults with information about the extent of the epidemic and the consequences of infection would serve as a constant reminder for them to avoid infection. Discouraging multiple concurrent sexual relationships and providing information about safer sexual practices would help reduce infections among adults.

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<sup>43</sup> A UNESCO Education For All (EFA) country report for Zambia shows that almost two-thirds of primary school children do not progress to secondary school in any given year. See (UNESCO, 2000).

Providing people living with HIV/AIDS with information about how they can live positively and responsibly is vital too. As infection is spread mostly through heterosexual sexual intercourse, information teaching infected persons how they can avoid infecting their sexual partners should be emphasised.

Knowing one's sero-status is important because it encourages individuals to make responsible sexual choices. Individuals who know they are HIV negative are more likely to want to maintain their negative status while HIV positive individuals would seek more information on positive living and ways of avoiding infecting their sexual partners.

Paramount to the success of the prevention strategy is the need for availability of affordable means of protection from infection. Redirecting expenditure from treatment to subsidising both male and female condoms is likely to have much better future outcomes in terms of reducing new infections and avoiding expensive ongoing treatment. Promotion of regular and consistent use of condoms is likely to be successful as a prevention strategy only if the cost barrier is eliminated. Currently condoms are unaffordable to most young people who may already be sexually active and therefore at great risk of getting infected.

#### **8.2.1.3 Addressing infection risk factors**

For prevention to be successful, it is also imperative to identify and deal with the risk factors that increase the vulnerability of young people to infection. Poverty has been cited as one of the main reasons for the existence of intergenerational and transactional sexual relationships between young people and much older partners. Addressing the issue of poverty will thus deal with a significant underlying cause of infection among young people, especially young women.

Other infection risk factors include social inequality, gender inequality, and customary and cultural practices like sexual cleansing and wife inheritance. Government and civil society can play significant roles in reducing both social and gender inequality through good quality education in schools, and promotion of activities that raise the value of women's time and promote women's economic independence. Much of the gender inequality is rooted in the economic dependence of women on men (Baylies, 2002). Government can also, in

conjunction with tribal leaderships, spearhead change in customary and cultural practices that increase the risk of infection with HIV/AIDS.

#### **8.2.1.4 Scope of the prevention strategy**

A comprehensive prevention strategy clearly needs to be a multi-pronged one that addresses and responds to the needs of the different societal sub-groups. Everyone, from infants to adults, is at risk of HIV infection. The strategy should therefore recognise the needs of the different age-groups and address their needs accordingly. At the centre of such a strategy should be education - education that empowers young people and gives them hope for a brighter future; education that reduces social and gender inequality; education that eliminates unsafe cultural and customary practices; and education that empowers all individuals to make informed decisions about their sexual and reproductive choices.

The prevention strategy should also promote other prevention methods such as the well known abstinence and faithfulness to one sexual partner methods. The abstinence message is especially important for young people who are not yet sexually active. An understanding and appreciation of the reasons for abstinence might help more young people delay their sexual debut and encourage them to be faithful to their partners later on.

#### **8.2.1.5 Benefits of a prevention strategy**

The benefits of a successful prevention strategy far outweigh the benefits of a treatment strategy. Available treatment does not reduce the number of infected individuals capable of infecting others. It actually increases it. This increases the likelihood of uninfected individuals pairing up with infected individuals and getting infected in the process. The HIV/AIDS incidence rate is therefore likely to increase as more infected individuals live longer.

Ignoring the moral outrage of denying people treatment that could prolong their lives and alleviate their immediate suffering, and the obvious short-term benefits of people on treatment getting better for a prevention strategy whose benefits are long-term and difficult to observe is not easy. The trade-off, however, has to be made and the decision needs to be based on more than moral outrage and observable but unsustainable short-term benefits. In the long-run, Zambia cannot afford to continue with provision of free universal HIV/AIDS treatment. As it is, most of the treatment funding is sourced from external

organisations such as PEPFAR, The Global Fund to fight HIV/AIDS, tuberculosis and malaria, USAID, and other foreign donor governments. How long the country can continue to rely on external funding is an issue that needs to be addressed urgently. Dangers of over-reliance on external funding have recently been highlighted by donors withholding their funds to Zambia because of alleged corrupt practices in the Zambian health system (Afrique en ligne, 2009; BBC News, 2010).

The benefits of prevention, on the other hand, extend from individuals to the macroeconomy. Reduced HIV/AIDS-related morbidity and mortality at the household level reduces the depletion of household assets and savings that tend to be expended when a household member is infected with HIV/AIDS. Households will be able to preserve their wealth and have the resources with which to improve their own standards of living.

Healthy individuals are more likely to invest more in their human capital accumulation because they have longer lives over which to recoup its costs and enjoy its benefits. Such individuals are more likely to be more productive which benefits both the individuals and the economy through increased earnings and output respectively.

The benefits of an increased tax base and increased taxable output accrue to government. This increases government ability to provide more welfare-enhancing services to the public.

With successful prevention, there is increased ability of the economy to grow and generate further resources that can be used in continued prevention programmes and growth of the economy. In a way, a virtuous cycle forms and prevention becomes sustainable long into the future. The same cannot be said about the current treatment strategy.

### **8.3 HIV/AIDS and household welfare**

Household welfare was shown to decrease in the presence of high HIV/AIDS prevalence. Reduced demand for labour by firms reduces the number of households with formal employment incomes. Reduced demand for consumption goods and services as markets shrink further causes firms to reduce their demand for labour. Increased production costs reduce firm profitability which also contributes to reduced demand for labour. Among the self-employed,

the death of a key individual in the income-generating activity often spells the end of that enterprise and loss of income to the household. Loss of adult household members in subsistence farming families often leads to loss of vital skills required to provide the families with sufficient food supplies. Loss of household assets, savings and incomes impoverishes many households. Some consequences such as withdrawal of children from school have longer-term consequences in that they consign the affected children to future lives of poverty. Dissolution of households upon the death of one or both adults in a household often leads to a dispersion of the surviving children among extended family members. This leads to increased dependency ratios and increased financial pressures on the recipient households. High adult HIV/AIDS mortality increases the number of orphans who have no adults to take care of them or support them through the education system with the result that a large proportion of orphans are not attending school.

### **8.3.1 Policy recommendation and rationale**

Government and civil society need to increase their support for maintaining households' livelihoods.

Most of the household problems emanating from the effects of HIV/AIDS have to do with the loss of the household's means of supporting itself – the loss of assets and savings, the loss of the household breadwinner, or in the case of children the loss of parental care and support for education. Rapid household transition to poverty following the death of the household income earner is not uncommon (Nampanya-Serpell, 2000).

Households with one income-earner are at greater risk of this rapid transition to poverty especially when they live in employer-provided housing. The loss of housing and regular income on the demise of the income earner often leaves the surviving household members with no choice but to relocate to less salubrious housing. The decline in their standard of living is often almost instantaneous because of the added earlier loss of assets and savings expended in the period prior to death.

#### **8.3.1.1 Short-term solution**

A short-term solution to this problem is through encouraging and supporting community-based organisations that provide support and training in various income-generating activities to individuals who find themselves in such

situations. Both government and civil society can actively participate in such organisation by helping them get started and linking them to other organisations or individuals that can provide them with the skills to become self-sustaining. Access to microfinance is an example of services to which government and civil society can facilitate for these organisations.

### **8.3.1.2 Long-term solution**

The long-term solution though is for government to ensure that it is providing good quality education to all and ensure that all children, especially girls, are given the same opportunities as boys to succeed. Promotion of educational success for girls and young women will contribute towards eliminating gender inequality and the economic dependency of women on men. With more women involved in either formal, or profitable informal work, or other profitable income generating activities, the loss of male income-earners need not lead to the immediate impoverishment of as many households.

### **8.3.1.3 Promoting and supporting household independence**

The solutions presented are geared towards promoting household independence rather than dependence on other households or the state for means of survival.

Adequate funding for education, especially primary school education, and the removal of school fees and requirements for uniforms are essential for ensuring that there are no barriers to all children's access to education regardless of their socio-economic backgrounds.<sup>44</sup> For most children in rural areas, a good education serves as their best hope for escape from the poverty that they find themselves in. Good quality education is thus a monumental step towards economic independence for most children.

In rural areas where most households depend on subsistence farming for their livelihoods, loss of farming knowledge associated with adult deaths can be ameliorated by the provision of adequate agricultural and veterinary extension services to improve both crop and livestock farming methods. With improved

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<sup>44</sup> Though government policy is for no fees or uniform requirement for primary schools, in practice schools encourage all students to buy uniforms. Monetary or other forms of contributions to schools are also common practices.

farming methods, there is the likelihood that production will improve sufficiently to sustain the households and possibly provide a surplus for sale. The dissemination of practical farming knowledge through agricultural extension services will benefit even those farmers with no formal education. Agricultural and veterinary extension services are essential also for addressing reported changes in cropping patterns associated with the gender division of labour. Loss of male household heads for example has been associated with reduced production of cash crops, while loss of female heads is associated with less production of household consumption crops.

#### **8.3.1.4 Implementing the recommendation**

Implementation of these recommendations requires either an increase in government revenue or reallocation of existing resources. It is unlikely that either is realistically possible with continuing high HIV/AIDS prevalence and a strategy of free provision of HIV/AIDS treatment. As for the previous recommendation, a shifting of resources from treatment to prevention offers the best chance of successfully implementing this recommendation. Prevention offers the best chance of reducing the HIV/AIDS prevalence rate and of growing the economy. The growing of the economy produces additional resources that can be used in continued prevention efforts, development of infrastructure, and provision of services that help to sustain households' livelihoods in both the formal, and informal sectors, as well as in the rural agricultural sector.

### **8.4 HIV/AIDS and willingness of public sector workers to live in rural areas**

Chapter 7 on the impact of HIV/AIDS on willingness of public sector workers to live and work in rural areas shows that HIV/AIDS does not affect the willingness of public sector workers to live in rural areas. The estimated probabilities of the various models in Chapter 7 show that unmarried rural-based public sector workers were more likely to want to live in rural areas especially in the presence of HIV/AIDS. While HIV/AIDS reduced the probability of willingness for married workers to live in rural areas, their probability of willingness was still high enough to suggest that they too preferred to live in rural areas.

The chapter concludes that there is no evidence that HIV/AIDS reduced the probability of willingness of rural-based workers to the extent that it would hamper government rural development efforts.

It also explores a number of alternative ways by which HIV/AIDS can affect rural development. It shows that HIV/AIDS can affect rural development through ineffectual planning and execution of plans brought about by the loss of experienced personnel through HIV/AIDS-related mortality and morbidity; the loss of significant work-time caused by inadequacies in rural infrastructure which causes workers to spend many hours away from work; and deterioration in public services due to inadequate government funding which leads to dilapidated work buildings, shortages of essential office equipment and generally conditions that are not conducive to high productivity.

A common feature of these problems is that they all have their origins in inadequate government funding.

#### **8.4.1 Policy recommendation and rationale**

Government should maintain an adequately trained workforce in rural areas and improve rural infrastructure.

Maintaining an adequately trained workforce in rural areas requires a commitment to ongoing professional development of rural-based workers. Such a course of action would ensure that there was always a set of workers with the requisite skills and training in all positions of responsibility. This would reduce the inefficiency introduced by the loss of senior or experienced personnel who tend to get replaced by less qualified or less experienced individuals.

Loss of work-time can be reduced by improving rural infrastructure like roads that facilitate easy and quick transportation to services that are not readily available in most rural locations. Innovative ideas, like mobile banking services and clinics could eliminate the need for many workers to take time off work to collect their monthly salaries or access health services which are not readily available in their locations. While initial set-up costs for implementation of such ideas may be high, the long-term benefits seem to justify implementing them if public sector workers are to effectively play their role in the process of achieving the goal of improving the condition of the rural populace.

Government needs to commit to and actually provide adequate work facilities. Adequate buildings and office equipment should be a priority for all public workplaces in rural areas. Public sector workers would be a lot more productive if they had the necessary tools with which to carry out their duties.

Implementation of these ideas requires either an increase in government revenue or a reallocation from other expenditure areas.

The importance of a successful prevention strategy is apparent here too. Not only does it stem the loss of personnel through reduced mortality and morbidity, a successful prevention strategy leads to growth in the economy and growth in government revenues. Ongoing professional development of workers needs funding, as does provision of adequate infrastructure. Ongoing professional development increases the skill level in the workforce and ensures reliable continuity in the event of personnel changes. Provision of adequate infrastructure minimises the loss of productive time and arms the workers with adequate resources with which to fulfil their mandate. A successful prevention strategy would contribute to the accomplishment of this recommendation.

## **8.5 Summary of recommendations**

Prevention of new infections underpins all the policy recommendations made in this chapter.

The advantage of a focus on a broad-based prevention strategy over a focus on treatment is clear when treatment is seen in a broader context that includes its impact on the management of other health conditions and its long-term viability. It is argued here that the net benefit of the HIV/AIDS treatment is unclear because of its negative impact on the management of other health conditions. The ongoing and long-term nature of the HIV/AIDS treatment and its expected increased cost as more people get infected makes it an unsustainable option in the long-term for a poor country like Zambia.

A successful prevention strategy on the other hand leads to reduced need for treatment as fewer people get infected. It leads also to a virtuous cycle whereby a significant reduction in new infections leads to an increase in the quantity and quality of the labour force, a growing economy, and extra resources that can sustain the prevention strategy and provide government with extra resources with which to support rural personnel and infrastructure needs.

A well-resourced education system that provides formal education (schools), informal (community-based activities that encourage and empower women), and practical education (such as agricultural and veterinary extension services) is indispensable to the success of the prevention strategy. Such an education system contributes towards preventing new infections as well as sustaining household livelihoods.

Through this set of recommendations, both macro and microeconomic issues related to the adverse impact of HIV/AIDS on economic development can be adequately addressed.

## **8.6 Conclusions**

Chapter 2 presented background information about the HIV/AIDS situation in Zambia. It showed that the HIV/AIDS epidemic in Zambia affects all strata of Zambian society. Among the factors responsible for the widespread transmission of HIV are high levels of poverty, high population mobility, some social and cultural practices, high prevalence of untreated sexually transmitted diseases and gender inequality. HIV/AIDS prevalence was shown to be highest in age-groups with the highest STI's – 6.8 per cent in women aged 30-34 and 10.4 per cent in men aged 40-44. The respective HIV/AIDS prevalence rates for these groups are 26 and 24.1 per cent.

Of particular concern for economic growth and development is the higher prevalence of HIV/AIDS among the better educated and wealthy Zambians. Prevalence among both males and females increases with increasing educational attainment and wealth quintile. As these are the groups more likely to have savings that can be used for investment, the higher prevalence in these groups implies a reduction in the availability of domestic resources for investment. With high HIV/AIDS-related mortality, the loss of skilled workers is bound to be high with adverse consequences for productivity in both the public and private sectors.

Also of concern is the emerging change in the population structure. Fewer children are reaching adulthood due to high infant and child mortality rates attributed to HIV/AIDS. Combined with a high adult mortality rate and a slow-down in the population growth rate due to an HIV/AIDS-induced reduction in fertility, these factors imply a further reduction in the growth of the labour force.

HIV/AIDS was shown to have had significant sectoral impacts in Zambia. The quality of public sector services such as education and health were shown to have been severely affected by high mortality among their staff. Shortages of staff in both sectors are high due to the high cost of training replacements. In the private sector, the impact seems to be dependent on the size of the firms. Large firms reported adverse HIV/AIDS-related increases in labour costs and reduced productivity. On the other hand a survey of small and medium enterprises found that SMEs did not consider HIV/AIDS to have a significant adverse impact on their operations.

Zambia's response to the HIV/AIDS epidemic has been a multi-sector response involving government, NGO's, civil society, firms and faith-based organisations. The response is co-ordinated by the National AIDS Council which is a statutory body. Since 2005, the government has offered free ARV treatment through the public health system. As of 2009, an estimated 68 per cent of those needing ARV treatment are estimated to be receiving it. Prevention of mother-to-child-treatment services are also offered in all districts in the country as are voluntary counselling and testing services. Effective implementation of these services is, however, hampered by a significant shortage of skilled labour and funding. The Zambian response is reliant on donor countries for most of its funding. In 2007 donor countries contributed almost 77 per cent of HIV/AIDS programmes expenditure.

A continued high infection incidence rate and increasing uptake of ARV treatment imply that the prevalence of HIV/AIDS in Zambia is likely to increase unless there is a significant reduction in new infections. Also likely to increase is the number of HIV/AIDS orphans. An estimated 700,000 children in Zambia have lost either one or both parents. As the extended family is the main institution for dealing with orphans, the dependence ratio has increased with increasing adult mortality. Zambia now has one of the world's highest dependence ratio of 0.9 compared to a global rate of 0.4. Studies suggest the extended family system is under severe strain and there has been a significant increase in the number of child-headed households and street-kids. The increase in the number of orphans raises concerns about their welfare and ability to attend school.

Chapter 3 presented a survey of the literature on the impacts of HIV/AIDS. It showed that there was no universal agreement that HIV/AIDS had

a significant impact on economic growth and development. It also showed that the magnitudes of estimated impacts tend to be dependent on the methodology used. While econometric studies found little or no impact on growth or per capita incomes, neoclassical growth models found small adverse impacts in total output. The impact on per capita incomes was dependent on among other factors changes in the capital depreciation rates, change in the savings rate, and changes in the population growth rates. Extended growth models by the World Bank found slightly higher adverse impacts on GDP and small impacts on per capita incomes. CGE-based studies found higher adverse GDP and per capita income changes than the growth and extended growth models. OLG models on the other hand estimated that HIV/AIDS would have catastrophic impacts on national economies of high prevalence countries over a number of generations

Studies of sectoral impacts were also reviewed. In the public sector, education and health sub-sector impact studies were reviewed because of these sub-sectors' importance to economic growth and development. Most studies estimated significant adverse impacts in these sub-sectors. Impacts on the agriculture sector were also reviewed because agriculture provides the most employment, and is the most important source of livelihood in most developing countries. For small scale farmers, the adverse impacts of HIV/AIDS tend to be dependent on the gender-distribution of their farming activities. The loss of skilled labour for larger scale farmers reduces their output and poses food security issues for high prevalence countries. Some studies have suggested that famines experienced in the Southern African region in recent years had been exacerbated by the impact of HIV/AIDS.

Studies of business firms suggest that increasing labour costs associated with HIV/AIDS morbidity and mortality, training and replacement costs of deceased employees, reduced productivity and terminal benefit payments are significant. Competition for scarce skilled labour is driving surviving skilled workers' wages up leading to reduced demand for less skilled labour.

The lack of studies of the impact on the Zambian economy utilising an economy-wide framework prompted the use of a CGE model for this study.

Chapter 4 analysed some aspects of the social accounting matrix that is the database for the model used in simulations in Chapters 5 and 6. Sectoral labour utilisation, household income sources, and household expenditure on sectoral

output were presented. While rural households got most of their incomes from providing labour and capital services, urban households got most of their incomes from providing labour and from enterprise transfers. Inter and intra-household transfers were more important for rural households than urban households while government transfers did not vary much between rural and urban households.

Other than large rural households, other rural households did not pay income taxes while income taxes for urban households ranged from 6 per cent to 22 per cent. Household savings rates were low for all households ranging from 0.12 per cent to 2.4 per cent.

The model equations and the model calibration process are presented in this chapter as is the price adjustment mechanism drawing heavily on the work of (Sadoulet & de Janvry, 1995). The extensions made to Sadoulet & de Janvry (1995)'s model are described including the incorporation of (Cuddington & Hancock, 1994)'s idea of HIV/AIDS having a "co-worker" impact that increases the adverse impact of having an infected employee by the estimated equivalent number of other workers whose productivity is affected by the illness of the infected employee. The co-worker impact value turns out to be an important determinant of results in simulations because of its impact on the number of workers affected depending on its value. Higher values lead to higher adverse impacts holding all else constant.

The shocks used in the simulations in Chapters 5 and 6 are also described in this chapter.

Chapter 5 presented results of simulations of the impact of HIV/AIDS on three macroeconomic indicators – GDP, investment and the trade deficit. With a prevalence rate of 17 per cent GDP decreased by between 6.8 and 12.1 per cent as the co-worker value was increased from 1.25 to 2 in scenario 1. In this scenario, investment decreased by between 32 and 62 per cent as the co-worker value increased. The trade deficit however, improved due to the reduction in import consumption being much larger than the reduction in exports. Sectoral output decreased in all sectors. The more capital-intensive mining sector, however, had the least output change as expected.

Increases in the wage rate were shown to lead to decreases in the demand for labour. Labour demand reductions ranged from 4 to 13 per cent as wages increased by between 5 and 20 per cent. This implies that some households

relying on labour income would be adversely affected by increases in the wage rate as employers responded by demanding fewer employees.

Government expenditure reductions had little impact on household and firm incomes as government transfers made up very small proportions of their incomes.

A combination of the three shocks produced a higher GDP reduction of almost 9 per cent with the low co-worker value scenario. Investment decreased by 34 per cent. This combined shock thus led to larger adverse changes in both GDP and investment. The combined shock leads to a much larger improvement in the trade balance as the reduction in imports fall by almost 12 per cent compared to the 0.24 per cent decrease in exports. As with scenario 1, the combined shock leads to output reductions in all sectors.

The simulations show unambiguously that GDP and investment are adversely affected by HIV/AIDS. The adverse impact on investment signals potential reductions in future expansion of productive capacity and job creation. With an increasing population, the capital-labour ratio is likely to decline.

Of the three shocks modelled, the HIV/AIDS direct impact on the quantity and quality of labour shock was shown to have the most adverse impacts on both GDP and investment. Reducing the prevalence rate resulted in smaller adverse effects on both GDP and investment.

Increases in income and production taxes were shown to increase government revenue. These tax increases, however, also lead to higher welfare reductions among the non-income tax paying rural households than urban income tax paying households.

The main contributions of this chapter have been findings that contribute to the weight of evidence that suggests that the most adverse impacts of HIV/AIDS occur through its effect on the quantity and quality of labour. A further insight from this chapter is the finding that although tax policy can be used to raise government revenue, it has the potential to decrease the welfare of remote and rural households more than it decreases the welfare of urban households.

Chapter 6 presented results of simulations of HIV/AIDS impacts on households. Household income, consumption and welfare changes were discussed. Household incomes were found to be adversely affected primarily

through the loss of labour income. A higher co-worker impact value raised the decrease in household incomes as did a higher prevalence rate. As household consumption is dependent on household income, consumption decreased too. Consumer prices for most commodities increased in response to the combined labour, wage and government expenditure shock. The combination of decreased incomes and higher consumer prices led, ultimately, to reduced household welfare.

This chapter showed that the magnitudes of household income impacts across households were different and that the impacts on urban households were almost twice those of rural agricultural households. Changes in consumption exhibited the same pattern as the income changes.

The combined shock led to small increases in government transfers to households although overall household incomes and welfare decreased. For most households, both rural agricultural and urban, welfare decreases fell in the range 18 to 30 per cent. The largest welfare decreases however are those of rural-non-agricultural households.

The chapter concluded that the lower income changes for rural agricultural households could be attributed to these households' lower reliance on labour income compared to urban households. In this chapter the impact on the quantity and quality of labour is also the main channel through which HIV/AIDS affected household incomes and ultimately welfare.

This chapter presented the first results of the impact of HIV/AIDS on households in a general equilibrium framework. Previous studies concentrated on the impact on GDP and per capita incomes. This study showed how the seemingly small impacts at the macroeconomic level can have large welfare effects at the level of the household. Results of impacts at the household level bring into sharp focus the actual impact on people and are useful for formulation of impact mitigation strategies.

Chapter 7 presented the results of an econometric analysis of whether HIV/AIDS reduced the willingness of public sector workers to live and work in rural areas. Using survey data collected from rural areas in the Southern and Western provinces of Zambia and probit regression models with combinations of demographic, socio-economic and HIV/AIDS-related variables, no evidence was found to support this view. All models in the analysis found high probabilities of

willingness to live in rural areas. Most HIV/AIDS-related variables had positive signs indicating that they contributed to increasing the value of the probability of willingness to live in rural areas.

Tests that reduced the coefficients of the HIV/AIDS-related variables to zero showed that the values of the resulting probabilities were slightly lower, but not below 0.5 which would indicate unwillingness. The resulting probabilities were still indicating willingness to live in rural areas. These results showed that the presence of the HIV/AIDS-related variables actually increased the value of the probability to live in rural areas. These results lead to the conclusion that HIV/AIDS does not affect rural development through the lack of public sector workers willing to live and work in rural areas.

Gender and marital status, which were initially hypothesised to be significant determinants of willingness to live in rural areas, were found to not have significant impacts on the probability of willingness. Though the probability of willingness of females was, in all models, less than that of males, its coefficient was never statistically significant at either the 5 or 10 per cent significance levels.

Among the statistically significant variables that contributed to increasing the probability of willingness were age of respondent, ability to generate extra income; household size; and being in a line of work where the impact of HIV/AIDS on employees was considered serious. These findings offer policy makers with useful information that can be used when allocating postings for public sector workers, especially to rural areas. Using this information would suggest deploying older workers to rural areas. This would benefit rural areas by not only having workers who were happy to be there, but also having experienced workers as work experience tends to be associated with age.

Other avenues through which HIV/AIDS affects rural development were explored in this chapter. Among them are losses of skilled and experienced workers through HIV/AIDS-related morbidity and mortality and their replacement with less skilled and less experienced workers especially at senior position levels; the loss of significant work-time related to inadequate infrastructure and lack of complementary services in remote areas; and the inadequacy of work facilities and resources in most rural public sector work places. Probable solutions to these issues were also explored.

## **8.7 Limitations and directions for future research**

The HIV/AIDS epidemic is characterised by differences in patterns of prevalence within and across countries. Economy-wide impacts will therefore be different across countries depending on each country's particular prevalence patterns. The simulation results are based on a single country model of Zambia. Important to the results of the model is the underlying structure of the economy as represented in the social accounting matrix that forms the database for the model. The results of the model reflect the interactions of the economic agents in the model. Caution may therefore be required in generalising the results from this model to countries with very different underlying economic structures. The methodology used may, however, be usefully applied to other countries' data.

While CGE models take into account a lot more information including important inter-linkages among different sectors and interactions among different institutions, they are not without limitations. The need for some form of aggregation means that some results may be more general and indicative rather than being specific to a particular product or part of an institution. CGE models tend to be data intensive. The need for data to be consistent means that data from different sources may have to be combined to create the database for the model. The process of creating the database for the model requires a lot of time. Timeliness is thus an issue with all CGE models. Benchmark data tend to be rather old by the time they are used in simulations. They may therefore reflect a reality that is in effect a bygone reality (Flores, 2008). However, these limitations apply to other analytical methods too. Awareness of these limitations, a careful setting up of the issue to be analysed and a judicious interpretation of the model results more than make up for these limitations.

The dearth of good quality time-series data in a country like Zambia precludes the estimation of some country-specific parameters required for general equilibrium modelling. This suggests that there is always room for improvement as data become available.

HIV/AIDS continues to be a significant health and economic development issue, especially in sub-Saharan Africa. Its impact on the welfare of households is undeniable yet difficult to measure accurately due to the heterogeneity of households. Successful mitigation strategies require that the problems be identified as accurately as possible. This problem provides another avenue for

future research. Country-specific research on the impact of HIV/AIDS on the different types of households is required. The value from such research would be immeasurable as it would be useful to policy makers in devising and implementing appropriate mitigation strategies to alleviate the human suffering associated with the adverse impacts of HIV/AIDS.

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